APPLICATION OF ACUTE PHASE PROTEIN ASSAYS IN WILDLIFE MEDICINE

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Abstract

The acute phase response (APR) is part of the early defense system after triggers from trauma, infection, stress, neoplasia, and inflammation.4,8 A primary goal of the APR is to reestablish homeostasis and initiate healing. More than 200 acute phase proteins (APP) have been identified as participants in the APR.7 Some APP such as albumin decrease with inflammatory processes and are known as negative APP. Others increase from 2 to 100-fold and are known as minor, moderate, or major APP. These may be part of the acute process while others dominate chronic inflammatory processes.

Protein electrophoresis (EPH) has been used for many years in avian and wildlife medicine to monitor the APR.2,3,10,11 While not quantitative of single proteins other than albumin, the method does provide quantitation for groups of APP in alpha, beta, and gamma globulin fractions. As with EPH, assessment of individual APP have been demonstrated to have a differential sensitivity for the inflammatory process (i.e., vs. fibrinogen, total WBC).2,8 For humans and some animal species, assays for specific APP have been implemented and have demonstrated the increased level of sensitivity for prognostic use as EPH may quantitate at the level of mg/ml level vs. APP assay quantitation at the ng/ml level. Automated assays as well as expensive and labor intensive ELISA based methods have been implemented especially for use with equine and canine samples.6,9 Recently, a paper was published indicating the possible application of these assays for use in different wildlife species.1 The goal of the current study is to validate and examine the cross reactivity of reagents in an automated platform for use with variety of wildlife and avian samples as well as seek their specific application as a diagnostic and/or prognostic marker in specific disease states.

The assays selected for review include serum amyloid A (SAA), C reactive protein (CRP), and haptoglobin (HP). SAA is considered a major APP of equine species and CRP is considered a major APP of canine species (and humans).4,8 Haptoglobin is often considered to be a minor APP, but it has an important role in chronic inflammatory processes in many species.4 Preliminary studies have indicated SAA to be a clinically valuable analyte in manatees with cold stress and trauma where values ranged from 81 to 2438 mg/L versus normal manatees with SAA

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<20 mg/L. Paired determinations were used in several animals and they revealed a progression to normality with positive response to rehabilitation efforts. SAA values were within normal limits as with other clinical indicators at the time of release. These results are consistent with those previously published with ELISA methods. Our work with other marine mammal samples (dolphins, beluga whales) indicates potential utility of both SAA and HP. In elephants, SAA and HP appear to be primary APP with normal values of <20mg/L and 1mg/ml, respectively. Preliminary studies using banked serum from EEHV infected elephants showed promise with correlation with viremia with a maximum 5 fold increase in SAA and HP in samples from some animals. Lastly, other preliminary studies have examined APP in a variety of avian species and small exotic animals. In birds, transferrin and SAA appear to have moderate to major function in APR. An HP counterpart (PIT54) was also detectable in samples from many birds that were suffering from infectious disease including aspergillosis. Transferrin increases were observed in samples from egg laying birds. Interestingly, however, APP increases were not consistently observed in those samples with abnormal EPH which indicates that there may be other major APP to quantitate in avian species. These preliminary studies corroborate the initial findings of Bertelsen and coworkers that there is a venue for the application of APP assays in wildlife medicine. Additional studies are underway to examine these findings further as well as to document disease models in other species.

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LITERATURE CITED


HYDROCOELOM AND LYMPHEDEMA IN DENDROBATID FROGS AT THE NATIONAL AQUARIUM, BALTIMORE

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Abstract

Hydrocoelom and lymphedema are common in amphibians1,2. A retrospective review of these syndromes in Dendrobatidae at the National Aquarium, Baltimore, from January 1, 2005 to December 31, 2010 was performed. Hydrocoelom was defined as coelomic distention with fluid; lymphedema was defined as fluid accumulation in the lymph spaces. Clinical signs, diagnostics, therapeutics, and outcome were assessed. Available necropsy and histopathology information was also assessed.

Seventy-five affected individuals from two genera were identified (Dendrobates and Phyllobates spp.), with high prevalence of D. auratus (n = 27). Nine cases presented as mortalities or were immediately euthanatized. Aspirates performed in 56.0% of individuals (n = 37/66) identified bacteria in 54.0% of cases (n = 9 cytology, n = 13 aerobic culture, n = 2 both) and correlated with histopathology completed on mortalities. Treatment protocols changed over time. Earlier cases were generally treated with immersion in hyperosmolar solutions and topical antibiotics. More recent cases were generally treated with furosemide (2 - 5 mg/kg PO q 24 - 48 hr) and systemic antibiotics.

Overall, 28.0% of individuals survived 6 mo or longer without clinical signs (n = 21/75). Early response to treatment appears predictive of long-term success, and preliminary analysis suggests more recent cases had improved survival. On histology, renal pathology was identified in 66.7% (n = 14/21) of submissions, including renal cysts, nephrosis and interstitial nephritis. Due to underlying pathology, hydrocoelom and lymphedema carry a guarded prognosis in dendrobatids. Therapeutic protocols including systemic antibiotics and diuretics offer the best chance at clinical resolution.

LITERATURE CITED

OCCURRENCE OF BACTERIAL URINARY TRACT INFECTION IN A LESSER ANTEATER (Tamandua tetradactyla), AT THE AQUÁRIO DE SÃO PAULO, BRAZIL: CASE REPORT

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Abstract

The lesser anteater has a wide distribution, occurring almost in all of Brazil.¹ Urinary tract diseases have been little reported in captive anteaters.² According to a study that analyzed 200 different anteater’s disease cases, only 2 animals presented with some kind of urinary disorder.²

On October, 2009, an approximately 2-mo-old orphan lesser anteater (Tamandua tetradactyla) was received at the Aquário de São Paulo. Five months after its arrival frequent hematuria was noticed. Urine was collected for urinalysis and bacterial culture. On the first exam, bacterial infection was observed along with triple phosphate crystals and urine alkalinity. The treatment goals were to acidify the urine and to eliminate the crystals and the bacterial infection.

Antibiotic treatment was based on antibiogram results. Apple cider vinegar was administered to acidify the urine and to eliminate the crystals. In addition, more liquid items such natural citric fruit juice were added to the diet. The animal was monitored weekly with urine exams for 6 mo. Tests such as blood count, biochemical profile and ultrasound, were performed to monitor changes in the urinary tract. Treatment lasted for 3.5 mo. Treatment ceased after successive negative bacterial culture and normal urine exams. Currently, blood and urine tests are performed as part of the animal preventive medicine management to ensure a safer clinical health of the animal. These procedures also promote access to critical information to establish benchmarks of utmost importance for maintaining this species in captivity.

LITERATURE CITED

EVALUATION OF NEOPLASIAS AS A CAUSE OF MORTALITY IN CAPTIVE TENRECS (Echinops telfairi)

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Abstract

Tenrecs are insectivores that reside primarily in central Africa and Madagascar. It has been observed that captive tenrecs commonly develop tumors.¹,² A retrospective survey was developed based on the husbandry, medical and necropsy records to determine how much of a concern neoplasia is in captive lesser Madagascar hedgehog tenrecs (Echinops telfairi) housed within Association of Zoos and Aquariums zoos. This survey evaluated the types of cancer as well as risk factors for development of tumors, such as age, gender, genetics and environment. Of the population represented by the survey (n=231, 20/32 zoos responding), 26 percent were female, 29.4 percent were male, and 44.6 percent were of an unknown gender. Overall, the tenrecs in this study ranged in age from 0 days to 18 yr old, with the average age of 4.9 yr. Neoplasia was found in 11.7 percent of tenrecs. Of those tenrecs that developed neoplasia, 33.3 percent were female, 48.2 percent were male and 18.5 percent were of an unknown gender and their ages ranged from 4.0 to 17.5 yr, with the average age of 11.5 yr. Carcinoma and lymphosarcoma were the most common types of tumors with the liver and thyroid gland as the most common locations. Approximately 33.3 percent of primary tumors identified in this study had metastasized. The most common sites of metastases were the liver and the lungs. There was no statistical significance in regards to risk factors. Further understanding of neoplasia in tenrecs will assist in the diagnosis, treatment and prevention of tumors in tenrecs and similar species.

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LITERATURE CITED


LUNGWORM STUDY OF NORTH AMERICAN RED PANDAS (Ailurus fulgens)

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Abstract

There have been four recent cases of verminous pneumonia in red pandas (Ailurus fulgens) in European zoos. A recent study in Europe found many captive red pandas infected with lungworms.1 Previously, lungworm infections have been identified in North American captive red pandas2 but a cogent study of the prevalence of infection had not been done. U.S. and Canadian zoos holding red pandas were solicited to submit fecal samples to the Parasitology Laboratory, College of Veterinary Medicine, University of Tennessee (UT-CVM), or perform fecal exams on their red pandas, during the summer of 2010. Fifty-seven zoos sent sufficient fecal samples to UT-CVM and five zoos performed the fecal exams themselves. Seventy-eight individual red pandas and nine groups of red pandas (situations where zoos were unable to separate animals for individual sampling) were evaluated. Only one red panda was identified as being infected with lungworms. The worms found resembled Crenosoma spp. but the taxonomy of that worm is still under investigation. No Angiostrongylus spp. were seen.

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The authors would like to the following zoos for submitting fecal samples or sharing the results of their in-house fecal exams: Akron, Atlanta, Binder Park, Billings, Birmingham, Boise, Chattanooga, Columbus, Denver, Des Moines, Detroit, Fargo, Franklin Park, Ft Wayne, Garden City, Greenville, Indianapolis, Knoxville, Lansing, Madison, Mill Mountain, Milwaukee, Minnesota, Nashville, Norfolk, NY Bronx, Prospect, Oklahoma, Philadelphia, Providence, Pueblo, Rio Grand, Santa Barbara, Sacramento, San Diego, Seattle, Southbend, Tautphaus, Trevor, Utica, West Orange, Wheeling, Winnipeg, Calgary, Granby, Edmonton Valley Zoo.

LITERATURE CITED


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SEX DIFFERENCES IN MORBIDITY AND MORTALITY OF CAPTIVE AMUR TIGERS (Panthera tigris altaica) IN NORTH AMERICA: A REVIEW OF NECROPSY REPORTS (1960 – 2009)

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Abstract

Tigers (Panthera tigris), who once roamed across Asia, are now endangered and confined to <7% of their historic range.1,2 Of the six surviving subspecies, the Amur tiger (P. t. altaica) suffers from severe genetic and habitat impoverishment.3-8 Managed, captive Amur populations have the potential to infuse genetic diversity into wild populations. The success of captive breeding and reintroduction programs depends upon knowledge of the causes and consequences of disease processes in managed populations. Such information, although vital for developing effective diagnostic or preventative procedures, and for subsequent epidemiologic monitoring and control, is scarce. We analyzed 265 Amur tiger necropsy reports (~1/3 of all reported deaths between 1941-2008) from 61 North American zoos. The cumulative survival curve for males (n=119) did not differ significantly from that for females (n=146) (Kaplan-Meier, log-rank test, p=.85). We assigned one of 12 primary causes of death or euthanasia (PCDE) to each tiger. Among immature (females: <3 yr; males: <4 yr), we found few sex differences in the occurrence and prevalence of PCDE, with ~1/2 of all immature deaths attributed to perinatal causes (30.5%) or trauma (17.1%). However, we found marked sex differences in the occurrence and prevalence of diseases in adults. Among males, degenerative joint diseases (DJD; 31.2%) and neoplasia (29.9%) accounted for similar proportions of 77 deaths. Conversely, among females, neoplasia was the top PCDE, accounting for 46.2% of 106 deaths (with >65% of neoplasias affecting the mammary glands), while DJD accounted for only 8.5% of deaths.

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LITERATURE CITED


A SURVEY OF DENTAL DISEASE IN CAPTIVE BLACK RHINOCEROSES (*Diceros bicornis*)

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Abstract

An online survey was sent to 33 institutions that currently hold black rhinoceroses (*Diceros bicornis*) in their collection. The survey contained questions about the frequency of immobilization and oral exam in each individual, as well as history of dental disease or chronic health problems, and housing and diet information. The goal of the study was to determine the incidence and severity of dental disease in captive black rhinos and to attempt to discover the etiology of these abnormalities by surveying the husbandry and diets of these animals. Only 29% of individuals had ever had a complete oral exam under general anesthesia, and all of those animals had abnormalities such as enamel points or severe periodontal disease. A low percentage of browse in the diet was a common finding amongst institutions. The results of this study illustrate the need for more routine oral exams in captive black rhinos, as well as the need to further evaluate the frequency and cause of dental disease in this species.

Introduction

Performing routine oral exams and being able to appropriately diagnose and treat dental disease is an important aspect of zoo medicine. In domestic species, dentistry is a rapidly expanding field of knowledge, the benefits of which are seen in length and quality of life. Two of the most important aspects of oral health include routine dental care and appropriate nutrition. In captive wildlife species, both of these factors can be difficult to provide due to restrictions with patient size or temperament, anatomic limitations, and availability of suitable diets. An excellent illustration of this point is emerging in the captive black rhinoceros (*Diceros bicornis*). It has become apparent in the last few years that individuals of this species are developing significant dental disease that has previously gone unidentified. It is particularly interesting that the skulls of wild black rhinoceroses do not show evidence of dental disease. The captive individuals have bone loss and periodontal disease that is not appreciated in the wild specimens (S. Citino, personal communication). It is also of note that the disparity between oral health in captive and wild individuals is not seen in the white rhinoceros (*Ceratotherium simum*) (S. Citino, personal communication). It is likely that this is due to the different diets and feeding methods used by each species; white rhinos are grazers, whereas black rhinos are browsers. It is notoriously difficult to replicate a browser’s diet in captivity, and it is unknown how much the actual feeding method contributes to oral health. Therefore, in an effort to better understand this disease process and improve the health and quality of life of this captive species, a survey was compiled.
and distributed to 33 of the institutions accredited by the Association of Zoos and Aquariums (AZA) in the United States that house black rhinos to determine the incidence and nature of dental disease in this species.

**Materials and Methods**

The survey was distributed online to the veterinarian of record for each institution. It gathered data about the subspecies of black rhino in each collection (eastern \(D. bicornis michaeli\) or southern \(D. bicornis minor\)), the number, age and sex of rhinos at each institution, and the basic feeding methods and diets offered to the black rhinos (including percentage and frequency of browse given). For each individual, there were questions regarding the medical history including date of most recent immobilization, history of oral exam and dental disease, and any chronic health problems and associated therapies. Of the 33 institutions surveyed, there was a 45% response rate.

**Results**

The eastern subspecies was present at 11 institutions, while the southern subspecies were only at 4 institutions. Data was gathered for 51 individuals, 53% of which were male and 47% of which were female. The average age was 15.4 yr, with an age range of 2-33 yr.

When questioned about immobilization, 49% of the individuals had no known record of a physical exam under general anesthesia. Another 8% had not been immobilized within the last 10 yr. Only 29% of individuals had ever had a complete oral exam under general anesthesia; of all the oral exams performed, every individual had abnormalities ranging from sharp enamel points to severe periodontal disease and tooth loss. More than half of the oral exams (8/15) reported were performed by authors of this paper.

As many as 22% of individuals were noted to have a decrease in appetite or were seen quidding (dropping food). When asked about dental disease, 24% of individuals had a confirmed history. Other chronic medical problems reported included many of the common diseases seen in captive black rhinos \(^2\) such as eosinophilic granulomas and oral or lingual lesions (some associated with idiopathic hemorrhagic vasculopathy syndrome), as well as colic, weight loss, loose stool, rhinitis, skin lesions, and foot problems.

Data gathered about diets and feeding methods were reflective of the difficulty of feeding a browser of this size in captivity. While the overall diets varied greatly, most consisted primarily of either a high-fiber pelleted diet or a grass hay. The enclosure substrates and feeding methods also vary, but browse is often included as part of an enrichment program. Only one institution reports feeding 10-25% of the total diet as browse, with all the others feeding less than 10% browse. Two-thirds of respondents do not offer browse daily. Most individuals receive nutritional supplements in accordance with current recommendations, such as additional vitamin E.
Discussion

The data collected in this survey illustrates the need for further study of dental disease in captive wildlife species. It especially brings to light the challenges faced when it comes to recreating an animal’s natural diet and the importance that feeding practices may have on an individual’s overall health. It is unclear at this time how much browsers rely upon appropriate gingival exercise, but interspecies differences that have been observed seem to suggest that it may have a significant impact. For black rhinos the need for immobilization and size limitations means that oral examinations are performed infrequently. However, this study demonstrates the need for such regular exams, particularly as this species seems to be so severely affected and so greatly endangered.

The data gathered in the survey raises other health concerns. Chronic health conditions that have been particularly described in captive black rhinos, including eosinophilic granulomas and idiopathic hemorrhagic vasculopathy syndrome, have no pathophysiology that is well-described. At least one case of death from sepsis has been reported which included severe bacterial endocarditis, necrotizing myocarditis, and microabscesses in the brain that were attributed by the pathologist to the animal’s underlying periodontal disease. However, for the most part the relationship between dental disease and other diseases is unknown in black rhinoceroses. More frequent oral exams would increase our understanding of dental disease in this species and provide the opportunity to treat the disease as it is identified. At the same time it would present an opportunity to perform a general physical examination under anesthesia to identify other health problems that might improve the overall wellbeing of black rhinoceroses held in captivity.

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LITERATURE CITED


LONG-TERM ASSESSMENT OF THE DIETARY INFLUENCE ON GLUCOSURIA IN OKAPI (Okapia johnstoni)

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Abstract

Glucosuria has been described in okapis, yet the etiology remained unclear.²,⁶ In August 2006 we tried to lower glucosuria by a dietary decrease of sugars and starch. During a period of 4.5 yr, urine and feces of five okapis were analyzed to look for relationships between glucosuria and diet, stress or pregnancy. An animal, born in 2008, remained non-glucosuric to age 2.5, whereas another one, born in 2006, became glucosuric near the age of three. The correlation between fecal cortisol and the urinary glucose/creatinine ratio (UR) was either negative (three animals) or positive (one animal), but never significant (P>0.05).⁵ Glucocorticoids increase free glucose by their insulin opposing effect, but stress appears to have no influence on glucosuria in okapis.⁴ The correlation between the new diet and the UR was negative but not significant (two older females, P>0.05) or positive and very significant (two animals, P<0.001).⁵ UR decreased during the second half of the pregnancy in two animals and the youngest became non-glucosuric with a significant (P<0.05) negative correlation between fecal progestagens and the UR.⁵ An increased fetal glucose demand might explain this, similar to the consumption of 60% of the glucose from the uterine circulation by the ovine placenta in late pregnancy.³ In conclusion, the new diet did not significantly reduce glucosuria in two animals and had no effect on the rising glucosuria in two others. Possibly, genetic research into benign renal disease, which is a known human inherited condition (autosomal recessive), might explain glucosuria in okapis.¹

LITERATURE CITED

COLLECTION AND ANALYSIS OF SEMEN FROM GOELDI'S MONKEY (*Callimico goeldii*)

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Abstract

Deforestation, fragmentation and the black market wild animal trade contribute to reduce the size of wild populations of neotropical primates. To avoid the loss of their genetic material, it is necessary to develop Assisted Reproductive Techniques. Basic knowledge on semen characteristics is essential to achieve this goal. *Callimico goeldii* is a neotropical primate that occurs in Bolivia, Peru, Colombia, Ecuador and Brazil. To our knowledge, there are no reports on semen collection for this species. Semen from six sexually mature captive Goeldi’s monkeys was collected by rectal probe electroejaculation. Semen was diluted in coconut water in natura extender immediatly after collection. Coagulum formation was noted in all ejaculates and some samples had an amber coloration. It is not known if these are characteristics of the species or a consequence of the collection method. All analyses were done after 30 min from dilution, except for pH which was done using fresh semen. Results were (mean ± SD): volume 27.91 ± 11.75 μl; pH 7.52 ± 0.27; concentration 176 ± 271 x 10⁶ spermatozoa/ml; total motility 38 ± 44%; linear progressive motility 25 ± 32%; plasma membrane integrity (eosin-nigrosin stain) 39 ± 15%; and acrosome integrity using simple acrosome stain 61 ± 6%, or commercial kit Spermac® (Stain Enterprises, P.O. Box 12421, 0110, Onderstepoort, South Africa) 65 ± 9%. We could conclude further investigation may be required to improve semen collection and handling, for example, methods to better dissolve the coagulum.

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LITERATURE CITED


EVALUATION OF MITOCHONDRIAL ACTIVITY AND ACROSOME INTEGRITY IN BLACK HOWLER MONKEY (*Alouatta caraya*) SEMEN

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Abstract

The black howler monkey (*Alouatta caraya*) is listed as least concern,1 and thus may be used as model for threatened species of the same genus. There are previous reports of semen analysis in *Alouatta caraya*3,6 but to our knowledge evaluation of acrosome integrity and mitochondrial activity have never been reported for this species. Eighteen semen samples were collected by rectal probe electroejaculation6 from six adult captive individuals, housed in pairs, trios or individually. After pH analysis, semen was diluted in Ringer lactate solution6 for other analyses. Results were (mean ± SD): volume 69.44 ± 37.52 µl; pH 7.48 ± 0.27; concentration 628.00 ± 614.00 x 10⁶ spermatozoa/ml; total motility 51 ± 29%; linear progressive motility 39 ± 28%; plasma membrane integrity5,6 45 ± 17%; acrosome integrity (simple acrosome stain)4,5 51 ± 16%; and mitochondrial activity (3,3’ diaminobenzidine stain)2,5 9 ± 8% class I, 52 ± 17% class II, 31 ± 16% class III, 8 ± 7% class IV. ANOVA and Tukey’s test were used to determine whether variables differed between animals and collections. The only significant differences (p < 0.05) were: semen concentration for animal 1 was higher than for animals 3 and 5; acrosome integrity in the third collection was higher than first and second; and mitochondrial activity in the first collection was significantly higher than second and third. This report presents new information on semen characteristics of this species which may be used as an aid for further studies on reproductive technologies in this and other neotropical primate species.

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LITERATURE CITED

TWIN REVERSED ARTERIAL PERFUSION SEQUENCE AND FATAL AMNIOTIC FLUID EMBOLI IN A CHIMPANZEE (Pan troglodytes)

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Abstract

A 36-yr-old female chimpanzee (Pan troglodytes) from a zoological collection was presented for suspected dystocia of a near-term pregnancy. Each of this chimpanzee’s three previous pregnancies had resulted in an uncomplicated, vaginal delivery of a healthy baby. Her clinical history upon presentation included 1 week of intermittent mild vaginal bleeding and less than four hours of persistent regurgitation, severe lethargy, and pale mucous membranes. A diagnostic workup performed under general anesthesia included physical examination, complete blood count, plasma biochemistry panel, coagulation panel, and uterine ultrasound. These tests indicated that the chimpanzee was pregnant with congenitally malformed, deceased twins and was likely in anuric renal failure with sepsis and disseminated intravascular coagulation. Vaginal delivery of the feti was assisted with intravenous oxytocin, intravaginal misoprostol, and manual extraction. The chimpanzee went into cardiac asystole upon completion of the delivery and CPCR was unsuccessful. Necropsies revealed the cause of death of the feti as twin reversed arterial perfusion (TRAP) sequence. TRAP is a congenital malformation of monozygotic twins that results in an acardiac twin that is perfused by a pump twin through placental vascular anastomoses.1,2 The maternal cause of death was multifocal amniotic fluid emboli (AFE). Neither TRAP or AFE has been reported in a chimpanzee.

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LITERATURE CITED


UPDATING ANATOMIC DESCRIPTIONS OF TWO GREAT APES: THE GORILLA
(Gorilla gorilla) AND THE ORANGUTAN (Pongo pygmaeus)

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Abstract

Atlas format descriptions of the anatomy of the gorilla (Gorilla gorilla) and the orangutan (Pongo pygmaeus) are rare or nonexistent. 2,3 Most anatomic descriptions of these species are focused on a specific feature of the anatomy as it relates to anthropology, comparative medicine, or medical specialties. A recent publication provides thorough photo-documentation of the musculoskeletal system of the gorilla.1 However anatomic descriptions of the orangutan and clinically significant internal anatomy of the gorilla are rare and do not include modern imagery methods.

A cooperative effort between the Louisville Zoological Garden and the University of Kentucky has been established to document anatomy of these species by photographs. In addition, CT, MRI, and radiography will be used as indicated. The goal of this project is to publish a more complete description of clinically relevant anatomy of these species. Since the complete remains are required for this project, characteristics of an individual animal considered for this project include: well known & documented medical history, death or euthanasia from diseases that are diagnosed with a high level of confidence, and agreements in place for donation of the remains to the project. These characteristics are important as remains will be embalmed with dissection, gross pathology evaluation, and collection of tissues for histopathology typical of a necropsy occurring over several months.

LITERATURE CITED

THE GREAT APE HEART PROJECT: AN IMLS FUNDED INITIATIVE TO ADDRESS HEART DISEASE IN CAPTIVE GREAT APES

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Abstract

Great apes [gorillas (Gorilla gorilla), orangutans (Pongo pygmaeus, P. abelli), chimpanzees (Pan troglodytes), and bonobos (Pan paniscus)] are charismatic species that draw the public to visit zoos. Cardiovascular disease (CVD) has been identified as a major cause of death in great apes; however, underlying causes are poorly understood.^1^-^5^ Likewise there is incomplete understanding of how to diagnose, treat and monitor affected apes and how to adapt techniques used to address heart disease in humans and domestic animals to apes. The goal of the Great Ape Heart Project (GAHP) is to design an innovative and coordinated national program to investigate ape CVD and establish uniform, state of the art, cardiac diagnosis, treatment and prevention strategies for great ape CVD. In order to accomplish this goal, an Institute of Museum and Library Services (IMLS) Collaborative Planning Grant (CPG) was obtained with the primary goal of ensuring adequate funding to bring together a targeted audience to participate in active planning and breakout sessions to establish specific action plans. The partners on the grant are Zoo Atlanta, Cleveland Metroparks Zoo, University of California School of Veterinary Medicine UC Davis and University of Georgia, College of Veterinary Medicine Emerging Diseases Research Group.

Specific aims of the grant are:

1) Hire a full-time coordinator, based at Zoo Atlanta, to assist partners by facilitating communication, handling routine inquiries for resources or referral to subject matter experts (SMEs); plan and implement CPG-funded meetings, assist in preparation of a white paper, and future grant applications;

2) Convene a workshop in Atlanta, to bring together Species Survival Plan (SSP) veterinary advisors and coordinators, stakeholders, collaborators and SMEs in ape CVD;

3) Develop a comprehensive strategy to address ape CVD, coordinated within and between the ape SSPs, SSP institutions and collaborators;

4) Produce a white paper on ape CVD to: summarize current diagnostic procedures, treatment, and monitoring; outline a strategy/database for sharing case information between institutions; and outline a research plan to identify causes, new tests and treatments for ape heart disease to
minimize or prevent this problem. White paper recommendations will be disseminated through presentations, journal publications, electronic media and public relations efforts to inform zoo, veterinary and other professionals and the lay public.

5) Prepare and submit a National Leadership Project grant proposal (and/or other proposals) for funding to address targeted components of ape CVD.

This innovative and forward-thinking effort is bringing together essential stakeholders from a wide range of disciplines and communities, to develop a timely and coordinated plan to address a critical health need for the great apes. The workshop, white paper, and grant applications resulting from this collaborative planning grant will serve as a national model for investigations addressing health issues in other species, thus improving standards of care in zoological collections.

LITERATURE CITED

ZOObIQUITY: A SPECIES SPANNING APPROACH TO MEDICINE

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Abstract

Zoobiquity Conference, organized by UC Davis School of Veterinary Medicine, the David Geffen School of Medicine UCLA, and the Los Angeles Zoo and Botanical Gardens, brought together leaders in both human and veterinary medicine to discuss the same diseases in a wide spectrum of animal and humans. The conference generated conversations and relationships between human and veterinary colleagues and demonstrated how collaborations between zoos and academic medical centers enhance the mission of both institutions.

Introduction

Animals and humans share vulnerabilities to the same health threats. In fact, the vast majority of diseases physicians encounter in their human patients are treated by veterinarians in their non-human patients every day. Disorders many physicians consider “human diseases” ranging from cardiac amyloid to glioblastoma multiforme to thyroiditis to obsessive compulsive disorder are routinely diagnosed and treated by veterinarians utilizing essentially the same diagnostic strategies and therapeutic interventions used by human physicians.

Despite this, veterinarians and human physicians have few opportunities to collaborate around shared clinical concerns. Indeed, the vast majority of clinical physicians will move through their entire professional lives without engagement with a single clinical veterinarian. This is deeply unfortunate because collaborations between veterinarians and physicians have the potential to improve the health of many species.

In recent years, there has been a call by leaders in human medicine, veterinary medicine, public health, and wildlife biology to forge bonds between these fields and related institutions. Despite the recognition of the potential and benefits of these types of collaborations, to date there have been few projects which explicitly bring members of the two professions together.

Materials & Methods

Over the past several years, a number of cross-professional collaborations have emerged between UCLA School of Medicine, UC Davis School of Veterinary Medicine, and the Los Angeles Zoo. Veterinary sub-specialists have been invited to the UCLA Medical Center to participate in rounds and conferences. Physicians have assisted with tertiary care of animal patients at the Los Angeles Zoo. UCLA medical students have taken comparative cardiology classes in which EKG, echocardiography and physical diagnosis are taught using human and animal patients. These programs are aimed at narrowing the distance between physicians and veterinarians who are
treating many of the same diseases in different species. And this goal is being realized by targeting emerging leaders in both veterinary and human medicine early in their professional education.

Closing gaps, creating conversations, and forging bonds between human and veterinary medicine was the inspiration behind the first Zoobiquity Conference, held January 29, 2011. “Zoobiquity Conference: A Conversation Between Veterinarians and Physicians Caring for the Same Diseases in Different Species” brought together over 200 veterinarians and physicians to discuss the same diseases in patients of many different species. Jointly sponsored by the UCLA School of Medicine, UC Davis School of Veterinary Medicine, the Los Angeles Zoo and Botanical Gardens and the UC Global Heath Institute, the cross-disciplinary conference was designed to encourage conversations and create relationships between physicians and veterinarians confronted with similar clinical challenges.

Goals of the conference included fostering: 1) a broader consideration of the epidemiology of disease with implications for shared environmental triggers and exposures, 2) the development of new approaches to the diagnosis and treatment of disease in both animals and humans 3) relationships and collaborations between physicians and veterinarians leading to novel clinical, educational and investigational approaches and 4) a greater appreciation for the shared biology and pathophysiology of humans and animals by veterinarians and physicians.

Zoobiquity Conference 2011

The morning began in the auditorium of the Ronald Reagan UCLA Medical Center where 200 leaders in veterinary and human medicine gathered. The Deans of both UCLA School of Medicine and UC Davis School of Veterinary Medicine welcomed the participants. Human and veterinary sub-specialists discussed cases in the areas of cardiovascular disease, infectious disease, oncology and psychiatry. Discussion between sub-specialists focused on comparative aspects of the disorders and their therapies.

Following the morning program, conference participants boarded buses and traveled to the Los Angeles Zoo to participate in "walk rounds" led by the zoo's veterinary staff. Several fascinating cases with important comparative elements were presented with expert commentary provided from both human and veterinary medical experts.

Results

The conference succeeded in generating conversations and relationships between human and veterinary colleagues. In addition, the event provided an example of the kind of collaborative and generative work which can be accomplished when zoos partner with academic medical centers. A key component of the conference was to expand the educational perspectives of medical and veterinary students and to generate ongoing dialogue between the fields.
MAGNETIC RESONANCE IMAGING DIAGNOSIS OF INTERVERTEBRAL DISC DISEASE AND MYELOMALACIA IN AN AMERICAN BLACK BEAR (Ursus americanus)

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Abstract

A 23-yr-old black bear (Ursus americanus) was examined because of paralysis. The onset of clinical signs was unknown due to seasonal torpor. An observational exam confirmed the absence of motor function in the pelvic limbs and normal thoracic limb function. The bear was immobilized using hydromorphone (Baxter Healthcare, Deerfield, Illinois 60015 USA; 0.08 mg/kg i.m.) and tiletamine/zolazepam (Telazol®, Fort Dodge Laboratories, Inc., Fort Dodge, Iowa 50501 USA; 4 mg/kg i.m.) for further evaluation. Radiography revealed increased mineral opacity and ventral bridging across vertebral segments T8 – T11. Magnetic resonance imaging revealed a focal hypointense, extradural lesion dorsal to the cord at the T8-T9 intervertebral disc space on sagittal and transverse T2-weighted (T2W) images. The transverse images confirmed cord compression associated with the mass. A mildly ventrally compressive lesion also was seen at this level, hypointense to the cord on T1-weighted (T1W) and T2W images. This was compatible with herniated disc material and suggested that the dorsal lesion may have also been extruded disc in an unusual location. Based on these findings, along with the bear’s advanced age, euthanasia was elected. Necropsy exam revealed ankylosing spondylosis from T7 – L3, and dorsal extradural extruded disc material in the area of T8 – T9. Histopathology demonstrated the dorsal horns of the affected cord were replaced by foamy macrophages extending into the white matter compatible with focal, severe, chronic myelomalacia. This is the first report of intervertebral disc herniation in an ursid and the first report demonstrating the use of MRI to diagnose IVDD in any large carnivore.1-4

ACKNOWLEDGMENTS

The authors would like to thank Berkley Boone and the Athens-Clarke County Department of Leisure for their willingness to pursue a complete work-up and for their excellent care of this bear while she was in their charge. The authors would also like to gratefully acknowledge the University of Georgia Bio-Imaging Research Center for donation of MRI time and Kim Mason for her MRI technical assistance.
LITERATURE CITED


THERMOGRAPHY CASE EVALUATIONS

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Abstract

Thermography detects differences in infrared radiation emitted by any object above absolute zero. With an increase in temperature, the amount of radiation is also increased and detected at the skin level through the use of an infrared thermography camera. Differences in emissivity are interpolated through color. In veterinary medicine, thermography is commonly utilized with marine mammals, though its use is increasing across a broader range of subjects.1-4

In many cases, visual evaluation of inflammatory or circulatory lesions belies the full extent of affected tissue. This is readily apparent with animals such as elephants. In one particular case, visual examination of a female African elephant (Loxodonta africana) demonstrated a small, superficial abrasion to the skin from intraspecific trauma, but thermography revealed much larger areas of inflammation at multiple sites. In another elephant, a small, localized abscess on the lateral aspect of the foot pad demonstrated erythema extending further proximally than could be assessed clinically. Lesions associated with abrasions in a sea lion (Zalophus californianus) revealed greater areas of erythema than what presented visually. A dromedary camel presented with a large, chronic, symmetrical swelling to the cranium. Use of comparative thermography determined the swelling was simply depots of adipose tissue. Decreased circulation, subtle differences in weight distribution, evaluation of thermoregulation and fluid administration under anesthesia, quarantine and pre-shipment exams, and detection of thermogradients in holding stalls can be determined through thermography as well.

Thermography increases the diagnostic capabilities of the zoo clinician when evaluating animals for underlying disease processes.

ACKNOWLEDGMENTS

The author wishes to thank the staff at the Kansas City Zoo for their expertise and care of the animals.

LITERATURE CITED

EFFECT OF BODY POSITION, LEG AND NECK EXTENSION, AND SEDATION ON LUNG VOLUME IN RED-EARED SLIDER TURTLES (*Trachemys scripta elegans*)

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Abstract

Pneumonia is a common problem in turtles and tortoises, which is typically diagnosed radiographically. An impact of body position and extension of extremities and neck on lung volume has been suggested, but has not been systematically described and quantified. Therefore we investigated the effect of body position (vertical vs. horizontal) and leg and neck position (extended vs. withdrawn) on lung volume in conscious and sedated red-eared slider turtles (*Trachemys scripta elegans*) (six female and eight male) using computed tomography. While sedation with dexmedetomidine (Pfizer Animal Health, New York, NY 10017 USA; 0.1mg/kg, s.c.), midazolam (Hospira Inc, Lake Forest, IL 60045; 1mg/kg, s.c) and ketamine (Fort Dodge Animal Health, Fort Dodge, IA 50501; 2mg/kg, s.c) had no significant effect on total lung volume, leg and neck extension resulted in a significant increase in total lung volume (*p* < 0.001) in sedated turtles. Left and right lateral and cranio-caudal vertical positioning had no significant effect on total lung volume, but resulted in a shift of coelomic organs ventrally, compressing and significantly reducing the volume of the dependent lung tissue (*p* < 0.01). No significant gender differences were found in lung volume and position. Based on these results, horizontal radiographic positioning of chelonian patients is recommended in order to avoid compression of lung tissue by shifting coelomic organs. Extension of the extremities and neck will lead to an increase in lung volume, and therefore, potentially improve the diagnostic value of imaging of turtles and tortoises suffering from diseases of the lower respiratory tract.

LITERATURE CITED

ULTRASOUND FAST SCANNING BEFORE AND AFTER FLUID THERAPY IN THE FIELD AS AN AID FOR THE DIAGNOSIS OF GASTROINTESTINAL PERFORATION IN A BOBCAT (Felis rufus)

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Abstract

A 10-yr-old female bobcat (Felis rufus) presented with a three day history of lethargy, anorexia, and two episodes of vomiting. An emergency field visit was scheduled to perform radiographs and abdominal ultrasonography. She was assessed to be ~5-10% dehydrated, based on decreased skin turgor and tacky mucous membranes. Free peritoneal gas, reduced abdominal serosal detail, and an abnormal appearing right-sided intestinal segment were identified in the lateral and ventrodorsal abdominal radiographs (indirect digital or computed radiographs). However, the emergency field clinicians were not knowledgeable of these abnormalities, because the radiographs had to be processed at the UGA-VTH. During an initial complete abdominal ultrasound evaluation, a non-dependent hyperechoic interface with reverberation artifact (intestinal or free gas) and focal intestinal changes suggestive of marked enteritis or peritonitis were identified. Free peritoneal fluid was not present on initial examination. In a focused abdominal sonography for trauma (FAST) scan, made following subcutaneous fluid administration (dose 130ml/kg), a small volume of anechoic free fluid was present in the peritoneal space. With ultrasound guidance, the fluid was aspirated and was grossly turbid. This fluid was subsequently confirmed as septic supplicative effusion, secondary to a foreign body-associated intestinal perforation. FAST is well described in human medicine, and to a limited degree in veterinary literature.1-3 This case represents a novel application of FAST scanning in an emergency field setting in a non-traumatized patient. It illustrates the potential utility of FAST exams for yielding additional and critical clinical information after establishing euvoolemia.

LITERATURE CITED

DIAGNOSTIC IMAGING AND SURGICAL RESECTION OF A MALIGNANT MENINGIOMA IN AN AFRICAN HUNTING DOG (*Lycaon pictus*)

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Abstract

A 9-yr-old male African hunting dog (*Lycaon pictus*) with a previous history of supraspinatus tendon injury and left forelimb lameness, presented with proprioceptive deficits and progressive paraparesis of the pelvic limbs over a four day period. A diagnostic evaluation, including blood work and plain film radiographs failed to indicate any lesion and a lumbar spinal tap was unsuccessful. The animal did not respond to medical therapy of tramadol (tramadol hydrochloride, Amneal Pharmaceuticals of New York, Hauppauge, NY 11788 USA; 2mg/kg p.o. b.i.d) and meloxicam (Cadlia Healthcare Ltd., Ahmedabad, India; 0.2 mg/kg p.o. s.i.d.). A magnetic resonance imaging (MRI) scan revealed an extradural contrast enhancing lesion at L2-L3 with significant spinal cord compression. Although it could have been a ruptured disk, the most likely differential was neoplasia. The dog did not improve with supportive care. A right sided hemilaminectomy was performed and a large mass was debulked from the spinal canal. The animal was standing 2 hours after surgery and normal ambulation was noted 3 days post-surgery. Histology revealed a high grade, anaplastic sarcoma that stained positive for vimentin, and E-cadherin, which is most consistent with a poorly differentiated meningioma. While the African hunting dog did well initially post-operatively, the hind limb paresis recurred and was nonresponsive to medical therapy. Euthanasia was performed for humane and further diagnostic purposes. Gross necropsy findings confirmed recurrence of the spinal lesion, with compression of the spinal cord from L2-L4.

ACKNOWLEDGMENTS

I would like to thank the administration, veterinary technicians and keeper staff of the Toledo Zoo, and especially the wild dog keepers for their efforts in this case. I would also like to extend my thanks to the staff at University of Toledo diagnostic imaging center for donating their time in this case.
A RETROSPECTIVE STUDY OF DISEASES IN ELASMOBRANCHS

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Abstract

To the author’s knowledge, no large retrospective studies of disease in elasmobranchs have been published. This report reviews diseases of 1546 elasmobranchs representing at least 60 species submitted to Northwest ZooPath from 1994-2010. Cow-nosed rays (Rhinoptera bonasus) (78), Southern rays (Dasyatis Americana) (75), dusky smooth-hounds (Mustelus canis) (74), bonnethead sharks (Sphyrna tiburo) (66), and bamboo sharks (Hemiscyllidae) (56) were the most commonly submitted species. Infectious/inflammatory disease was most common (33.5%) followed by nutritional (11.9%, mostly emaciation), traumatic (11.3%), cardiovascular (5.5%, mostly shock) and toxin-associated disease (3.7%). Bacterial infections (518/1546, 15%) included sepsis (136/518, 26%), dermatitis (7%), branchitis (6%), and enteritis (4%). Fungal infections (10/1546, 0.6%) included dermatitis (30%), hepatitis (30%) and branchitis (20%). Viral infections (15/1546, 1%) included papillomatosis (47%), herpesvirus (20%) and adenovirus (7%). Parasitic infections (137/1546, 9%) included nematodiasis (36/137, 26%), ciliate infections (23%), trematodiasis (20%), coccidiosis (6%), myxozoanosis (5%), amoebiasis (4%), cestodiasis (1%) and flagellate infections (1%). Inflammation of unknown cause (401/1546, 26%) included enteritis (55/401, 14%), branchitis (9%), encephalitis (9%), and dermatitis (7%). Traumatic diseases (174/1546, 11.3%) included skin (103/174, 60%), stress/maladaptation (9%), and gut trauma (7%). Toxicoses (57/1546, 4%) toxic gill disease (16/57, 26%), gas bubble disease (19%), fenbendazole (7%), ammonia (7%), chlorine (5%), and ozone (4%). Species predispositions included papillomatosis in bamboo and sand tiger sharks (Odontaspidae); visceral nematodiasis in black nosed (Carcharhinus acronotus) and sandbar sharks (C. plumius); intracoelomic coccidiosis in cow-nosed rays; ciliated protozoan, herpesvirus and adenovirus infections in dusky smoothhounds; toxic gill disease and microsporidiosis in lemon sharks (Negaprion brevirostris); necrotizing pancreatitis in horned (Heterodontus francisci) and zebra sharks (Stegostoma fasciata); tattoo ink embolism in orange spot stingrays (Potamotrygon motoro); branchial trematodiasis in southern rays; branchial nematodiasis in cownose rays; and goiter in swell (Cephaloscyllium ventriosum) sharks.
COMPARISON OF THREE ANTICOAGULANTS FOR HEMOLYSIS AND MEASUREMENT OF PLASMA BIOCHEMICAL VALUES IN CAPTIVE SOUTHERN STINGRAY (Dasyatis americana)

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Abstract

Blood samples were collected from 11 stingrays by ventral tail venipuncture on three occasions and placed in blood tubes containing either: lithium heparin (LH) (2mL blood: 3mL lithium heparin tube), elasmobranch modified anticoagulant citrate dextrose (E-ACD) (3mL blood: 0.35mL E-ACD), or elasmobranch modified heparin ethylenediamine tetraacetic acid (hepEDTA) (3mL: 0.1mL hepEDTA). Subjectively LH samples had the greatest gross hemolysis and ACD samples the least. Cellular morphology on blood smears also appeared affected most by LH and least by hepEDTA. Significant differences (P < .05) were greater means for PCO2 and PO2 on ACD, and HCO3 on hepEDTA; and lower means for pH on ACD, and pH, total CO2, and O2 saturation on hepEDTA than LH samples. Whole blood in ACD cannot be used for base excess, HCO3, total CO2 concentrations, or O2 saturation determinations by iStat. Significant differences (P < .05) in plasma biochemistries were greater mean concentrations of phosphorous, glucose, sodium, and potassium on ACD; and AST enzyme, phosphorous, and potassium on hepEDTA samples; and lower mean concentrations for globulin, urea nitrogen, and calcium on ACD, and urea nitrogen and calcium on hepEDTA than on LH anticoagulant samples. These differences appear to reflect interactions between stingray blood and respective osmolality, pH, and chemical composition of these anticoagulants and should be considered when selecting an anticoagulant for marine elasmobranch blood samples with high plasma osmolality. The LH appeared to be the better anticoagulant for blood gas and acid-base, and biochemical analyte determinations. The hepEDTA anticoagulant appeared best for blood smears.
NEW FINDINGS ON THE PHARMACOKINETICS OF CEFOVECIN (CONVENIA) IN MARINE MAMMALS

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Abstract

The pharmacologic properties of cefovecin (Convenia® Pfizer Limited, Sandwich-Kent CT13 9NJ, UK) may pose an advantage for the exotic veterinary field1,3 due to its broad-spectrum4, administration route and long duration of activity which overall allows minimal handling and stress. Preliminary studies proved that administration of cefovecin at 8mg/kg induces plasma concentrations over the MIC90 during 17d in adult bottlenose dolphins (Tursiops truncatus) and around 80d in adult Patagonian sea lions (Otaria flavescens)2.

In the present study, cefovecin was administered subcutaneously in sea lions at three doses (2, 4, 8mg/kg). Peak plasma concentrations (14.31; 24.30 and 55.21μg/ml, respectively) and total drug in plasma along treatment (312, 663 and 881μg∙d/ml) were dose dependent. However, the maintenance of therapeutic concentrations seemed not to differ between doses of 4 and 8 mg/kg (tC>MIC90≈80d), being significantly shorter for the 2mg/kg dose (tC>MIC90≈50d).

Intramuscular administration at 4mg/kg in a walrus (Odobenus rosmarus) induced a lower peak in plasma levels (11.86μg/ml) than those estimated for sea lions, although the kinetic behaviour and maintenance of plasma therapeutic levels (tC>MIC90>50d) seemed to be similar for both species.

Four dolphin neonates were treated at 8mg/kg (n=3) and 16mg/kg (n=1). At 8mg/kg, the maximum drug concentration observed in neonates was lower (35.49μg/ml) to those reported for adults (79.19μg/ml). Significant differences were also found in the duration of the drug concentrations over the MIC90 (13 vs 17d, respectively). Double dosage of 16mg/kg seemed only to affect the peak plasma concentration after injection (49.67μg/ml) but not the duration of the treatment (tC>MIC90=12d).

ACKNOWLEDGMENTS

The authors would like to acknowledge Pfizer Salud Animal for their support as well as all the Biology Department of the L’Oceanogràfic, Zoomarine and Oltramare for their great effort in animal training, allowing for sampling the animals routinely to obtain the antibiotic kinetic curves.
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HEMOLYTIC UREMIC SYNDROME-LIKE COMPLICATIONS IN A *Tursiops truncatus* WITH PERACUTE *Erysipelothrix rhusiopathiae* SEPTICEMIA

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Abstract

In 2002, a 5-yr-old, 169 kg male Atlantic bottlenose dolphin (*Tursiops truncatus*) contracted a peracute septicemic *Erysipelothrix rhusiopathiae* infection, which was confirmed via blood culture. Though this form is nearly always fatal to cetaceans, this particular animal survived, despite the development of a severe uremia, anemia, and thrombocytopenia. This triad of findings very closely resembles a clinical condition known in humans as hemolytic uremic syndrome (HUS).

The patient presented with a sudden onset of depression and inappetance. A profound leukopenia and thrombocytopenia was detected on initial blood work. An intensive course of injectable antibiotics and corticosteroids was begun, as well as oral and subcutaneous fluid therapy. A progressive deterioration in clinical condition and worsening uremia and thrombocytopenia necessitated the addition of phosphate binders, calcium supplementation, diuretics, and nutritional support. Gradually the animal recovered, with the improvement in BUN, creatinine, and hematocrit following the steady increase in platelet numbers.

HUS is the most common cause of acute renal failure in young children. This syndrome is characterized by progressive renal insufficiency and failure, and may be caused by a myriad of agents which can affect the integrity of the microvasculature of the kidneys. These factors may include bacterial, viral, rickettsial, or fungal infections, chemotherapeutic agents, or autoimmune complexes, among others. However, the most common etiology is a shiga toxin-producing *E. coli* O:157:H7.

LITERATURE CITED

LEPTOSPIROSIS IN A PYGMY HIPOPOTAMUS (Choeropsis liberiensis)

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Abstract

Leptospirosis is an infectious disease, caused by species of the Leptospiraceae family, which has a worldwide distribution. Multiple species have been found to be affected by leptospirosis with many others considered to act as reservoirs for the bacteria; in the case of Leptospirosis icterohaemorrhagiae an important vector is the black rat (Rattus rattus). Although the common hippopotamus (Hippopotamus amphibus) has been recorded to have antibody titres to leptospires little has been documented with regards to the pygmy hippopotamus (Choeropsis liberiensis) relationship with leptospira titres nor clinical leptospirosis. This case report details a fatal leptospirosis infection attributed to Leptospirosis icterohaemorrhagiae in a male, 10-yr-old 271 kg pygmy hippopotamus.

Clinical Signs

Clinical signs started with non-specific lethargy and anorexia that was non-responsive to symptomatic therapy with Flunixin (Finadyne solution, Schering-Plough, 50 mg/ml) 350 mg IM and oxytetracycline (Duphacycline LA, Fort Dodge, 200mg/ml) 6 g IM given via pole syringe. Examination under general anesthesia was undertaken. Induction was induced with medetomidine (medetomidine, Kyron Laboratories, 40 mg/ml) 25 mg and ketamine (ketamine, Kyron Laboratories, 200 mg/ml) 300 mg IM in the left neck using a carbon dioxide powered rifle (Daninject JM Special Rifle, Daninject). He was intubated with a 16 mm endotracheal tube and maintained with isoflurane, oxygen and a small animal circle (CycloFlo, Burtons). Examination was unremarkable. Treatment consisted of oxytetracycline LA 5 g IM, flunixin 250 mg IV, lactated ringer’s solution (Aqupharm 11, Animalcare) 3.5 litres IV via 20 g medial saphenous cannula, liquid paraffin 1litre via stomach tube. The working differential diagnoses consisted of ileus, colic, systemic illness, neoplasia, or other. Biochemistry was indicative of early renal and hepatic failure. Serum was sent for L. icterohaemorrhagiae antibody titres and the animal started on lactated ringer’s solution LA 5 g IM, flunixin 250 mg IV, procaine penicillin and dihydrostreptomycin sulphate (Penstrep injection, Norbrook, 200 mg/ml, 250 mg/ml respectively) 10 ml, and flunixin 250 mg IV. Leptospirosis titres were returned and were strongly positive for Licterohaemorrhagiae. By day eight of infection and little change in clinical signs the animal became jaundiced. Therapy was continued with two more repeat anesthetics for assessment, intravenous fluid therapy, repeat biochemistry and CBC which showed deterioration in renal and hepatic parameters. On day 13 the animal was found in distress and due to poor prognosis
euthanasia was opted for on welfare grounds. Anesthesia was induced and he was euthanatized with 50 ml cinchocaine HCL and secobarbital sodium IV (Somulose, Arnolds, 25 mg/ml, 400 mg/ml respectively).

**Gross Post-Mortem**

The oral mucous membranes, perineum and skin were a bright yellow color. This continued throughout the post mortem with articular surfaces, larynx, trachea, mucous and peritoneal membranes and visceral surfaces bright yellow in color. All body systems were grossly normal with little pathology to be noted. There were no transudates and the lymph nodes were not enlarged. On the heart there were pericardial hemorrhages but these were not organized and were thought to be associated with the method of euthanasia, the lungs had evidence of hypostatic congestion but again little gross pathology. The liver was extremely friable but grossly normal, and the gall bladder had bile in but was not distended. The stomach was unusual in that it was full with grass and oats, yet the hippo had not been seen to eat for 2 weeks and had not been offered oats for that same period: the contents smelt fresh and not sour. The renal system was grossly normal with no evidence of polycystic kidney disease bilaterally; the cortex was slightly yellow in color and there were some streaks of hemorrhage in the medulla. The adrenals had a thick cortex and a thin medulla. The larynx had long vocal folds and the trachea was 19 mm in diameter.

**Histologic Findings**

The combination of histologic findings, particularly in the light of the positive titre for *L. icterohaemorrhagiae*, was consistent with that of leptospirosis, consisting particularly of lesions in kidney, liver and pancreas. There was significant non-suppurative tubulointerstitial nephritis with ongoing neutrophilic tubular inflammation and necrosis, and active epithelial regeneration that included occasional atypical multinucleated cells. There was also widespread precipitation of bile pigments in tubules consistent with the jaundice. In the liver, the changes were more subtle, but there was evidence of marked intrahepatic cholestasis, and hepatocyte cords were jumbled with loss of clear lobular architecture in some cases, suggesting earlier injury. Inflammation was not prominent, but there was widespread vacuolar change in hepatocytes. There was also evidence of an earlier episode of pancreatitis, with minimal active inflammation but multifocal interstitial fibrosis and replacement of acinar tissue with immature ductules. Pancreatitis has been noted to be a feature of leptospirosis in some species, including dogs and humans. Extramedullary hematopoiesis in the liver was likely to be a systemic reaction to inflammation and anemia.

**LITERATURE CITED**

INTAKE AND TREATMENT OF OILED SEA TURTLES IN LOUISIANA DURING THE 2010 BP DEEPWATER HORIZON OIL SPILL

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Abstract

On April 20, 2010 the offshore oil rig Deepwater Horizon exploded off the Louisiana coast resulting in the spillage of millions of barrels of oil into the Gulf of Mexico. Federal and state wildlife officials recovered over 450 live oiled sea turtles in the ensuing months which were transported to primary care facilities in Louisiana, Mississippi and Florida. The Audubon Nature Institute in New Orleans, Louisiana received 187 oiled sea turtles, including Kemp’s Ridleys (Lepidochelys kempi), Greens (Chelonia mydas), Loggerheads (Caretta caretta) and Hawksbills (Eretmochelys imbricata), most of which were under 3 kilograms body weight. As no guidelines regarding the care of oiled reptiles were available, a treatment protocol was developed.

On intake turtles were weighed, measured, and identified with a tag. A blood sample was collected from the dorsal cervical sinus for immediate analysis using an i-STAT® CG8 (Abbott Point of Care, Inc., Princeton, NJ, 08540, USA) and submitted for a complete blood count, chemistry panel, and hydrocarbon analysis. Physical examination was performed including corneal stain with fluorescein, heart rate by doppler, respiratory rate, body temperature and oral examination. Generally turtles were moderately to heavily oiled, often lethargic, were mild to moderately dehydrated and some were bradycardic and bradypneic. A thick layer of highly viscous oil frequently occluded the nares and coated both eyes and all oral tissues extending into the esophagus. Equal volumes of 0.9% saline and Lactated Ringers Solution supplemented with vitamin B complex (0.1 to 0.2 ml/kg) were administered s.c. at 20 ml/kg. Common blood abnormalities from the i-STAT included hypo- or hyperglycemia, hypo- or hyperkalemia, hypocalcemia, hypernatremia, and acidemia. Additives such as dextrose, potassium chloride, calcium gluconate and sodium bicarbonate were administered when medically appropriate.

Vegetable oil was applied externally to loosen the crude oil and turtles were scrubbed clean with Dawn® dishwashing detergent. Mayonnaise was applied to the eyes and periorbital tissues to loosen crude oil, and corneal ulcers were treated with topical antibiotic ointment. Oral tissues were cleaned with mayonnaise-impregnated gauze. Due to concerns over possible stress-related immunocompromise and the potential for respiratory compromise from crude oil exposure or aspiration, all turtles were started on prophylactic antibiotic therapy (ceftazidime, Fortaz, GlaxoSmithKline, Research Triangle Park, North Carolina 27709, USA, 20 mg/kg i.m. every 3 days for 3 wk). Turtles were also given prophylactic iron dextran (5mg/kg i.m. once) due to a report of anemia following ingestion of crude oil by juvenile loggerhead turtles.1 Turtles were initially given activated charcoal (Toxiban®, Lloyd Inc., Shenandowah, Iowa 51601, USA, 5ml/kg) via oral gavage; however, nearly all turtles regurgitated the charcoal despite vertical positioning post-administration. Turtles were instead gavaged a mixture of 2 parts mayonnaise
to 1 part cod liver oil (5 ml/kg) which was well tolerated as an oral cathartic and emulsifier. Turtles were initially placed in shallow fresh water for four days, though due to the development of severe hyponatremia in some cases, this was changed to 25 ppt salt water. A few obtunded turtles were covered with a water-based lubricant and “dry-docked” overnight. All animals were examined thoroughly the following day, including a recheck iSTAT®, administration of parenteral fluids (10 ml/kg), additional medications as needed, and another cleaning. Turtles were given a second dose of mayonnaise/cod liver oil 48 hours after intake and monitored daily until completely stable.

ACKNOWLEDGMENTS

We are extremely grateful to the vast numbers of Audubon staff, volunteer veterinarians, technicians, and biologists, too numerous to name here, who worked day and night in extreme heat and hazardous conditions to receive and care for the animals affected by this incident.

LITERATURE CITED

THE DEVELOPMENT AND TESTING OF A SOLAR HYDROGEN ELECTRIC BIO-MECHANICAL PORTUGUESE MAN-O-WAR (*Physalia physalis*): BIO-MECHANICAL AND BIO-MIMETIC APPROACHES TO SUB-AQUATIC PHYSICAL AND CHEMICAL IMMOBILIZATIONS

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Abstract

Sub-aquatic physical and chemical immobilization of small and large animal species has been challenging and dangerous.3 Fluid dynamic studies have demonstrated that the Portuguese Man-o-War can be analyzed by biophysical parameters.2,4 Bio-mechanical studies have also been conducted to explore the development of biomimetic tentacles for use in infusion parches in patients.7,9 We have been developing a solar hydrogen electric bio-mechanical Portuguese man-o-war Physalia spp. (sHe-BMPM), which has a platform for immobilization (Figure 1, 3 and 4).1,5,7 The anesthetic apparatus mimics the bio-mechanics of the cnidocysts of the Portuguese man-o-war. Based on in-house hydrostatic data, it is designed to immobilize aquatic species, which have masses of 5 Kg or less (Figure 3).10 The anesthetic apparatus consists of a robotically operated, webbed hand, which can capture a fish. A liquid anesthetic such as MS 222, can be sprayed by micro-nuzzles located in the palmar aspect of the hand (Figure 2). The micro-nuzzles are attached to plastic tubes which are connected to a micro-infusion pump, located in the hull.6,8 The probe carries test tubes, which can be used for collecting water samples at a variety of depths and latitudes.6 The inner lining of the mechanical pneumatophore has a layer of thin solar panels. The motor attached to the propeller is powered by solar hydrogen electrical energy.10

ACKNOWLEDGMENTS

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Figure 1. Three winches close to three 6V hydrogen fuel cells in the sHeBPM. The middle winch has the penta-digitated mechanical tentacle, which has a web arrangement of inter-digital nets. The third winch is attached to the multi-test tube water sampling probe.
Figure 2. *Physalia physalis*


Figure 3. Buoyancy model data.
Figure 4. Bio-mechanical tentacle: A. Proximal joint, B. Anesthetic fluid line, C. Proximal digits from joint, D. Distal ends of anesthetic fluid line, E. Middle joints, F. Net, G. Distal tip of digits with padded rubber caps, H. Afferent leads to servo motors in the medial joints, I. Efferent leads from servo motors in the medial joints, J. Cable tape, K. Afferent leads to servo motors in the proximal joint L. Efferent leads from servo motors in the proximal joint, M. Distal interdigital joints.
ASSESSMENT OF MULTIANTIGEN PRINT IMMUNOASSAY (MAPIA) AND RAPID LATERAL-FLOW TEST (RT) FOR THE DETECTION OF Mycobacterium bovis INFECTION IN MALAYAN TAPIR (Tapirus indicus)

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Abstract

A multiantigen print immunoassay (MAPIA) and a rapid antibody test (RT) developed and validated for detection of mycobacterial seroreactive antibodies in elephants (Elephas and Loxodonta)1 was assessed in Malayan tapir (Tapirus indicus). Retrospective analysis of frozen banked serum was performed in 2007 from one infected and seven apparently uninfected tapir by MAPIA and RT. The infected tapir was a 20-yr-old female wild caught animal that died in 1995 with culture confirmed Mycobacterium bovis infection. A blood sample obtained 2 mo before death demonstrated clear seroreactivity in both MAPIA and RT testing. The apparently uninfected animals included four males and three females ranging in age from 1 to 25 yr of age. Four died without post-mortem evidence of mycobacterial disease and blood samples were collected from these within days to 3 yr of death. Three remained healthy for 2 to 13 yr following sample collection. Blood samples had been frozen for days to 15 yr before testing. None of the seven uninfected tapir demonstrated seroreactivity in either test. These results suggest that MAPIA and RT tests have potential utility for rapid detection of M. bovis infection in Malayan tapir.

ACKNOWLEDGMENTS

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LITERATURE CITED

COMPARISON OF ASPERGILLUS ANTIBODY AND GALACTOMANNAN VALUES IN WILD AND CAPTIVE HUMBOLDT PENGUINS (Spheniscus humboldti)

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Abstract

Serologic testing (antibody and galactomannan antigen) is commonly used for aspergillosis diagnosis. This study compared serologic data from captive and free-ranging penguins. A database was constructed using 10 yr of retrospective data from healthy penguins at three zoos and wild penguins from the Punta San Juan Reserve, Peru. Captive penguins were considered healthy based on physical examination, normal total white blood cell count, and lack of apparent clinical illness for 1 mo prior to and following the date of blood collection. Wild penguins were deemed healthy based on physical examination and total white blood cell count alone, although no cases of respiratory disease have been noted on examination of over 350 penguins at the reserve over the past 4 yr.

Antibody and galactomannan levels were determined by ELISA through the University of Miami, Miller School of Medicine. Using reference data established for psittacine species, 95% of the captive (57/60) and 90% of the wild (36/40) birds were antibody positive. For galactomannan, 6% of captive penguins (2/32) were positive, while 5% of wild penguins (2/40) were positive. Using Fisher’s exact tests, no significant difference was detected for either antibody or galactomannan tests between captive and wild populations, sex, zoo, or by age classification (<15, >15 yr old). Results suggest cut-off values established for psittacines may be applicable for penguins, as exposure (with subsequent antibody production) is common in captive birds and undefined in wild populations. Thus, assessment of aspergillosis based solely on antibody indices is likely to yield high numbers of false positives. Additional work is needed to establish antibody and galactomannan reference values specific for Spheniscus penguins.

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Financial support provided by the Chicago Zoological Society and Saint Louis Zoo WildCare Institute. We thank Dr. Patricia Majluf, Marco Cardeña, and other colleagues at Cayetano Heredia University for their continued collaboration on field programs in Peru that allowed for sample collection from wild penguins. We appreciate the support of Brookfield Zoo, Saint Louis Zoo, and Oregon Zoo for providing captive penguin data.
LITERATURE CITED


MEASUREMENT OF BLOOD PRESSURE IN AWAKE WESTERN LOWLAND GORILLAS (Gorilla gorilla gorilla)

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Abstract

Cardiac disease is a leading cause of morbidity and mortality in captive western lowland gorillas. The etiology of this disease remains a mystery. In humans, hypertension is an important contributor to cardiac disease and blood pressure measurements are crucial in monitoring disease and response to treatment. However, hypertension has not been clearly defined in any great ape species. Blood pressure is routinely measured in anesthetized gorillas, but to date, measurement in awake gorillas has been difficult. A device has been designed to hold a blood pressure cuff capable of obtaining accurate blood pressure measurements in awake gorillas. The design consists of a protective casing for a blood pressure cuff incorporated within an extension into a training sleeve. Validation testing was used in order to verify that the design functions properly and meets the user needs. This set up has allowed for the measurement of blood pressure in the forearm of awake gorillas, improving both the accuracy and early detection of hypertension in captive gorillas. The purpose of this presentation is to discuss the blood pressure sleeve design and training steps involved in desensitizing gorillas to the device and share preliminary findings from Zoo Atlanta.

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The authors would like to thank Nisha Bhatia, Stephanie Drewicz, Scott Seaman, David Sotto, in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University, for their capstone course work to develop the device which assists in blood pressure measurement.

LITERATURE CITED

PROTEIN-BINDING OF CEFOVECIN (CONVENIA®) IN 25 ZOOLOGICAL SPECIES: A PREDICTOR FOR EXTENDED DURATION OF ACTION

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Abstract

Cefovecin is a 3rd-generation cephalosporin with an efficacy of two-weeks following a single injection in dogs and cats. 9,10 Studies evaluating cefovecin in non-domestic animals are increasing, with pharmacokinetic and elimination studies already completed in various species including six reptiles, 2,11 eight birds, 2,4,8,11 four primates, 1,2,7 four ruminants, 2 three felids, 2 four marine mammals, 2,4 sting rays, 4 rabbits, 5 and ferrets. 2,6 The cefovecin half-life is variable (0.9 hour in domestic fowl to greater than four weeks in Patagonian sea lions). 1-11 Several theories have been proposed for the prolonged cefovecin elimination rate including extensive renal tubular reabsorption and high plasma protein-binding. 9,10,12 Cefovecin is highly protein bound in dogs (96%-98.7%) and cats (>99.5%), 9,10 but has not been evaluated in non-domestic species, except for primates. In this study, cefovecin in vitro protein-binding was evaluated in plasma from 25 non-domestic species. Animals of the order Carnivora demonstrated protein-binding levels >99%, which is supportive of the long half-life seen in related species. 2-4,6,9,10 Additionally, barasingha deer, okapi, bottlenose dolphins, and red river hogs had protein-binding levels >99%. Elimination studies have demonstrated a long half-life of cefovecin in bottlenose dolphins and domestic swine, 2,3 but studies on cervid and giraffid species are lacking. All reptiles, birds, aardvarks, gazelles, and equids showed lower protein-binding (0-94%), which corresponds to the short half-life observed in the literature for related species. 2,4 These results suggest that a high degree of protein-binding may be predictive of species in which cefovecin would have an extended duration of action. These findings may also aid in selecting species for cefovecin pharmacokinetic research.

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This study was reviewed and approved by the Wildlife Conservation Society Institutional Animal Care and Use Committee. Project Number: 09:05
LITERATURE CITED


DETECTION AND PREVALENCE OF Ranavirus IN CHELONIANS USING A QUANTITATIVE PCR

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Abstract

Ranavirus has caused disease epidemics and mass mortality events globally in free-ranging amphibian, turtle, and tortoise populations. Viral isolation and conventional PCR are the most common methods for diagnosis. In this study, quantitative real-time PCR (qPCR) assays were developed using a TaqMan probe-based and two distinct SYBR Green primers from a highly conserved region of the major capsid protein of frog virus 3 (Family Iridoviridae, genera Ranavirus). Standard curves were generated using each primer set, as well as the conventional PCR primer, from a viral DNA segment cloned within a plasmid. TaqMan qPCR primer sets detected virus at a level ten times lower than SYBR Green primers and 1000 times lower than conventional PCR. Thirty-one clinical samples (whole blood and oral swabs) from box turtles were tested using these assays and prevalences compared. The advancement of qPCR allows rapid, sensitive, and quantitative for nucleic acid detection and is advantageous for early detection and disease monitoring.
IMMOBILIZATION OF SOUTH AMERICAN PREHENSILE-TAIL PORCUPINES (Coendou prehensilis AND Sphiggurus spinosus) WITH KETAMINE HYDROCHLORIDE, ACEPROMAZINE, AND MIDAZOLAM

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Abstract

South American prehensile-tail porcupines are arboreal herbivores from the family Erethizontidae that occupy most of South American territories. Six wild adult animals (three Coendou prehensilis and three Sphiggurus spinosus) were captured during the pre-filling phase of the construction for a small hydroelectric power dam. The animals were immobilized with ketamine hydrochloride (10 mg/kg), acepromazine (0.05 mg/kg) and midazolan (0.3 mg/kg) intramuscularly for field clinical procedures, including complete physical exam, marking, blood collection, and biometry. In all individuals induction was smooth and uneventful. Muscle relaxation, response to stimulus, analgesia, and depth of anesthesia were excellent for Coendou porcupines and moderate for Sphiggurus porcupines. All Sphiggurus porcupines needed some additional physical restraint. Recovery occurred without psychomotor disturbances and every animal remained calm until normal ambulation resumed. Sphiggurus porcupines seemed more resistant to the protocol used, but a slight change in dosage resolved the issue. Two Sphiggurus porcupines were immobilized with ketamine (15 mg/kg), acepromazine (0.1 mg/kg) and midazolan (0.3 mg/kg) and with excellent results and unremarkable immobilizations, similar to the successful Coendou protocol. Based on these results, the anesthetic protocol appears safe for both species. The protocol is recommended for routine management and medical procedures at the lower dosage for Coendou porcupines and the higher dosage for Sphiggurus porcupines. As this is the first report of this particular species-specific difference in drug response in wild South American prehensile-tail porcupines, additional research is needed.
INTRANASAL NALOXONE: COULD IT SAVE YOUR LIFE?

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Abstract

Ultra-potent opioids are commonly used to immobilize zoological species and the Association of Zoos and Aquariums requires all accredited zoos to have an accidental drug administration protocol. Thirty zoological institutions, representing a wide size range of veterinary programs, were asked to provide their accidental drug administration protocol to evaluate the methods recommended to treat accidental exposure to injectable opioid agents, such as etorphine, carfentanil, and thiafentanil. Nine zoos provided their accidental drug administration protocol for evaluation. Eight protocols instructed persons to attempt to place an intravenous catheter. Varying doses of naloxone (Narcan™, Endo Pharmaceuticals Inc., Chadds Ford, Pennsylvania 19317, USA), ranging from 2mg to 12 mg administered intravenously were recommended by the protocols. All protocols stated to give naloxone intramuscularly if intravenous access could not be achieved. No protocol suggested the use of intranasal naloxone for the accidental exposure to ultra-potent opioids.

Two studies have shown concentrated 1mg/ml naloxone given intranasally to people is as effective as giving the same dose intramuscularly or intravenously.2,4 Another study demonstrated that 83% of individuals suspected of opioid overdose responded to intranasal administration of naloxone without the need for supplementation of intravenous naloxone.1 Intranasal administration of naloxone is achieved via a mucosal atomization device (MAD™, Wolfe Tory Medical, Inc., Salt Lake City, Utah 84107, USA).2 Intranasal administration of naloxone appears to be as effective as intravenous naloxone and should be considered as an alternative method to provide emergency relief in the zoo or field settings to individuals not trained in intravenous administration of medications to humans.

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LITERATURE CITED

MODELS AND METAMODELS FOR DISEASE RISK ASSESSMENT IN THREATENED WILDLIFE POPULATIONS

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Abstract

Once touted as a “flagship industry” in the emerging discipline of conservation biology, population viability analysis (PVA) is a very useful tool for assessing the impacts of human activities on threatened wildlife populations. Data on species biology and ecology, and identifiable threats to population dynamics, are used as input to computer simulation models. Given a set of user-specific rules that collectively describe the species’ life history and which define the model’s overall structure, a PVA can project the future fate of a population under a specific set of biological and environmental conditions. Despite the increasing sophistication and broad use of PVA models in species conservation planning, many conservation biologists remain critical of such models because of their relative simplicity in the face of highly complex endangered species problems that often demand a transdisciplinary solution. For example, the process of disease introduction and transmission is often treated very simplistically in demographic models for PVA. Moreover, the single-species focus is often identified as a major weakness of PVA when consideration of multi-species interactions is vital to effective management.

We are addressing these criticisms by creating a new stochastic simulation called Outbreak that realistically simulates wildlife disease epidemiologic dynamics. More importantly, we have created a new technology that allows multiple discipline-specific models to run concurrently and explicitly exchange data to create a more informative and realistic environment for better conservation decision making. We see this approach, which we call metamodeling, as a revolutionary way to effectively engage multiple disciplines simultaneously in endangered species conservation. We will describe the metamodeling environment, demonstrate its use, and briefly discuss selected case studies of its application to endangered species management.
Abstract

In 1995, lions in Kruger National Park were discovered to be infected with *Mycobacterium bovis* (bovine tuberculosis), a non-endemic disease maintained by the park’s buffalo. While *M. bovis* certainly affects individual animals, it is not known how *M. bovis* will affect the lion population in Kruger as a whole.

Lions in Kruger contract *M. bovis* from eating infected buffalo and from other lions (through aerosol transmission and through percutaneous transmission from bite wounds), but measuring these transmission rates directly is difficult. We merged a stochastic, spatial, individually-based lion simulation model with a disease model to investigate the relative importance of different modes of *M. bovis* transmission in Kruger’s lion population. We varied *M. bovis* transmission rates from buffalo to lion, from mother to cub, from lion to lion within a pride, and from lion to lion between prides within reasonable ranges estimated by experts familiar with the system. We then simulated lion populations and measured population size, disease prevalence, and disease spread over that time. We matched our simulation results against observational data of Kruger’s lions to determine the parameter space of possible disease transmission rates. We then used these rates to forecast lion population size and disease prevalence.

The model suggests that transmission of *M. bovis* from buffalo to lions dominates the spread of bovine tuberculosis in Kruger National Park. It is therefore likely that lions are a spill-over species for *M. bovis* and that the prevalence and spread of *M. bovis* in buffalos will be the biggest predictor of prevalence and spread of *M. bovis* in the lion population.
LITERATURE CITED


BIOMEDICAL SURVEY OF BROWN HYENAS (Hyaena brunnea) IN NAMIBIA

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Abstract

Brown hyenas (Hyaena brunnea) are the only large carnivorous predator of the southern Namib Desert, and are considered an indicator species for ecosystem health. Due to their small and declining global population size, and unknown disease status, a biomedical survey was initiated. Baseline biomedical parameters were established for brown hyenas in Sperrgebiet National Park in southern coastal Namibia. Serum samples from 30 hyenas collected from 1997 to 2010 were submitted for biochemistry profiles and antibody titers to canine distemper virus (CDV), canine parvovirus / feline panleukopenia virus (CPV/FPLV), rabies, Ehrlichia canis, and Neorickettsia risticii. A cross-sectional analysis was performed by sex (15 males, 13 females, 2 unknowns), age (21 adults, 6 subadults, 1 cub, 2 unknowns), and region (16 coastal, 11 urban, 3 inland) with additional analysis by year and season. All brown hyenas tested negative for rabies, E. canis, N. risticii, and CPV/FPLV. Thirteen (43%) were seropositive for CDV, of which antibody titers of adults (13/21 seropositive) were significantly higher than those of subadults (0/6 seropositive). Regionally, a cluster of CDV seropositive hyenas was identified around the coastal city of Luderitz where a CDV epidemic occurred in domestic dogs from 2002-2003; however, overall, there was no significant difference in seroprevalence between coastal versus inland hyenas nor between urban versus nonurban areas. Biochemistry values of brown hyenas appear similar to that established for the domestic cat and domestic dog.1 Preliminary results suggest that regional differences in diet may affect some biochemical values. Fecal examinations indicate a surprising low endoparasite incidence.

ACKNOWLEDGMENTS

The authors would like to thank Oklahoma City Zoo for funding this project through their Conservation Action Now grant program. Gratitude is also extended to the Namibian Ministry of Environment and Tourism; Namdeb; Corin Willers and Steve Appleton; Dr. Elizabeth Bunting, Dr. Edward Dubovi, and Dr. Belinda Thompson at Cornell University; Dr. Gary Anderson, Dr. Susan Moore, and Emily Mahan-Riggs at Kansas State University; and Dr. Cynthia Holland at ProtaTek.

LITERATURE CITED

VISCERAL GOUT AND DEATH OF A CALIFORNIA CONDOR (Gymnogyps californianus) UNDER DUAL CHELATION TREATMENT FOR LEAD TOXICITY

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Abstract

Lead toxicity remains a significant cause of morbidity and mortality in wild California condor (Gymnogyps californianus) populations.3 Eleven free-ranging condors in Mexico were found to have elevated blood lead levels (>30 ug/dl) on annual health exam in 2007. All birds were relocated to the San Diego Zoo Safari Park. Due to logistical issues, the birds arrived at two different times; an initial group of five birds (early group) followed by a group of six birds (late group), three days later. All were clinically normal and of adult size (wt. range 7.4-10 kg). The treatment of lead intoxication for man and animals, including birds, is with the chelating agents calcium EDTA, DMSA or a combination of both.2,4,5 The daily treatment protocol consisted of 300 mg i.m. calcium EDTA (3M Pharmaceuticals, Northridge, CA 91324, USA); 300 mg p.o. meso-2,3-dimercaptosuccinic acid (DMSA, Bock Pharmacal, St. Louis, MO 63141, USA) and 300 ml s.c. isotonic fluids. The early group received 11 treatments over 13 days. One bird in this group was found dead on day 14. The late group had received 9 treatments in 11 days. All dual chelation treatment was stopped at this time. Necropsy revealed severe visceral and renal gout which has not been documented in condors with lead intoxication. There was no evidence of nephrosis or renal inclusion bodies which are diagnostic of lead poisoning in animals and man.1 These findings suggest this dual chelation protocol is nephrotoxic in California condors and should not be used to treat lead intoxication.

LITERATURE CITED

THE EFFECT OF BRODIFACOUM ON JAPANESE QUAIL (Coturnix japonica) COAGULATION: A MODEL FOR ASSESSMENT OF EXPOSURE IN WILD BIRDS

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Abstract

Brodifacoum is an effective tool for controlling rodent populations. Rodent-consuming birds, such as owls and raptors, in which rodenticide may bioaccumulate have a significant mortality risk. As a second-generation, long-acting anticoagulant, brodifacoum disrupts hepatic production of vitamin K-depandent clotting factors, necessary for a functional extrinsic coagulation pathway. The extrinsic or amplification pathway is critical for avian hemostasis and is most commonly measured by the prothrombin time (PT) assay. This study measured PT, activated clotting time (ACT), hemoglobin levels, and PCV in Japanese quail (Coturnix coturnix japonica) exposed to 0, 0.8, 1.6, 2.5, and 3.4 mg brodifacoum per kg body weight at 1, 3, 5 and 7 days post-exposure. ACT and PT in normal and corn oil control quail ranged from 48–170 and 11-15 seconds respectively. ACT and PT were prolonged in samples from quail gavaged at any dosage on day one with generally increased prolongation over time at days 3 and 5. Fifty fold prolongation was documented at the higher brodifacoum dosages and correlated to petechial hemorrhages found at necropsy. Prothrombin time and activated clotting time have proven to be reliable methods of assessment of brodifacoum exposure in quail and will therefore likely be useful in the assessment of rodenticide intoxication in owls, seabirds, and other impacted populations similarly to domestic species. Hepatic values of brodindiacoum and metabolites have been measured in the quail and will be correlated with findings.
INFLUENZA SUSCEPTIBILITY AND RESISTANCE IN 72 WILDLIFE SPECIES: IMPLICATIONS FOR CONSERVATION AND COLLECTION MANAGEMENT

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Abstract

To better understand the potential impacts of influenza pandemics on wildlife and the role of alternative hosts in disease ecology, we evaluated tissues from seventy-two wildlife species for expression of avian and human influenza virus receptors (α-2,3 and α-2,6 sialic acid residues, respectively) using lectin histochemistry and performed in situ binding assays with avian and human-adapted viruses.

Potential susceptibility to infection as indicated by the type of influenza virus receptor expressed was not always consistent within taxa. Nine species of small and large felids and four species of viverrids consistently expressed receptors for both avian and human influenza viruses. In contrast, four species of Canidae expressed receptors for avian influenza viruses only, while three expressed receptors for both avian and human influenza viruses. In the families Mustelidae (10 spp.), Procyonidae (4 spp.), Ursidae (3 spp.), and Suidae (3 spp.), all species examined expressed receptors for human influenza viruses, but a few individual species from each family also expressed receptors for avian influenza viruses. Among the great apes, lowland Gorillas (Gorilla gorilla) and pygmy chimpanzees (Pan paniscus) expressed only avian influenza receptors, while Sumatran orangutans (Pongo abelii) expressed neither receptor.

Although virus receptor expression is only one component of disease susceptibility, our findings correlated well with previously published reports of influenza virus infections in wildlife.1-3 Collectively, these data will enable zoo and wildlife managers to respond more appropriately to influenza pandemics, and will provide improved tools for modeling future effects as viruses continue to spill over into alternate hosts.

LITERATURE CITED

THE USE OF RIFLE MOUNTED CAMERAS FOR TRAINING AND REVIEWING REMOTE CHEMICAL IMMOBILIZATION TECHNIQUES

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Abstract

Training in remote chemical immobilization techniques is currently limited to practical teaching, on the job experience and literature review. The use of video review of techniques is practiced across a range of sports and allows critical review of personal technique. When applied to remote chemical immobilization systems the recordings can be used for personal audit of skills and the production of digital video for training inexperienced veterinarians or capture care teams. The welfare of the animal being darted is improved but the technique also allows an increase in performance with implications for cost, efficiency and reputation.

Introduction

In the United Kingdom remote chemical immobilization equipment is governed by the Home Office and requires a firearms license, with dart rifles and blowpipes being classed as Section Five firearms (this includes mini-guns and uzis). As such it is difficult to obtain training and expertise in the use of these systems prior to application for a firearms certificate. There are several references on appropriate use of dart equipment and management of the patient at the time of darting.1-3 In addition the dart rifle manufacturer’s instruction manual provides some information. However there is a lack of information regarding problems that may occur during the darting procedure and how to overcome these or minimize their incidence. Often this knowledge comes from practice and learning on the job.

Digital video recording of technique has been used for years in many sports to assess the ability of individuals and to allow critical review of technique. The authors felt that this technique could be used with remote chemical immobilization. Initially the primary objective was the production of teaching materials for undergraduate students, however it was realized that this technique had benefits for clinical audit of personal ability and development for the individual practitioner actively darting. Digital video recording of darting procedures was documented over 3 yr initially using a normal digital camera with video properties, evolving into the use of a rifle mounted extreme sports camera.
Materials and Methods

A standard protocol was developed for darting procedures, using digital video recording. A Dan-Inject JM Special, carbon dioxide powered rifle (Dan-Inject, Taunton, Somerset, TA4 1YX, England) was used in all of the darting procedures. The first camera system used was a Canon G9 (Canon UK Ltd, Reigate, Surrey, RH2 8BF, England) recording in an audio video interleave format. The dart rifle operator would be accompanied by an assistant using a range finder that would also operate the camera. Filming would include the dart rifle operator and the animal to be darted. The GoPro Hero (Woodman Labs, Inc, Half Moon Bay, California, 94019, USA) extreme sports camera was then selected due to the 180° field of view and the range of attachments that can be used to attach it to the rifle itself. The GoPro Hero recorded in a MP4 format requiring no post download modification compared to the previous systems used. A bicycle handle bar mount was used to attach the camera to the barrel in a ventral position (Figure 1, site one). In some instances it was attached in a dorsal position, caudal to the telescopic sites allowing visualization through the scope (Figure 1, site two).

All videoed sessions were reviewed and analyzed by the author within twenty-four hours. Criteria recorded included date; operator; species; reason for darting; distance; pressure; system; volume of dart; darting attempts; duration of darting attempt; accuracy of darting; success of discharge; darting injury; and any other comments. Changes were implemented in the darting technique and methods in response to monthly reviews to assess impact of the changes.

Discussion

The use of digital video recording is a cheap and effective method for the review and professional development of remote chemical immobilization skills. For the individual the video can be used for review of successful and unsuccessful darting events, allowing improvements to be made in skill and technique. A periodic review of darting skill also benefits the overall darting program. Increased efficiency and a reduction in darting failures improves animal welfare, decreases waste of immobilizing agents and insures that equipment is functioning correctly.

The development of a library of darting procedures and videos allows teaching materials to be developed that can be used as instruction tools by students, inexperienced veterinarians or capture teams. This provides material that depicts successful and unsuccessful darting events and the possible sequelae that may occur if darting is undertaken inappropriately and discuss the approach to how they should be managed.

LITERATURE CITED


Figure 1. Camera placement.
EFFECTS OF TWO, SINGLE-DOSE PZP VACCINE FORMULATIONS ON OVARIAN ACTIVITY IN MARES (*Equus caballus*)

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Abstract

Humane alternatives to adoption and long-term holding are needed to effectively manage wild horse populations, which can have growth rates as high as 22%. Porcine zona pellucida (pZP) immunocontraception currently has the greatest potential to control fertility because it is easy to administer and safe. ImmunoVaccine Technologies, Inc. (IVT) in Halifax, Canada produces the only pZP vaccine with proven single-dose multi-year contraceptive efficacy (SpayVac®), which makes it practical and economical for broad-scale field application. The effect on ovarian activity of two single-injection formulations, SpayVac®/Modified Freund’s Adjuvant (MFA) non-aqueous or SpayVac®/MFA aqueous, compared to controls (n=7 per group) were assessed in a 7-mo study.

Comparative reproductive parameters included serum concentrations of progesterone (P4) determined by ELISA, ovarian activity assessed by transrectal ultrasound and palpation, as well as gross and histologic examination of ovaries upon necropsy (n=9 or 3 from each group) or after ovariectomy (n=12 or 4 from each group). Mean (P4) were significantly lower in the non-aqueous MFA treatment group compared to control mares (p<0.05), and ovarian weights were lower in this group as well (p<0.00001). The non-aqueous and aqueous MFA treatment groups had significantly smaller-sized ovaries and fewer follicles (p<0.05) compared to the control. Most mares vaccinated with the non-aqueous MFA (6/7) and the aqueous MFA (3/7) SpayVac® formulations ceased cycling 1-2 mo prior to the end of the study; whereas all control mares continued to cycle throughout the study. Research with 90 free-ranging mares to test contraceptive efficacy of the SpayVac®/MFA non-aqueous and aqueous formulations is underway.

ACKNOWLEDGMENTS

The authors thank Scot Greenwood and his staff for their assistance in the care of these mares. Makensie Anderson, Amanda Kyser, and Scott Oeffner collected weekly blood samples, and Scott helped with routine transrectal ultrasounds as well. The authors also thank Dr. Leon Pielstick, who performed the ovariecotomies. This project was funded by a grant from USGS (G10AP00087).
RESPONDING TO OILED WILDLIFE IN THE POST-DEEPWATER HORIZON WORLD

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Abstract

The Oiled Wildlife Care Network, a state-affiliated program of the UC Davis Veterinary School, responds to oil spills in California, and often assists or acts in an advisory position during national and international spills. During the Deepwater Horizon spill in the Gulf, current and former members of the OWCN served in various leadership positions. The disastrous nature of that spill garnered a tremendous amount of public and media attention, and veterinary professionals from around the world offered their assistance. Lack of training, as well as communication and political considerations, made it challenging for wildlife professionals to contribute their expertise. In the wake of the Gulf spill, the OWCN is developing a mechanism to enable interested zoological institutions, veterinarians, and husbandry staff to both acquire the appropriate training and provide their expertise and assistance during significant oil-related events that impact wildlife. As we develop this process, we welcome input from our colleagues and hope to work with many of you to improve oiled wildlife care across the globe.
CONSERVATION AND HEALTH IMPACTS OF THE GLOBAL TRADE IN WILDLIFE

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Abstract

The global trade in wildlife is one of the most dynamic, ill-defined, and lucrative networks in the world. Legal trade of wildlife has been valued at hundreds of billions of dollars per year worldwide, although true estimates are impossible to derive due to lack of adequate data. Estimates at the regional level often exceed estimates at the global level and indicate an unsustainable impact on source populations.1,2 Understanding the extent of the illegal trade in wildlife is also highly difficult due to the vast, covert, and sophisticated nature of the business. One study found that nearly 90% of CITES member countries report illegal trade, producing an average decrease in source populations of 60 to 70%.3 In addition to its impacts on conservation, the global wildlife trade may contribute to emergence and spread of infectious diseases, pest introduction, and economic losses.3,4 The U.S. is the world’s largest importer of wildlife, importing nearly one and a half billion live animals since 2000, most of which are destined for the pet trade.5 The vast majority of invasive species and pathogens introduced via the wildlife trade have been identified only after their introduction to the U.S. Enhanced pathogen surveillance of both live and non-live wildlife entering the country could improve assessment of health risks to humans, native wildlife and the agricultural industry. Governmental regulatory initiatives, innovative disease surveillance programs, and options for engagement by the veterinary community are components of the current strategies employed to target this issue.

LITERATURE CITED

WORKING AGAINST ILLEGAL WILDLIFE TRADE IN THE PASTAZA REGION, ECUADORIAN AMAZON: AN INITIAL ANALYSIS

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Abstract

In Ecuador, the harvest and trade of wild species for consumption, medicine and recreation in addition to the over exploitation of natural areas, is too great to be sustainable and is leading to massive biodiversity loss and extinction.

Ecuador recognizes the rights of nature within its national constitution however, ensuring these rights are applied and that the legal system defends them remains one of the many obstacles that effect the progression of many conservation efforts. Other limitations include the lack of resources and inadequate numbers of professional, technical and appropriately experienced work groups. The growing population which has civilization extending towards the Amazon region, commercial deforestation, poverty, lack of education, and the lucrative illegal trade market are other key elements.

Our group is implementing educational, research and active rescue and rehabilitation programs of the conservation of wild species of fauna, flora and natural areas. As well our group is raising awareness of the illegal wild life trade globally and creating and maintaining government and other official contacts to help with the politics of the illegal trade system.

Operating closely with government organizations and other conservation groups for the confiscation of illegal wildlife is imperative to many species survival. With the enhancement of current environmental projects and the creation of model projects, such as a well functioning wildlife rehabilitation centre, alongside the development of quality educational programs for schools and universities, would lead the current situation into a positive and more hopeful direction.
WILDLIFE TRADE IN SOUTHEAST ASIA AND HEALTH AS A CONSERVATION TOOL

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Abstract

The legal and illegal trafficking of wildlife is a large, and expanding global trade.1 Southeast Asia is a prominent source and consumer of wildlife, and also acts as a conduit for products originating outside the region and destined for other countries.3 Wildlife trade is driven by demand for staple and luxury foods, exotic pets, or for use in research and traditional medicine. Suppliers of the wildlife trade are numerous, spanning a broad range of social and economic sectors. Globalization and modernization has facilitated the expansion in wildlife trade in Southeast Asia in a number of ways such as road construction improving access to protected areas, better communication via cell phones and internet, and increasing social prosperity and availability of disposable income. These conditions have led to a wide scale depletion of wildlife resources with far-reaching conservation and economic consequences such as loss of biodiversity, depletion of natural resources for subsistence, reduction of opportunities for sustainable development3 and a link with other trans-boundary crime including human and arms trafficking.1 Furthermore, wildlife trade presents a significant risk to public health.2 Hunting, butchering and sale of wildlife are high risk activities which increase the opportunity for amplification and/or exchange of potential pathogens at the human-wildlife-domestic animal interface. Demonstrating measurable economic costs that arise from health risks inherent in wildlife trade has the potential to increase political support for trade controls, and move society beyond the view of wildlife trade as an acceptable crime to an issue that matters on a national and international scale.

LITERATURE CITED

LEGAL TRADE IN FELIDS: THE IMPACT OF INFECTIOUS DISEASES ON CONSERVATION

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Abstract

Many captive felid populations are not currently sustainable, and all non-domestic felids are declining in the wild. To increase the sustainability of captive populations, animals need to be moved between facilities for breeding, and there may be the need to import new founders. Wild populations are increasingly fragmented, and translocation of animals between populations is a necessary tool for effective management. However, infectious diseases limit the ability to move animals among facilities and in situ. While artificial reproductive technologies may assist some individuals, success with these techniques is not guaranteed, and for some infectious agents (e.g. feline immunodeficiency virus (FIV)) infection via germplasm is possible. Uncertainty about the importance of infectious agents has been compounded by inconsistencies in diagnostic testing, a lack of accurate prevalence data and uncertain clinical significance for some pathogens. Infectious disease concerns in wild populations are heightened by increasing interaction with humans and their domestic animals, recent discussions of re-establishing cheetahs (Acinonyx jubatus) and tigers (Panthera tigris) into regions within their historic ranges, and disease outbreaks in critically endangered populations of felids such as the Iberian lynx (Lynx pardinus) and Florida panther (Puma concolor coryi). Therefore, it is imperative that we gain a better understanding of infectious disease in order to comply with movements of animals for breeding recommendations and to make informed recommendations on translocations for the successful future management of captive and wild populations of felids.

A multitude of viral, bacterial, and parasitic diseases has been documented in captive and free-ranging felids. Studies in the 1980’s and 1990’s gave us a large body of initial information concerning the prevalence and clinical significance of these diseases in captive and free-ranging felid populations. Since that time, diagnostic capabilities have improved and further pathogens have been documented to cause morbidity and mortality in captive and free-ranging populations. feline leukemia virus, FIV, feline herpesvirus, virulent feline calicivirus, canine distemper virus, and Toxoplasma gondii represent some of the most significant disease causing agents lacking sufficient information. Many AZA institutions test and/or vaccinate against these pathogens regularly, although not always through the same laboratories, making comparison of data difficult.
Although the Felid Taxon Advisory Group (TAG) published preventative medicine guidelines in the 2009 Felid TAG report (http://nationalzoo.si.edu/SCBI/AZAFelidTAG/Resources/2009AnnualReport.pdf) pp. 40-46 and 89-96, including standardized tests and recommended laboratories for these pathogens (Table 1), there is still considerable confusion about the appropriate testing and what happens when an animal tests “positive” for an infectious agent. A veterinary research working group of the Felid TAG concluded that before sound recommendations can be made for moving felids, both between AZA institutions and to and from wild populations for import and reintroduction, a better understanding of these diseases and their consequences is vital. To this end, surveys regarding felid diseases will be created and sent to AZA institutions holding felid species in the coming year. Participation in these surveys will be vital to answering these questions to ensure better management of the felid species in our care.

ACKNOWLEDGMENTS

The authors would like to thank all the participants of the Veterinary Research Working Group at the 2011 Felid TAG meeting in Omaha, Nebraska for gathering the information for this presentation and for the idea of a felid disease survey for AZA institutions.

**Table 1.** Recommended testing and laboratories for select pathogens of felid species.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Screening test</th>
<th>Confirmatory test</th>
<th>Recommended Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feline herpesvirus</td>
<td>Serology – SN\textsuperscript{a}</td>
<td>PCR\textsuperscript{c} (swabs, biopsies)</td>
<td>SN – Cornell University</td>
</tr>
<tr>
<td>Feline coronavirus</td>
<td>Serology</td>
<td>PCR (feces )</td>
<td>University of California</td>
</tr>
<tr>
<td>Feline leukemia virus</td>
<td>Serology - ELISA\textsuperscript{b}</td>
<td>IFA\textsuperscript{d} (bone marrow), PCR</td>
<td>None</td>
</tr>
<tr>
<td>Feline immunodeficiency virus</td>
<td>Serology - ELISA</td>
<td>Western Blot</td>
<td>Cornell University</td>
</tr>
<tr>
<td>Feline calicivirus</td>
<td>Virus isolation/PCR</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Feline panleukopena virus/canine parvovirus</td>
<td>EM (feces)</td>
<td>PCR \textsuperscript{e}</td>
<td>None</td>
</tr>
<tr>
<td>Canine distemper virus</td>
<td>Serology - SN</td>
<td>IHC (tissues)</td>
<td>SN - Cornell University</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Serum neutralization  
\textsuperscript{b}Enzyme-linked immunoassay  
\textsuperscript{c}Polymerase chain reaction  
\textsuperscript{d}Indirect fluorescent antibody  
\textsuperscript{e}Immunohistochemistry
WILDLIFE TRADE AS A POTENTIAL SOURCE OF EMERGING ZOONOTIC PATHOGENS IN SOUTH AMERICA

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Abstract

Despite existing laws that regulate and ban the trade of wild animals in the region, wildlife markets work openly every day across South American countries. Wildlife trade occurs daily in at least 26 markets in Peru, and during weekend markets in most regions of Bolivia. More than 3000 live animals can be offered in a single day at a market in Peru, with wildlife species accounting for 5% to 65% of this open trade. Furthermore, large numbers of these species are smuggled internationally. Our records indicate that at least 23 000 live animals were illegally shipped from a Peruvian city during a period of 9 mo (2010-2011). Due to the illegal nature of this trade, controls on animal health are routinely evaded.

Inappropriate animal husbandry practices may act as potential drivers for pathogen emergence and transmission among wildlife, livestock and humans. Although some wild species are well known reservoirs of zoonotic pathogens, this fact seems to have no effect on their trade. Several species of bats maintain the sylvatic cycle of rabies in the Amazon, and many of them are commonly hunted, traded and consumed for medicinal purposes in Bolivia. Pet monkeys have been involved in rabies transmission to humans, and psittacoses is reported in people handling confiscated parrots. Here we report the isolation of zoonotic enterobacteria and avian paramyxovirus from live animals sold at wetmarkets in Peru. The identification of these pathogens provides evidence of the health risks wildlife trade may pose in South America, and stresses the need for effective policies and controls to protect both public and animal health. Conservation of endangered species will also benefit from limits to this trade.

LITERATURE CITED

MOLECULAR DIAGNOSTICS FOR SPECIES AND PATHOGEN IDENTIFICATION IN BUSHMEAT: TOOLS FOR ANIMAL CONSERVATION

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Abstract

Wildlife trade is a multibillion dollar global industry that impacts conservation, biodiversity and health. Millions of wild animals are collected and legally or illegally traded annually. Approximately 75% of emerging infectious diseases are zoonotic, and the majority originate from wildlife. Hence, handling and trade of wildlife are important factors in the emergence and spread of infectious diseases. However, little is known about species or repertoire of pathogens moved through the bushmeat trade. In this presentation we will discuss current molecular assays and their implementation in a program focused on surveillance of bushmeat confiscated at several US ports of entry. ‘DNA barcoding’ results identified bushmeat sample origin from nonhuman primates, including guenon (Cercopithecus sp.) and mangabey (Cercocebus sp.), bats, such as the greater long-tongued fruit bat (Macroglossus sobrinus), and cane rat (Thryonomys sp.). The application of family-level virus screening, also known as consensus PCR, of bushmeat from non-human primates revealed multiple strains of simian foamy virus and primate herpesviruses from two genera. Our results demonstrate the applicability of molecular diagnostic testing for species and pathogen identification in wildlife trade products. These results further help define animal species and pathogens present in the global wildlife trade and will be important in informing discussions and implementing strategies to protect public health as well as the conservation of animal species.

ACKNOWLEDGMENTS

The authors would like to thank the Centers for Disease Control and Prevention for funding this project.

LITERATURE CITED

FULLY REVERSIBLE ANESTHESIA IN ASIAN SMALL-CLAWED OTTERS (Aonyx cinereus) USING DEXMEDETOMIDINE-MIDAZOLAM-BUTORPHANOL, AND COMPARISON OF ANESTHETIC AND CARDIAC PARAMETERS WITH KETAMINE-MIDAZOLAM

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Abstract

The ability to fully reverse anesthesia has benefits for animals both in captivity and in the field. Recently a medetomidine-butorphanol-midazolam combination, reversed with atipamezole-naloxone (or naltrexone)-flumazenil has been used with success in felid and canid species. 1,2 We anesthetized twelve captive Asian small-clawed otters during their annual exams, substituting the newly available alpha-2 agonist dexmedetomidine for medetomidine. We measured temperature, heart rate (HR), respiratory rate, oxygen saturation, end-tidal CO2, blood pressure, arterial blood gas values, and echocardiographic parameters and compared them with captive otters anesthetized with ketamine-midazolam (KM). We used a crossover study design. For the new protocol (DBM), we administered dexmedetomidine 0.015mg/kg; butorphanol 0.2mg/kg; and midazolam 0.15mg/kg intramuscularly for immobilization and atipamezole 0.19mg/kg; naloxone 0.1mg/kg; and flumazenil 0.06mg total dose intramuscularly for reversal. For the KM protocol, we used ketamine 10.1mg/kg and midazolam 0.27mg/kg intramuscularly. All otters were intubated, and isoflurane was administered if necessary. Otters were monitored every 5 minutes throughout the procedure. We have found that average HR and lactate were higher with KM (98 vs. 146 bpm; 0.37 vs. 0.46 mmol/L), whereas average mean blood pressure was higher (94.7 vs. 65.6 mmHg) and the average decrease in temperature was greater (5.3 vs. 4.1 °F) with DBM. Induction and recovery were shorter and subjectively smoother with DBM.

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LITERATURE CITED

IMPROVING PREGNANCY SUCCESS WITH LAPAROSCOPIC ARTIFICIAL INSEMINATION IN BRAZILIAN OCELOTS (*Leopardus pardalis mitis*)

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Abstract

Many of the world’s 36 wild felid species are threatened with extinction, including the ocelot (*Leopardus pardalis*), most notably the two distinct subspecies endemic to southern Texas (*L.p.albescens*) and southern Brazil (*L.p.mitis*). To help conserve this species, the Association of Zoos and Aquariums (AZA) established a Species Survival Plan (SSP) to coordinate a cooperative breeding program among AZA institutions housing Brazilian ocelots. However, limited founder numbers and poor breeding success are impairing the SSP’s ability to achieve its genetic management goals. Assisted reproductive techniques, such as artificial insemination (AI), could be invaluable for improving reproduction of behaviorally or physically incompatible pairings or for creating genetic exchange between disjunct populations without requiring the transport of living animals. However, for AI to be an effective and reliable genetic management tool, the success of this technique must be improved for use with either freshly-collected or frozen-thawed spermatozoa.

The standard AI protocol for felids requires treatment of females with equine chorionic gonadotropin (eCG) and human chorionic gonadotropin (hCG) to induce ovarian follicular growth and ovulation, respectively, followed by laparoscopic intra-uterine sperm deposition. Although this approach has resulted in multiple pregnancies in domestic cats and cheetahs, AI success in other felid species, including the ocelot, has been less consistent, possibly related to the gonadotropin regimen used and/or the site of insemination. Because hCG persists in circulation for up to 5 days post-injection, the formation of ancillary follicles and secondary corpora lutea (CLs) may disrupt the post-ovulatory endocrine environment and impair oviductal embryo transport. Furthermore, intra-uterine AI techniques often require substantial sperm numbers (>10 million motile sperm/AI) for fertilization, which limits the number of potential AI procedures per ejaculate collected. This is especially true in small-sized cats which often have low total sperm numbers per ejaculate or when using frozen-thawed spermatozoa that has been compromised by cryopreservation-related damage.
In our earlier domestic cat studies, we obtained promising pregnancy results with a novel laparoscopic AI approach using porcine luteinizing hormone (pLH) as an alternative to hCG for ovulation induction and depositing low numbers of spermatozoa directly into the oviduct. In the current study, our objectives were to: 1) evaluate the ovarian and hormonal response of Brazilian ocelots following eCG/pLH treatment; 2) assess pregnancy success after intra-uterine vs. intra-oviductal AI in eCG/pLH-treated females; and 3) investigate the reliability of a commercially available canine relaxin kit to detect urinary relaxin for pregnancy diagnosis in ocelots. For ovarian stimulation, Brazilian ocelot females (n=5 cats; 7 AI procedures) received 400 IU eCG followed 84 hr later with 3000 IU pLH. At 39-42 hr after pLH injection, females were anesthetized for laparoscopic insemination bilaterally into the uterine horns (n=5 AIs) or oviducts (n=2 AIs) with freshly-collected semen from resident males. Fecal samples were collected for 50-80 days post-AI and assessed for fecal progesterone metabolite levels using a validated enzyme immunoassay. Fresh urine samples collected at Day 50-61 post-AI were evaluated for urinary relaxin using a commercially available canine test kit.

All ocelot females ovulated in response to eCG/pLH treatment, averaging (± SEM) 2.7 ± 0.5 CL and 4.4 ± 1.7 unovulated follicles per female. Five females were inseminated using the intra-uterine technique, receiving an average of 16.6 ± 6.2 million motile spermatozoa per AI. One female conceived and gave birth to a single, healthy female kitten after a 79 day gestation. Two females were inseminated using the intra-oviductal technique (10.2 ± 3.0 million motile spermatozoa per AI). One female conceived and gave birth to a single, healthy female kitten after an 80 day gestation. Fecal progesterone monitoring in non-pregnant females revealed luteal phases lasting 44.2 ± 3.8 days (range, 31-55 days) post-AI. Thus, fecal progesterone levels that remained elevated past 55 days were indicative of pregnancy. Relaxin kit testing of concentrated urine samples collected from pregnant and non-pregnant ocelots were all negative for the presence of relaxin.

Our findings indicate that the eCG/pLH regimen is effective in ocelots for inducing ovarian stimulation and ovulation for AI procedures and that both intra-uterine and oviductal laparoscopic insemination may be used to produce pregnancies in eCG/pLH-treated females. These results also suggest that oviductal AI offers the potential of improved pregnancy success in ocelots while using fewer spermatozoa or spermatozoa of poorer quality such as occurs following cryopreservation. Fecal progesterone monitoring was found to be a reliable method of pregnancy diagnosis in ocelots beginning at 55 days post-AI, but use of a commercial canine relaxin kit for urinary relaxin detection was not accurate and is not recommended for pregnancy diagnosis in ocelots.

LITERATURE CITED


METRONOMIC CHEMOTHERAPY IN A LION (PANTHERA LEO) WITH SPINDLE CELL SARCOMA: CONTINUOUS LOW-DOSE ANTIANGIOGENIC PROTOCOL

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Abstract

A dorsal subcutaneous mass was excised from an 18-yr-old female lion. Histopathology revealed spindle cell sarcoma with necrotic center, high mitotic index, and narrow surgical margins. Similar tumors have been reported in other non-domestic felids.7,9,12 A continuous, oral, metronomic, antiangiogenic chemotherapeutic protocol was initiated post-operatively: cyclophosphamide (Roxane Laboratories, Columbus, OH) 25 mg/m² PO EOD, piroxicam (TEVA Pharmaceuticals, Sellersville, PA) 0.27 mg/kg PO SID, and doxycycline (West-ward Pharmaceutical Corp. Eatontown, NJ) 4.5 mg/kg PO BID. Periodic urinalyses, complete blood counts, and chemistry panels were monitored for evidence of side effects. The surgical site healed without significant complications. The lion was euthanatized 7.5 mo post-operatively for disease unrelated to the tumor; no neoplasia was identified on gross or microscopic evaluation.

In domestic cats, a combination of aggressive surgical excision, radiation therapy, +/- intravenous chemotherapeutics is the recommended treatment for soft tissue sarcomas; recurrence with local invasiveness is common although metastasis is relatively rare.4,5,10 Metronomic antiangiogenic chemotherapy uses chronic administration of chemotherapeutic agents at low, minimally toxic doses with no drug-free breaks to overcome drug resistance by shifting the therapeutic target from tumor cells to tumor vasculature.11,13 Metronomic protocols incorporating oral cyclophosphamide and piroxicam have shown promise for treatment of sarcomas in domestic dogs; doxycycline has demonstrable antiangiogenic properties.1,2,8,14 Metronomic antiangiogenic therapy has not been previously reported in Panthera species and warrants further evaluation for management of neoplasia in carnivores. If effective, it could improve outcome while minimizing anesthetic events and undesirable side effects associated with chemotherapy.3,6

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The authors thank the staff of the Departments of Animal Health, Pathology, and Animal Care at the Smithsonian Institution’s National Zoological Park for assistance with this case.
LITERATURE CITED

SEVERE HEPATIC AND NEUROLOGIC COMPLICATIONS SECONDARY TO INFLAMMATORY BOWEL DISEASE IN AN AMUR TIGER (*Panthera tigris altaica*)

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Abstract

Inflammatory bowel disease (IBD) is starting to be recognized in the captive tiger population. This report outlines a case of controlled IBD that decompensated into acute liver failure and neurologic disease. An adult 5-yr-old intact male Amur tiger (*Panthera tigris altaica*) with intermittent loose fetid feces with undigested food was diagnosed with marked chronic lymphoplasmacytic colitis. Oral prednisolone (0.88 mg/kg BID) and metronidazole (18.9 mg/kg BID) improved his condition. After he was switched from horsemeat (Classic feline diet, Nebraska Brand, North Platte, NE 69103 USA) to beef (Premium beef, Nebraska Brand), the metronidazole was discontinued and the prednisolone tapered off.

Approximately 1 yr later, the diet was changed to a different beef product (Special beef, Nebraska Brand). The feces became abnormal again and metronidazole was prescribed. He became anorexic and lethargic with acute severe bilirubinuria and had a short seizure prior to emergency immobilization. He had marked icterus, bilirubinemia (17.4mg/dl), and elevated bile acids (>300 umol /l). Moderate lymphoplasmacytic cholangiohepatitis was diagnosed via percutaneous liver biopsies. Following the procedure he had abdominal pain, mental dullness, severe ataxia, and several small seizures but was compliant with all supportive medicines prescribed. The ataxia and weakness improved after 2 weeks. Due to 7 weeks of intermittent epistaxis, yunnan baiyao (Prince of Peace Enterprises, Hayward, CA 94545 USA), a Chinese herb, was given for its hemostatic properties. Maintenance therapy consists of oral prednisolone (0.55mg/kg q48hr), metronidazole (5.5mg/kg SID) and Ursodiol (6.5mg/kg 2x/week) and the Premium beef diet.
TIBIAL PLATEAU LEVELING OSTEOTOMY FOR THE TREATMENT OF CRANIAL CRUCIATE LIGAMENT RUPTURE IN A GREY WOLF (*Canis lupus*)

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Abstract

A 9-yr-old spayed female grey wolf (*Canis lupus*) presented with acute lameness that did not respond to anti-inflammatory therapy. Physical examination revealed a positive cranial drawer sign and cranial tibial thrust. Tibial plateau leveling osteotomy (TPLO) and partial medial meniscectomy were performed to treat the cranial cruciate ligament deficient stifle and meniscal tear, respectively. Three weeks post-operatively, the surgical incision dehisced. An examination and culture did not reveal an obvious cause. The incision was treated by lavage, debridement, and delayed primary closure, but opened again twice more in a 6 week period. The chronic sinus was considered a possible reaction to the implants, an adverse effect reported in 1.1 – 5.2% of TPLO cases.1 The site was managed as an open wound with daily chlorhexidine lavage and topical antibiotics until the plate could be removed at 15 weeks post-operatively and the incision closed. Repeated self-mutilation of the site prolonged recovery for another 8 weeks, requiring 4 additional surgeries to lavage, debride and close the wound. Several preventative modalities were attempted to prevent self-mutilation and maintain closure of the incision, including psychotropic drugs and physical barriers. A combination of two Elizabethan collars, a tranquilizer (acepromazine), and casting of the leg finally proved effective in complete wound healing. After 8 mo, this animal was successfully re-introduced to the pack. Ultimate recovery was excellent in terms of limb function.

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LITERATURE CITED

SILVER VINE: BETTER THAN CATNIP? – THE PLANT CATS GO CRAZY FOR

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Abstract

Silver vine (Actinidia polygama), also called matatabi, has been used in Asian cultures over centuries for medicinal purposes. Studies have shown it to have a strong stimulating effect on cats. Matatabi acts as a physical and mental stimulant via olfactory receptors. Over almost 3 yr, silver vine has been researched in the United States in its stimulating behavioral effects on domestic cats and a variety of large exotic felids. The herbal essence was sprinkled in powder form onto commonly used toys or cage furniture. Shortly after investigating the area the cats, domestic, feral, and exotic alike, demonstrated strong interest for the toy, by pouncing on the toy, playing with it, and rubbing their body against it. One African leopard (Panthera pardus) even exhibited marking behavior on one of his toys. The cats kept their interest on the toys for more than 30 minutes at times and usually returned for playful interaction thereafter. While tigers (Panthera tigris), in general, did not respond to the presence of the silver vine powder. In conclusion, due to its strong repetitive stimulating effect, silver vine could be used for behavioral enrichment in most captive exotic felids.
CARDIOPULMONARY DISEASE IN OKAPI (*Okapia johnstoni*)

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Abstract

While pulmonary disease is quite common in ruminants, cardiac disease is an uncommon finding and has not been previously reported in okapi (*Okapia johnstoni*). To date, there have been four known or suspected cases of cardiac abnormalities in okapi. Two of these cases have occurred in pregnant females at White Oak Conservation Center. These okapi presented with an increased respiratory rate, dyspnea, productive coughing, serous nasal discharge, lethargy, and decreased appetite. Both individuals had significant pleural fluid on ultrasonographic evaluation and suspected pulmonary edema. Echocardiographic evaluation of Okapi 1 indicated mild mitral valve regurgitation, an enlarged left atrium with hypertension and was tentatively diagnosed with congestive heart failure. Serum creatinine phosphokinase and serum troponin in this individual were also elevated. Both pregnant individuals responded with improved respiratory quality and rate when given parenteral furosemide and transitioned to oral dosing. The clinical signs observed in Okapi 1 resolved with treatment (oral furosemide, enalapril, and spironolactone) and she gave birth without complication to a clinically normal calf. At the time of this publication, Okapi 2 is responding to treatment (oral furosemide and enalapril) and is not as stable as Okapi 1 and has not yet given birth. The underlying etiology of the cardiopulmonary disease observed in these okapi has not been determined.
DIAGNOSIS, TREATMENT, AND RESOLUTION OF A Trichophyton mentagrophytes OUTBREAK IN A HERD OF SCIMITAR-HORNED ORYX (Oryx dammah)

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Abstract

Six Scimitar-horned oryx (Oryx dammah) calves presented with multifocal, circular, raised, crusting skin lesions over a four-week period in December 2010. The lesions were located along the nasal planum, pinnae, and cervical region. Hooves and mucous membranes were unaffected. Skin biopsies, bacterial and fungal cultures, fungal speciation, and blood samples were obtained and resulted in a clinical diagnosis of Trichophyton mentagrophytes.

T. mentagrophytes has been diagnosed in few exotic ruminants including nilgai antelope (Boselaphus tragocamelus) and southern chamois (Rupicapra pyrenaica). Dermatophyte infections are typically self-limiting. The decision to treat this oryx herd was based on minimizing risk of transmission to other animals in the collection and preventing zoonotic disease transmission to keeper staff.

The affected calves were treated topically with miconazole ointment and miconazole spray once per week for two weeks. Oral griseofulvin was administered to the entire herd at a dosage of 10 mg/kg orally once daily for 20 days. Environmental control consisted of routine disinfection and treatment with captan fungicide spray. Resolution of clinical signs was achieved within three weeks of initiating treatment.

ACKNOWLEDGMENTS

The authors would like to acknowledge Dr. William Fales for his assistance with fungal culture and isolation. Special thanks to the veterinary technician staff and Plains Barn keepers at the Kansas City Zoo for their assistance in successfully treating the oryx herd.

LITERATURE CITED


POTENTIAL FACTORS RELATED TO NEONATAL MORTALITY AND FAILURE TO THRIVE IN A HERD OF THOMSON’S GAZELLES (Eudorcas thomsonii) OVER A 12-YEAR PERIOD

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Abstract

Neonatal mortality and failure to thrive in Thomson’s gazelles are common problems in AZA institutions with an average AZA population neonatal mortality rate of 36-38% over the last 20 yr. To determine potential causes of this problem risk factors were assessed for one institution over a 12-yr period. A total of 111 neonates were classified as normal [64% (n=71); survived with no hand rearing] or abnormal [36% (n=40); required hand rearing (n=10) or died within 6 days of birth (n=30)]. Risk factors examined included: PCV, total solids, GGT, glutaraldehyde, birth weight, age at first handling, sex, sire, dam, handling, vaccination, venipuncture, rainfall, and mean low environmental temperature.

The most common cause of death was failure to nurse (n=23). A significant difference (p <0.05) was found between groups for: glucose, GGT, weight, rainfall, glutaraldehyde, birth weight, age at first handling, sex, sire, dam, handling, vaccination, venipuncture, rainfall, and mean low environmental temperature.

The most common cause of death was failure to nurse (n=23). A significant difference (p <0.05) was found between groups for: glucose, GGT, weight, rainfall, glutaraldehyde, birth weight, age at first handling, sex, sire, dam, handling, vaccination, venipuncture, rainfall, and mean low environmental temperature.

A binary logistic regression analysis of the significant parameters revealed blood glucose to be a significant indicator for survival among all the neonates (p<0.05).

This study found no evidence of significant effects of human contact (handling, venipuncture, vaccination, or age at first handling), environmental temperature, or neonate sex or parentage on survival. Low birth weight and indicators of failure of passive transfer were associated with decreased survival rates. The correlation of rainfall and decreased survival could indicate a need for early intervention or heightened vigilance following rainy nights, and assessment of shelter availability and herd use.

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The authors thank the Wildlife Conservation Society (WCS) animal care personnel who care for the Thomson’s gazelles, along with the veterinarians, veterinary technicians, laboratory staff, and pathology staff. A special thank you to Dr. Bonnie Raphael (WCS) for her encouragement during this project, Tracy Clegg from the University College Dublin for her assistance with statistical analysis, and Kevin Browne from the James San Jacinto Mountains Reserve for his assistance with procuring environmental data.
CHIROPRACTIC ADJUSTMENTS AND COLD LASER THERAPY FOR MANAGEMENT OF A GIRAFFE CERVICAL SPINE INJURY

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Abstract

A 2-yr-old male reticulated giraffe (Giraffa camelopardalis reticulata) was noted with a pronounced cervical spinal curvature (C3-C4) upon arrival as an incoming shipment. Initial medical management included treatment with a musculoskeletal relaxant (methocarbamol) and non-steroidal anti-inflammatory medications (phenylbutazone, then meloxicam). Clinical improvement was observed as the neck straightened considerably within the first few weeks, however, the giraffe continued to guard neck movements and showed sensitivity on the left side of the neck. Using target training, the giraffe was operantly conditioned to allow chiropractic adjustments and cold laser therapy of the neck. Therapeutic laser (LiteCure Companion Therapy Laser) treatments of areas of cervical muscle spasm and contracture were performed twice per week for 1 mo, then once per week. Within 5 mo of the initial injury, the animal showed no evidence of guarded neck movements, neck sensitivity, or cervical spinal curvature. Mild spinal misalignment and muscle contracture have subsequently developed in the scapular region and the lower lumbar spine. Laser therapy and chiropractic adjustments are currently being used to address these new areas of concern and continued treatment of the affected region of the neck has been ongoing.

ACKNOWLEDGMENTS

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THE DISCOVERY OF NEW MALIGNANT CATARRHAL FEVER (MCF) VIRUSES AND THEIR IMPACT ON RUMINANT DISEASE MANAGEMENT AND CONSERVATION

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Abstract

Malignant catarrhal fever (MCF) continues to be a significant disease of captive and free-ranging wildlife throughout the world.1-3 Five rhadinovirus species have been recognized to cause clinical illness in artiodactyls and have been provisionally classified as MCF viruses.3 However, with advances in molecular technology, new rhadinoviruses are being identified and linked to classic MCF and atypical MCF-like disease with increasing frequency.4 To better understand the ecology of rhadinoviruses and their potential to cause illness, we opportunistically tested 97 species and subspecies of ruminants (over 700 different individuals) in the San Diego Zoo and Safari park collection for the presence of rhadinoviruses. DNA was extracted from blood, tissue, and swab samples and tested with a consensus-based PCR targeting the DNA polymerase gene of the family Herpesviridae followed by DNA sequencing of positive reactions. Associations with transmission were evaluated to better understand rhadinovirus epidemiology. Fifty-six species and subspecies (56/97; 58%) were infected with rhadinovirus. Forty-four different viral genotypes were identified, including 42 genetic sequences that had not been previously reported. Sixteen of the genotypes (16/44; 36%) were identified in multiple host species. Sixty-five of 134 positive animals with blood samples (49%) were viremic. Data demonstrate the diversity and prevalence of rhadinovirus infection in ruminants and propensity for interspecies transmission in captive management systems. These data will provide a valuable resource for making management recommendations to reduce spillover from reservoir hosts to susceptible hosts.

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LITERATURE CITED

COMPARISON OF TWO INJECTABLE IMMOBILIZATION COMBINATIONS IN HIMALAYAN TAHR (Hemitragus jemlahicus): MEDETOMIDINE, KETAMINE, AND ATIPAMEZOLE VS. CARFENTANIL, XYLAZINE, NALTREXONE, AND ATIPAMEZOLE

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Abstract

A cross-over study was performed in 12 Himalayan tahr (Hemitragus jemlahicus) undergoing pre-shipment examinations to compare partially reversible and fully reversible intramuscular anesthesia protocols. The partially reversible protocol (MKA) consisted of induction with medetomidine (0.06 ± 0.009 mg/kg) and ketamine (2.03 ± 0.315 mg/kg), and atipamezole (0.30 ± 0.044 mg/kg) reversal. The fully reversible protocol (CXNA) consisted of induction with carfentanil (0.009 ± 0.003 mg/kg) and xylazine (0.08 ± 0.019 mg/kg) with naltrexone (0.867 ± 0.332 mg/kg) and atipamezole (0.105 ± 0.023 mg/kg) reversal. During immobilization, animals were monitored for quality and length of induction and recovery, heart rate (HR), respiratory rate (RR), rectal temperature (Tr), indirect mean blood pressure (MBP), oxygen saturation (SO2), and end tidal carbon dioxide (ETCO2). Blood was collected for serum cortisol measurement. No differences were observed for induction time, HR, RR, Tr, SO2, or ETCO2. MKA resulted in significantly higher MBP (137±21 vs. 93±22 mmHg, p = 0.004), higher serum cortisol (6.76±1.39 vs. 4.28±3.69 µg/dL, p = 0.007), and longer recovery time (15.67±11.18 vs. 5.00±1.95 minutes, p = 0.001) compared to CXNA. More importantly, the quality of induction and recovery was very different. With MKA, animals spent less time ambulating during induction, remained recumbent longer during recovery, and demonstrated more ataxia on rising. Despite differences between the protocols, both were successful and safe. These differences should be taken into consideration when selecting the anesthetic protocol because either regimen may be more or less desirable for different medical or immobilization settings.

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The authors are grateful to the Department of Mammalogy staff and veterinary technicians for their assistance with the procedures, and to David Powell for discussing statistical analysis of the data.
EPISTAXIS SECONDARY TO SUSPECTED HYPERTENSION IN MALAYAN TAPIRS 
(Tapirus indicus) WITH HYPERCALCEMIC CHRONIC RENAL DISEASE

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Abstract

Two Malayan tapirs (Tapirus indicus), a 21-yr-old female and a 35-yr-old male, displayed intermittent, often severe bouts of epistaxis, lasting from 1 to 3 days in duration for nearly 2 yr. Hematocrit following these episodes ranged from 11% to 30%, and blood work revealed uremia and hypercalcemia. Both tapirs were diagnosed with chronic renal disease (CRD). Indirect blood pressure measurements from the female were suggestive of hypertension. Antemortem nasal endoscopy and postmortem gross and histologic evaluations revealed no evidence of mucosal ulcerations to account for the epistaxis. At necropsy, both tapirs showed severe nephropathy, and generalized arteriosclerosis and mineralization of vessels within multiple organs including kidneys, brain, eyes and heart. The female tapir had generalized vascular changes supportive of hypertensive adaptations.

The intermittent epistaxis in these tapirs was most likely due to underlying hypertension. Hypertension is common in domestic animals and people with renal disease, but its association with CRD in large animals has been poorly studied.1,2 A syndrome of CRD with hypercalcemia has been reported in the horse, another perissodactylid.2,3 The underlying pathophysiology of hypercalcemia remains unclear, but may be related to the large amount of calcium renally excreted by both horses and tapirs.

Epistaxis or hypercalcemia may be signs of CRD in Malayan tapirs. Treatment with antihypertensive medication may be warranted to help slow the decline in renal function and manage epistaxis.

LITERATURE CITED

PODODERMATITIS IN CAPTIVE FLAMINGOS (*Phoenicopteridae*)

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**Abstract**

Pododermatitis is a common problem in many captive avian species.1,2 This disorder is widespread in captive flamingos.3 A comprehensive study investigated the lesions in multiple Swiss facilities and included gross appearance, histology, bacteriology, virology, electronmicroscopy and immunhistochemistry. Important husbandry factors (pond type, nutrition, water) as well as influences of sex, weight, age, origin, breeding status and flight ability were also evaluated. The present study focuses on the macroscopic and histologic features observed in captive flamingos compared with those from free-ranging wild flamingos from the Camargue (Southern France).

Macroscopic lesions were divided into three different groups: Cracks (superficial/deep), nodules (without/with ulceration) and papillomatous proliferations (finger-like/cauliflower-like). Macroscopic lesions were first seen in a 4-week old chick while histologic changings were already seen in a 3-week old chick without evident macroscopic lesions. Early histologic lesions were hyperkeratosis, epidermal hyperplasia, hydropic swelling and degeneration and heterophilic infiltration of the dermis with exocytosis. Different stages (zoospores, hyphae) of *Dermatophilus*-like bacteria were infiltrating the epidermis and are considered to be an important co-factor in the progression of the disease. Therefore, further work will be carried out to identify these bacteria. In comparison with wild animals, feet from zoo flamingos showed a marked hyperplasia of the epidermis and especially of the stratum corneum, keratinization of immature keratinocytes and an increase in matrix and fibroplasia in the dermis. These changes were considered to be mechanically induced (due to standing on hard and rough substrate). Flamingos kept in ponds with concrete showed more severe lesions than animals in zoos with natural ponds, confirming our hypothesis of a primary mechanical problem.

**ACKNOWLEDGMENTS**

The authors acknowledge the staff of the Zoo Basel, especially the responsible keeper, Bruno Gardelli, the staff from all participating zoos for their valuable cooperation, Antoine Arnaud for organising import permits and Prof. Monika Welle for her advice concerning skin pathology. The study was partly funded by the Swiss Association of Zoo-, Wild- and Pet animal medicine (SVWZH).
LITERATURE CITED

OUTBREAK OF SARCOCYSTOSIS IN RAINBOW LORIKEETS (*Trichoglossus heamatodus*) HOUSED IN AN OUTDOOR AVIARY

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**Abstract**

Eight lorikeets presented with acute signs of respiratory distress or were found deceased within a 3-mo time period. The affected birds were diagnosed, post-mortem, with acute pulmonary and systemic sarcocystosis. Outbreaks of sarcocystosis have been documented in psitticines and often result in high mortality in these species.²,⁴ Ante-mortem testing of sarcocystosis is limited to few diagnostic tests.¹,³

One of the affected lorikeets responded to a thirty-day course of ponazuril and was successfully returned to the aviary. The exhibit soil was replaced and resulted in a decrease in mortality within this lorikeet flock. Sarcocystosis should be considered as a differential diagnosis in psitticine collections experiencing multiple, acute deaths with few premonitory signs.

**ACKNOWLEDGMENTS**

Special thanks to Michael Garner, DVM, Dipl. ACVP for assistance with histopathology.

**LITERATURE CITED**

POST-INTUBATION TRACHEAL OBSTRUCTION IN BIRDS- 22 CASES FROM TWO INSTITUTIONS

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Abstract

Post-intubation tracheal obstruction may be more common in zoo birds than previously recognized.1-4 A review of medical records from two institutions over a 13-yr period revealed 22 cases, with an incidence of 2.5-5%. For both institutions, Ciconiiformes, Columbiformes, Galliformes, and Gruidiformes more commonly developed this complication, though Anseriformes and Passeriformes were also affected at one institution. Birds most commonly presented in acute respiratory distress, though 3 cases only displayed respiratory distress when handled or stressed. Diagnosis was commonly made by observing a soft-tissue density within the trachea radiographically and/or by tracheoscopy.

Five birds died acutely prior to treatment. Seventeen were treated: nine medically (three survived) and eight surgically by tracheal resection (four survived). Medical treatments included tracheal suction and manual removal of intraluminal material, intratracheal topical treatments, and nebulization. The three surviving medical cases were less severely affected, having only a mucoid plug that was not adhered to the trachea. Four surgical cases failed due to re-stricture/obstruction. Factors leading to the failures are unclear as all procedures were performed similarly and only one case was anastamosed under tension.

Based on histologic review, the underlying cause is suspected to be trauma from the end of the endotracheal tube, or possibly from forced air flow, leading to mucosal damage, reactive exuberant mucous, and granulation tissue formation. No association with concurrent illnesses, tube type, or tube cleaning/sterilization procedures was observed. Care should be taken when intubating susceptible species.

ACKNOWLEDGMENTS

We gratefully thank all the clinical, technical, and animal care staff involved in the individual cases. Special thanks to Susan Feltman and the medical records departments of Disney’s Animal Kingdom for assistance with record review. Thanks to Dr. Stephanie James for initiating and inspiring this review.

LITERATURE CITED

PROTEINOGRAM OF BLUE FRONTED AMAZON PARROTS (Amazona aestiva) AND BLUE AND GOLD MACAWS (Ara ararauna) TESTING POSITIVE AND NEGATIVE FOR CLAMIDIOSIS

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Abstract

Due to the increasing contact with people, zoonotics diseases related to psittaciformes have become more worrisome. Common diseases, like clamidiosis, have high prevalence and the definitive diagnosis is relatively difficult because of the complex physiopathology of the infection caused by Chlamyphila psittaci. Studies about complementary tests for clamidiosis have become very important and significant. The objective of this study was to evaluate the serum acute phase proteins and immunoglobulins of blue fronted amazon parrots (Amazona aestiva), and blue and gold macaws (Ara ararauna) testing positive and negative for clamidiosis, using sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE). The proteinogram allowed visualization of up to 27 proteins in the serum of both species. Important biological differences in the concentrations of acute phase proteins and immunoglobulins of blue fronted amazon parrots and blue and gold macaws, testing positive and negative for clamidiosis could be observed. Present only in parrots positive for clamidiosis was the molecular weight 21 kDa protein. Therefore, the serum concentrations of haptoglobin, α1-glicoprotein and the proteins with molecular weight of 275 kDa and 34 kDa were increased in the positive parrots. Within the macaws, an increase in the serum level of the protein with molecular weight of 34 kDa could be noticed. The proteinogram using SDS-PAGE can be consider a good auxiliary method for the diagnosis of clamidiosis in blue fronted amazon parrots and blue and gold macaws, regards at the molecular weight 21 kDa protein, which can be consider a biomarker for clamidiosis in A. aestiva.
CHRONIC DERMATITIS IN THE WALDRAPP IBIS (Geronticus eremita)

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Abstract

The Waldrapp ibis, also known as the Northern bald ibis, is a critically endangered bird with a small wild population existing in Morocco.1 Sixteen institutions in the United States that hold this species were surveyed in 2010 regarding health, veterinary care and nutrition and all institutions responded. Of those surveyed, 13/16 (81%) of institutions reported birds with skin lesions in their collections. The survey revealed that 42/132 captive U.S. birds (approximately 32%) suffer from some degree of chronic, ulcerative dermatitis that is minimally or non-responsive to medical intervention. This condition is often progressive and may become so severe that it results in the death of the bird, either by humane euthanasia due to lack of response to treatment, or by sequelae such as bacterial infection.

Skin lesions are usually located on the dorsum and may affect the entire back of the bird. Lesions may also be found in the axillary regions, and occasionally on the keel. Early in the disease process, lesions may appear as areas of feather loss, often accompanied by erythema and hyperkeratosis or flaky skin. As the lesions worsen, a thick scab may develop which cracks and bleeds. Lesions may wax and wane but often progress to an ulcerative, exudative dermatitis.

Histopathology of affected skin usually reveals chronic, hyperplastic, hyperkeratotic, ulcerative and crusting dermatitis. Bacterial or granulomatous folliculitis is often present, as is perivascular inflammation. Occasional smooth muscle mineralization has been seen, consistent with a chronic inflammatory process. The majority of biopsies collected have been from affected skin only. A more systematic approach to diagnostic workups is recommended, to include both affected and unaffected skin biopsies, as comparing the two can be helpful in determining the presence of true inflammatory disease.2

A myriad of treatments have been used to treat dermatitis in the Waldrapp Ibis including targeted antibiotics based on culture and sensitivity results, anti-inflammatory drugs, antifungals, psychotropic drugs, antihistamines, debridement and bandaging, vests and collars, and various nutritional supplements. Medications have been administered orally, parenterally, and topically. In some cases, clinicians felt that they were able to keep the lesions from progressing but few felt that medical intervention helped to any meaningful extent. Sun exposure was cited by a few veterinarians as helpful in drying out the lesions, which can become very moist and exudative.

Enrichment was recommended by several institutions who felt that it decreased self-mutilation behaviors. Wild Waldrapps spend several hours a day foraging with their long bills in sandy soil, under rocks, and in crevices for insects and other food items. Provision of a soft substrate for
probing with the beak, and scattering live insects could decrease self-mutilation by increasing time spent foraging. One institution trained ibis to approach keepers for hand-fed treats and to step onto a scale, and reported decreased stress and increased play behaviors³. Auditory enrichment has recently been successfully used to increase breeding behavior and reproductive success (Hofling, pers. comm.).

To date, no one etiology has been definitively identified and the problem is believed to be multifactorial in origin. Self-mutilation as a result of behavioral and social stress is currently thought to be the primary initiating factor for the development of dermatitis in this species (Hofling, pers. comm.). A highly social and gregarious species, the Waldrapp Ibis is currently recommended) to be maintained in groups of more than 8-10 birds by both the European Endangered Species Program (EEP) and the AZA’s Species Survival Plan (SSP). Maintaining birds in smaller groups than this, or upsetting the social structure of the group by translocating mature birds can contribute to stress (Hofling, pers. comm.).

Further research is planned to determine if abnormal nutritional status might predispose this species to the development of ulcerative dermatitis. Collection and comparison of all biopsy histopathology is under way, and recommendations for systematic biopsy collection are planned.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Miguel Quevedo of Jerez Zoo in Spain, and Veterinary Advisor for the IAGNBI for sharing his many years of experience regarding dermatitis in the Waldrapp Ibis. The authors are also grateful to the institutions who responded to our survey, and whose contributions will increase our understanding of this significant disease process.

LITERATURE CITED

OCCURRENCE OF NEOPLASIA IN ADULT CAPTIVE ATTWATER’S PRAIRIE CHICKENS (Tympanuchus cupido attwateri) AT FOSSIL RIM WILDLIFE CENTER FROM 2004 TO 2010

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Abstract

Necropsy results for 192 adult (8-mo or older) Attwater’s prairie chickens (Tympanuchus cupido attwateri) were examined to determine the incidence of neoplasia from 2004 to 2010. Lymphosarcoma and squamous cell carcinoma were the predominant types of neoplasia identified on histopathology. Both tumor types are among the most commonly seen in galliformes. Lymphosarcoma was found on necropsy in 9 cases (4.7%). Four additional cases (2.08%) were suspicious for lymphosarcoma but unconfirmed on histopathology. Lymphosarcoma findings were associated with an outbreak of reticuloendotheliosis virus (REV) infections, and all birds tested positive for REV. REV is a retrovirus infecting ducks, geese, turkeys, quail, pheasants, and chickens that is associated with immunosuppression and subsequent secondary infections, as well as tumor formation in the kidneys, bursa, gonads, or digestive tract. Tumors that can occur include lymphomas, lymphosarcomas, adenomas, and carcinomas. The affected Attwater’s prairie-chickens (APCs) ranged in age from 10-mo to 8-yr with an average age of 3.8-yr-old at death. One bird (0.52%) was identified with a histiocytic sarcoma that was thought likely to be associated with REV infection. Squamous cell carcinoma (SCC) was found in the oral cavity of 6 birds (3.1%). SCC is one of the most common oral tumors in birds but is less commonly reported than other forms. SCC was found only in APCs over 5-yr-old with an average of 7-yr-old. In this captive collection, young birds were more likely to die with neoplasia associated with an infectious disease, while SCC was found in aged birds only.

LITERATURE CITED


EFFECTS OF DESLORELIN ACETATE ON EGG PRODUCTION AND PLASMA SEX HORMONES IN JAPANESE QUAIL (Coturnix coturnix japonica)

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Abstract

Deslorelin acetate (Suprelorin®) is a GnRH agonist that is formulated as a subcutaneous, controlled release implant designed for use in dogs as a reversible contraceptive. Deslorelin reportedly suppresses reproductive hormones in dogs for 6-12 mo,¹ and has been employed for reversible contraception in many species,²–⁶ including anecdotal reports of reproductive suppression in several avian species.⁷ A randomized, masked, controlled study was performed with twenty, eight-week-old female Japanese quail (Coturnix coturnix japonica). Japanese quail were selected for this study because they are a high fecundity species that typically lay one egg every 24.5 hours.⁸ The birds were divided into control (n=10) and treatment (n=10) groups. Following a seven-day acclimation period of consistent egg laying, each bird received either a 4.7mg deslorelin implant or identical placebo implant subcutaneously between the shoulder blades.

Egg production for all birds was monitored daily, and plasma sex hormone concentrations (17b-estradiol and androstenedione) were measured via commercially available radioimmunoassay (RIA) kits (ImmuChem Double Antibody 17b-Estradiol ¹²⁵I RIA and Double Antibody Androstenedione¹²⁵I RIA, MP Biomedicals, Costa Mesa, CA, USA) at days 0, 14, 30, 60, and 90 days post-implant placement. Six out of 10 birds of the treatment group stopped laying eggs one week following implant placement, and the mean egg production continued to be reduced throughout the study. In contrast, birds in the control group had no appreciable change in average egg production. The complete results, including the effect on egg production over 90 days and plasma hormone concentrations, will be presented after completion of the study.

Peptech Animal Health Pty Limited, Australia.

LITERATURE CITED


CHARACTERISTICS OF FECAL AND CROP CYTOLOGY IN WILD NESTLING SCARLET MACAWS (Ara macao) AND GREEN-WING MACAWS (Ara chloropterus)

Nadia Stegeman, DVM, MPH, 1* Lizzie Ortiz, MZV, 2 Christina Belcher, DVM, 3 Fernando Takano Blgo, 2 Elizabeth Smith, 2 Meagan Selvig, 2 Patrick Inácio Pina, 2 Donald Brightsmith, MS, PhD, 2 and J. Jill Heatley, DVM, MS, Dipl ACZM, Dipl ACVP (Avian) 4

1 Private Contractor, Houston/Austin, TX USA; 2 Tambopata Macaw Project, Tambopata Reserve, Peru; 3 Greenville Zoo, Greenville, SC USA; 4 Small Animal Clinical Sciences, College of Veterinary Medicine, Texas A&M University, College Station, TX USA

Abstract

A total of 39 fecal samples and 19 crop content samples were obtained from 15 wild Scarlet Macaw (Ara macao) and 4 Greenwing Macaw (Ara chloropterus) nestlings living in the western Amazon basin in Peru. Ages of nestlings ranged from 2 to approximately 70 days post-hatching. Samples were evaluated for bacterial content, fungal elements (hyphae or yeast), and presence of inflammatory cells using Diff-Quik and Gram staining techniques. Of the 19 crop samples, 1 (5.3%) had inflammatory cells, 17 (89.5%) had epithelial cells, and 15 (78.9%) had a fungal element. Total bacterial counts per 1000x field averaged 77.7 with a standard deviation of 77.6. Average percentage of rods (as opposed to cocci) per field was 87.2% (SD=24.3%). On average, 90.7% of the bacteria were gram positive (SD = 7.9%). Of the 39 fecal samples, 3 (7.7%) had inflammatory cells, 35 (89.7%) had epithelial cells, and 28 (71.8%) had some sort of fungal element. Total bacterial counts per 1000x field averaged 192.6 with a standard deviation of 71.3. Average percentage of rods per field was 92.8% (SD 9.4%). On average, 95.7% of the bacteria were gram positive (SD = 4.9%). While previous speciating of fecal sample bacterial populations has been evaluated on samples from the adults in this group 1, this is the first study investigating flora of hatchling populations with results presented in a format easily transferrable to clinical application.

ACKNOWLEDGMENTS

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LITERATURE CITED

TIPS FOR WRITING RESEARCH GRANTS IN ZOOLOGICAL MEDICINE

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Abstract

Several days to weeks should be allocated to writing a research grant proposal in zoological medicine. The investigator needs to know the scientific literature on the specific topic and must be able to write a convincing argument as to why the proposed project is critical. The proposal must convince the agency that your research group understands the problems and is the best group to address the issue.

The actual writing of the grant can be tedious and is somewhat formulaic, however the process helps to focus the project and requires the investigators to have a clear understanding of the research objectives. Granting agencies are looking for creative solutions to problems and issues specific to their mission. The key is understanding the priorities of the granting agency and to convince the reviewers that your proposal is within the scope of their charge.

Establish a Team

It is rare that one individual can accomplish all aspects of a research project. Collaboration is usually necessary so identify your partners before beginning the grant. It helps if the granting agency recognizes and trusts one or more of the partners.

Choose your partners wisely and discuss openly what each person’s role will be in the project. This discussion should include position on the grant, portion of the funding going to different institutions, and authorship on publications.

Read Instructions

Go line by line through the grantor's guidelines and instructions. Make sure your proposal is in line with the funding agency's priorities. Do not try to make the grantor's program fit what you want to do. Use the same terms in your proposal that the foundation used to describe what they support. Buzzwords can push important buttons.

Who has the agency funded in the past?

Examine what research projects have been previously funded by the granting agency. Talk to colleagues who received funding from the same organization and ask for advice and ideally copies of their successful grants. Review some successful proposals and model your grant along a similar template.
An Investment

Granting agencies look for creative solutions to problems and needs, but they do not want to fund risky projects. Think of yourself & your research as an investment – what are the risks, what are the chances for success of the project. Provide information in the grant that convinces the reviewers that you have all the “tools” to complete the research and that your project is going to be successful.

The Abstract

This can be the single most important paragraph of your proposal. You should know exactly what you’re planning to do, and express it in elegant simplicity. For the reviewer, the abstract should provide a quick overview of exactly what you expect to do, with whom, when, how, and toward what measurable outcome.

Background Information

Think of this section as the statement of need. Present the facts and evidence that support the need for the project. This section needs to be succinct, yet persuasive. Present all the evidence in a logical sequence that will readily convince the reviewer of the importance. Avoid overstatement. You are convincing the funding agency to support your proposal because either the problem you are addressing is urgent or more severe than others or the solution you propose or the information you will obtain makes more of an impact than others. Cite research that supports the project and if possible reference projects funded by the agency you are applying to.

This is also the section that can establish that your research group understands the problems and is the best group to address the issue. Include references to your prior publications or presentations on a similar or related topic. This demonstrates to the reviewer that your team has the skills to take the project to completion.

Preliminary Data

Show the granting agency that the research proposal is feasible. Preliminary data demonstrates to the reviewers that you can actually do the procedures you are asking them to fund. Pilot data shows that you have been working on the idea and invested time and funds towards the research.

Hypothesis

Most zoological medicine research involves testing hypotheses about populations. A hypothesis is just a statement that can be tested. An entire population cannot be assessed, therefore sufficient data are generated that can provide adequate evidence against a hypothesis, allowing the hypothesis to be rejected. If the data do NOT provide evidence against a hypothesis, the hypothesis cannot be rejected. The null hypothesis usually states that there is no difference between populations with respect to some quantity, or that there is no relationship between
variables. In most situations, the null hypothesis is thought to be not true. If it was thought that
the null hypothesis was correct, why go through the trouble of carrying out a study to test it?
Therefore, the purpose is to state the hypothesis that you are predicting will be true. This is the
alternative hypothesis, which is the hypothesis that you will accept if the null hypothesis is
rejected. The alternative hypothesis states that something is going on—that there is a difference
between populations with respect to some quantity, or that there is a relationship between
variables.

Objectives

Defining your research objectives is one of the most important parts of the grant. The objectives
of a research proposal are the measurable outcomes that will be achieved within an expected
timeframe with the resources available. Objectives include the description of the action to be
completed and what information will be collected. Keep your research objectives realistic! The
intent of the objective is to provide relevant, accurate & unbiased information. Grant writers
often confuse objectives with goals, which are broader concepts and tend to be more abstract.

Experimental Methods and Design

The methods section describes the specific actions and data collected to achieve the objectives.
Methods can be written for each objective if appropriate and not redundant. The methods section
provides the details to the reviewer to grasp how the data will be collected or the project
implemented. Again, the methods need to convince the reviewer that you know what you are
doing, thereby establishing your credibility. Justification for choice of species used in the model,
number of animals or drug dosage being tested can be stated in this section.

Budget

Have a reasonable, detailed budget. Do your homework on costs to explain your budget even if
there are no requirements to do so. A red flag for grant reviewers is the indication you’ve
planned to accomplish more than your budget makes realistically attainable. It is better to limit
your proposal to less, more assuredly attainable goals, than to promise more than you can
deliver. Most projects find they badly underestimated funding for staff and particularly
technology support. Be realistic and conservative. If the budget allows you to list no-cost aspects
that will be provided by your institution, be sure to include donated equipment and staff time
provided for the project.

Proofread

Spelling and grammar errors do not convey a positive image and can be perceived as annoying
by the reviewer.
Less is More!

Put yourself in the reviewer’s place, reading stacks of proposals. Grant reviewers will scan text. If your proposal is short and to the point, and addresses the key questions, the grant will be viewed as comprehensible and fundable. If the reviewer is bogged down with too much rambling detail they will have a hard time understanding your proposal and it is likely to end up in the "NO" pile. Grant reviewers appreciate when applicants have paid attention to their guidelines – especially page limits and font size.

How will the grant agency measure success?

Know what the granting agency values, how they want to be acknowledged and give it to them. Grant-givers need to be acknowledged for helping make good things happen – it brings them recognition and more donors. It might be scientific presentations at conferences, scientific publications, colorful images for their website, colorful posters, or student participation. Many in-house grants want to be the seed money to help the institution obtain a larger grant from outside agency. Will you use the social media to get the word out about your project, and to attract more partners and participants?

Rejection

A perfect application may still receive a rejection. Most foundations have limited resources with which to fund projects. Do not get discouraged. If your project is rejected, ask the grantor for reviewer comments. The comments can offer invaluable tips for improving your future grant applications. The planning and writing process still allows you to resubmit your idea elsewhere. Boilerplate paragraphs from old grants are typically recycled.

Multiple Funding Sources

While it is considered to be inappropriate to submit the same grant to multiple funders at the same time, one option is to change the grant slightly so multiple funded grants would actually dovetail together instead of creating duplication.
AVOIDING THE BIGGEST PITFALLS IN RESEARCH

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Abstract

The purpose of this presentation is to provide some tips on how to avoid the most common pitfalls in designing, conducting, and publishing research studies. The most important pitfall arises when we fail to distinguish between descriptive and experimental research and to consider how this distinction influences the conclusions we can draw from our study. Other common pitfalls include choosing an inadequate sample size, overestimating the quality of data in our medical and pathology records, failing to distinguish between statistical significance and biological significance, confusing association with causation, and not recognizing when additional expertise is needed. By recognizing and addressing these issues during the study design phase, we can greatly enhance the success of our research.

Study Design Phase

The most significant pitfall arises when we fail to distinguish between descriptive and experimental research and to consider how this distinction influences the conclusions we can draw from our study. In grant proposals this problem is manifested as a study design that fails to answer the question being posed, while in manuscript submissions it manifests as a conclusion that is not warranted by the data.

Descriptive research consists of describing an event or observation in a very careful and systematic way with the purpose of gaining understanding and generating hypotheses that can be tested more rigorously in the future. For example, if you experience a novel infectious disease outbreak in a wildlife population one of the most important things you can do is publish a very detailed description of the outbreak. One weakness of such a descriptive report is that we have incomplete knowledge of the many variables that can influence the occurrence and outcome of a disease outbreak (i.e., we have no controls), so we are limited in the conclusions we can draw. We could not even claim that the same disease would manifest itself in the same way in another population (the findings might not be generalizable). All we can do is describe what happened and allow the reader to determine whether the information is relevant for them. In spite of this weakness, descriptive studies in the form of case reports, case series reports, and surveys are extremely valuable, but should always be interpreted in accordance with their limitations.

At the other end of the spectrum is experimental research, where we develop a research question or hypothesis to test, identify the dependent and independent variables of interest, incorporate controls for each of the independent variables, and design the study with a large enough sample size to provide the statistical power needed to answer the question. Such experimental research
often involves laboratory animals or laboratory settings and is outside the scope of what most zoo and wildlife researchers do. The key advantage of experimental research is that we can carefully control for factors or variables that could influence the outcome of our investigation, which allows us to draw stronger conclusions from our findings. But the validity of our conclusions depends to a large extent on how well we control for extraneous factors and whether we can generate the appropriate sample size. Pulling this off is a tricky business and one of the main reasons why a PhD is very helpful for individuals pursuing a career in experimental research.

More relevant for us are observational studies in the middle of the research spectrum. Observational studies differ from experimental designs because the researcher has no control over the allocation of study subjects or variables to the groups being compared. They differ from descriptive studies because they are specifically designed to test a hypothesis and compare two or more groups by adding carefully selected controls. Essentially, observational studies could be considered descriptive studies with added controls. I'll illustrate this by giving an example of a descriptive study that would fail to answer the question being posed if not for some carefully designed controls.

One of the most important wildlife health concerns today is the spillover of human and domestic animal diseases to wildlife. If I want to demonstrate that human or domestic animal diseases are spilling over into a particular wildlife population, a key variable of interest in my study would be transmission direction, but evaluating transmission direction is extraordinarily difficult in most natural settings. For example, a study currently being conducted in Africa proposes to test the hypothesis that human enteric pathogens are spilling over into chimpanzee populations. A simple descriptive study demonstrating that sympatric human and chimpanzee populations share the same salmonella strains would not prove that spillover was occurring from humans to chimpanzees - one could just as easily argue that spillover was occurring from chimpanzees to humans. The current study assesses transmission direction in part by demonstrating that antibiotic resistance patterns of human and chimpanzee bacterial isolates are the same in areas where their populations overlap, but the antibiotic resistance disappears in bacterial isolates from chimpanzees deeper in the forest (while remaining in isolates from humans further removed from the chimpanzees). This is an elegant solution to a difficult problem and will allow the researchers to draw firmer conclusions from their study.

Another common pitfall is failing to determine whether our sample size will actually provide enough statistical power to detect a meaningful difference in our population measurements. In the above example, the plan might have been to collect as many samples as possible in one field trip, with the assumption that the more samples the researchers can get the better, but whatever they get will be enough. This is a faulty assumption that can lead to erroneous conclusions. For example, if my sample size is too small, I might fail to detect that spillover is actually occurring simply because the prevalence of the target agent is too low for my chosen sample size to detect. The best way to avoid this problem is to determine in advance what detection level is biologically meaningful (e.g., I want to be able to detect the agent even if the prevalence is only 5% because the disease could severely impact my population) and what confidence limits are
appropriate based on the consequences of my findings (e.g., I want to be 95% certain of my
findings because they will have major consequences for policy decisions). I can then determine
the sample size required to detect this prevalence level with the given degree of confidence. It is
important to note that calculating sample sizes can be complex and depends on the study design,
so it is often best to collaborate with a statistician to determine the appropriate numbers needed
to meet the research objectives. There are also tables and free software programs available for
approximating sample size that may be appropriate to use in some situations. Most granting
agencies now require sample size calculations in grant applications to demonstrate that you will
be able to obtain the necessary data to answer your research question. Since such calculations
are based on large sample size theory, the number of study subjects required might exceed what
is possible when conducting research with small populations or limited resources. In these
situations, we might need to adjust our research goals accordingly.

Study Execution Phase

An often underappreciated problem in research studies is the tendency to overestimate the
quality of data in our medical and pathology records, and to underestimate the pitfalls associated
with extracting the data.\textsuperscript{4,5} For example, it is not unusual for a medical record to indicate that an
animal has a particular disease or is "positive" for a disease agent without any indication of what
test was used or why the test was conducted. In order to properly interpret the meaning of that
test result, we need to know not only what test was performed, but why the test was performed.
This is because the predictive value (i.e., how useful the test is when applied to animals with an
unknown disease status) will be largely determined by the accuracy of the test being used and by
the true prevalence of disease in the study population (e.g., whether you were testing a sick
animal with compatible clinical signs or were screening a healthy animal for a disease of low
prevalence). Even the simple act of extracting data from medical and pathology records can
present problems.\textsuperscript{1} For example, some types of data are more easily extracted from medical
records than others, which can lead to data abstraction bias (e.g., favoring one source of
information over another). Medical records also tend to have a bias towards recording positive
test results (or observations) over those that are negative. Very often, negative results or
observations are either not recorded, or are recorded in such a way that it is not possible to
determine whether an animal tested negative or was not tested at all. In research studies, positive
and negative observations are equally important. We can also unwittingly introduce bias if we
overlook (or overemphasize) variation in observer reliability. Dealing with missing or
conflicting data can also be complicated and is one of many important reasons for including
epidemiologists as collaborators.

Analysis of Results and Drawing Conclusions

If we have overlooked the distinction between descriptive and experimental research at the
outset, we can run into problems during the analysis phase by unwittingly drawing conclusions
that are not warranted by the data. In our first example, this would be drawing the conclusion
that spillover of a human enteric pathogen into chimpanzees had occurred based only on the
isolation of similar strains in areas of population overlap. Without the antibiotic resistance
patterns as an added control, the researchers would not have been able to draw any meaningful conclusions.

Even if we have understood the distinction between the different study types, have chosen a robust sample size, done the appropriate power analysis, and have properly designed our study, there are other pitfalls that can arise with interpretation of our findings. We sometimes fail to recognize that it is possible for a finding to be statistically significant but not biologically significant. Undetected bias can easily lead to spurious statistical significance. Using a sophisticated statistical analysis does not obviate the need for clear thinking and applying our broad knowledge as veterinarians. A related problem is confusing association with causation. The fact that two events or variables are associated in time or space does not imply that one caused the other. Even though we are all familiar with this problem, the temptation to draw unwarranted causal inferences during disease investigations can be overwhelming.

Finally, a wide variety of complex and interesting problems can arise in all phases of a study when we unwittingly drift outside the boundaries of our expertise and begin designing and executing studies better left to specialists in other fields. Knowing when and how to recruit outside expertise is a skill worth acquiring.

In summary, the most significant and most frequent pitfalls in research can be avoided by understanding that the questions we can answer with a study, and therefore the conclusions we can draw from it, depend largely upon the controls and sample sizes we select. Selecting the proper controls or comparison groups requires identifying the most important variables that influence the outcome we are trying to measure. If you have trouble doing this, that is the first indication that you might need a collaborator with skills in that area. Determining the appropriate sample size begins with identifying the study design, the effect size we wish to detect, and the level of confidence we need in the result. We can then choose the appropriate method for calculating the sample size required to meet our research objectives. We need to be aware of the potential for bias in the extraction of data from our medical records, and how the quality of information in our records can vary. When interpreting the results of our study, we need to make sure our conclusions are only as firm and specific as our study design and controls or comparison groups allow, and to keep in mind the difference between statistical significance and biological significance.

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LITERATURE CITED

BUILDING A SUCCESSFUL WILDLIFE RESEARCH PROGRAM

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Abstract

Research success is dependent upon three core components: capacity, passion, and relevance. You can implement or revitalize your wildlife research program by considering these components like the legs of a stool. Capacity is a reflection of your ability to conduct the research based upon training, aptitude, and available infrastructure. The training can be acquired formally through graduate clinical or academic programs or through collegial mentoring and self-directed learning. While training is important, it does not guarantee aptitude. Aptitude is a reflection of your ability to think critically, design quality studies, write convincing proposals, and carry out the work in a thoughtful and organized fashion. In the wildlife research realm, adequate infrastructure is often achieved through collaborations among captive facilities, field programs, and sophisticated laboratories.

Once the core capacity components are in place, your team’s research success is still dependent upon the passion of the investigators. Building a research program requires a commitment to the subject matter and an unyielding tenacity to secure necessary funding. Wildlife researchers are usually strong on the passion component, especially for conservation problems. However, research programs cannot succeed without an audience or user of the results. This user is key for funding to be acquired and maintained. This audience can be donors or research funding institutions, but without interest from the funding community, the research program stool will topple. Wildlife researchers can consider these core components when making an investment in a new scientific endeavor or invigorating their existing programs to maximize the probability for success.
DEVELOPING FIELD RESEARCH AND CONSERVATION PROGRAMS: EXAMPLES FROM THE SAINT LOUIS ZOO’S WILDCARE AND SCIENCE INSTITUTES

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Abstract

In 2004 the Saint Louis Zoo consolidated and markedly expanded its conservation activities when it formed the Saint Louis Zoo’s WildCare Institute (www.wildcareinstitute.org). In a similar way, in 2011, the Saint Louis Zoo is currently consolidating and expanding its research activities under a “Science Institute” that will have a special focus on conservation medicine.

The WildCare instate has made contributions to conservation medicine in several areas to conservation medicine in the field, including the health of birds in the Galapagos Islands, biomedical monitoring of Humboldt penguins in Punta San Juan, Peru and lemurs across Madagascar, and work to try to determine the serious decline of hellbender numbers in Missouri. Hallmarks of this effort have included Zoo staff members closely integrated into the projects, and a strong emphasis on inter-institutional collaboration as evidenced by the WildCare Institute’s 180+ partners. Given its 6-yr history, both success and challenges of the WildCare Institute will be presented.

More recently, in 2011, has been enhancement of the Saint Louis Zoo’s ongoing research efforts (reproductive biology, endocrinology, nutrition, behavior, genetics, and veterinary medicine) with the addition of a veterinary epidemiologist and organized under the umbrella of newly a Saint Louis Zoo “Science Institute.” The goal is to identify and create interdisciplinary projects, programs and partners that will create synergistic effects.

A larger goal is to integrate the efforts of the WildCare Institute and the “Science” Institute in continuums that range from ex situ to in situ animals, and that emphasize research that leads to conservation action.
LITHOTRIPSY FOR RECURRENT RENAL STONES IN A PATAS MONKEY 
(*Erythrocebus patas patas*) SECONDARY TO PRIMARY HYPERPARATHYROIDISM

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Abstract

A 15-yr-old, 6.8 kg female Patas monkey (*Erythrocebus patas patas*) was evaluated for persistent weight loss, partial anorexia, and hypercalcemia (15 mg/dl; normal = 9.297 ± 0.689 mg/dl). Previous diagnostics, including complete blood count, serum chemistry panel, survey radiographs, and gastric endoscopy failed to identify an underlying cause. A computed tomography (CT) scan identified left renal calculi which were removed by shock-wave lithotripsy (Storz Modulith SLX-T lithotripsy unit, NextMed). A total of 1500 gaited shock waves were administered, gradually increasing the power at 50 shock intervals until a maximum level of “6” was attained at 300 shocks. Initial improvement in clinical signs was not sustained and right renal densities were later identified on survey radiographs. Parathyroid hormone (PTH; 167.5 – 213.20 pmol/L) and ionized calcium values (1.69 – 1.91 mmol/L) were elevated compared to conspecifics (PTH = 57.0 - 64.8 pmol/L; ionized calcium = 1.27 mmol/L). A CT scan confirmed the presence of right renal calculi and cervical ultrasound identified a 6 mm mass in the left thyroid region. A partial left thyroidectomy was performed to remove an embedded mass, confirmed as a parathyroid adenoma on histology. The lithotripsy procedure was repeated for the right kidney, using the same technique as previously described. Serum calcium, ionized calcium, and parathyroid hormone were at expected values and improved appetite and weight gain was observed 1 mo post-surgery. The patient died 6 mo later with histologic evidence of chronic interstitial nephritis, fibrosis, and tubular proteinosis with myocardial and valvular fibrosis.
SUCCESSFUL REMOVAL OF A UNILATERAL CATARACT IN AN INDIAN CRESTED PORCUPINE (Hystrix indica) VIA PHACOEMULSIFICATION: LONG-TERM FOLLOW-UP

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Abstract

An adult female Indian crested porcupine (Hystrix indica) was diagnosed with bilateral immature cataracts. Based on electroretinography and ocular ultrasound findings, phacoemulsification was only indicated for, and performed on, the left eye (OS). Post-operatively, analgesics (1% atropine sulfate OS BID), anti-inflammatories (1% prednisolone acetate OS QID and prednisone 20 mg PO BID), and antibiotics (0.3% ciprofloxacin OS TID and enrofloxacin 136 mg PO SID) were administered. Corneal edema, moderate aqueous flare, and severe keratoconus developed within seven days of surgery. Prednisolone acetate OS was increased to six times daily and 0.03% flurbiprofen OS TID was initiated. Hypertonic saline (5%) OS TID to QID was instituted to decrease corneal edema. Within five days, the cornea was less edematous and assumed a less conical contour. The cornea remained cloudy with neovascularization evident 1 mo post-operatively. Cyclosporine (0.2%) OS BID was instituted to reduce corneal granulation and pigment development. All medications except flurbiprofen and hypertonic saline were discontinued within 2 mo after surgery. Over the next 5 mo, the corneal edema and keratoconus continued to resolve. A mild corneal scar and corneal edema remained at 31 mo post-operatively. Corneal edema was completely resolved at 40 mo post-operatively with only a minor corneal scar remaining. Hypertonic saline was continued indefinitely to prevent recurrence of corneal edema. Keratoconus is a rare complication of cataract surgery in domestic animals. Further investigation and additional cases are needed to determine whether these complications are more common in porcupines than other taxa.

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The authors are grateful to the technical staff at Long Island Veterinary Specialists for their assistance during the procedure and to the Wildlife Conservation Society’s Special Animal Exhibits keepers who care for this animal on a daily basis.
Sarcocystis sp. MENINGOENCEPHALITIS IN A RED PANDA (Ailurus fulgens fulgens)

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Abstract

A 1.5-yr-old female red panda (Ailurus fulgens fulgens) presented for an acute left-sided head tilt, ataxia, and circling. Complete blood count and serum chemical analysis were unremarkable except for moderately increased alanine aminotransferase and aspartate aminotransferase. Cerebrospinal fluid (CSF) analysis showed a marked lymphocytic pleocytosis consistent with lymphocytic meningoencephalitis. Serologic testing for potential infectious causes such as Toxoplasma gondii, canine distemper virus, West Nile virus, and lymphocytic choriomeningitis virus was negative. Analysis of the CSF sample for T. gondii and Neospora caninum by polymerase chain reaction (PCR) and aerobic and anaerobic cultures was also negative. The red panda’s condition declined rapidly, and on the third day it was found to be moribund with paraparesis, anisocoria, and whole body intention tremors. The red panda was humanely euthanized and histopathology showed severe nonsuppurative meningoencephalitis with focal intralesional protozoan cysts and schizonts. The protozoan cysts were identified by PCR as Sarcocystis sp., most closely resembling S. tapai, S. ramphastosi, and S. neurona. Sarcocystis neurona is an apicomplexan coccidial parasite and is the causative agent of equine protozoal myeloencephalitis (EPM), a neurologic disease of horses that produces similar clinical signs including ataxia, asymmetric weakness, and cranial nerve deficits. Intermediate hosts are infected through ingestion of sporocysts shed in the feces of the opossum (Didelphis virginiana). S. neurona-associated meningoencephalitis has been described in cats, mink, fisher, raccoons, striped skunks, ponies, Pacific harbor seals, and southern sea otters. To the authors’ knowledge, this is the first report of Sarcocystis-associated meningoencephalitis in a red panda.

LITERATURE CITED

REGIONAL ODONTODYSPLASIA IN A TWO-YEAR-OLD AMUR TIGER (*Panthera tigris altaica*)

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Abstract

A 2-yr-old, male Amur tiger (*Panthera tigris altaica*) presented for vital pulp therapy of a complicated crown fracture of right mandibular canine (404). On complete oral exam a right mandibular swelling was revealed in the region of PM4 (408) with multiple erupted and partially erupted deformed and discolored tooth structures. Intra oral radiographs of the area revealed multiple embedded tooth structures of various sizes with no mandibular bone lysis or soft tissue changes. If untreated, these abnormal tooth structures were at risk for developing endodontic and periodontal disease. There was also risk of dentigerous cyst formation from the remnant enamel organ from the embedded tooth structures.¹ Surgical extraction of the tooth structures with synthetic bone graft and histopathologic examination was recommended and performed. Histopathologic diagnosis was dysplastic odontogenesis. Regional odontodysplasia (RO) is rare, non-hereditary human developmental disorder of unknown etiology, affecting a localized area of the dentition.²⁻⁵ Clinically, the affected teeth are localized to one arch having abnormal morphology and discoloration with eruption of affected teeth often being delayed.²⁻⁵ Other conditions such as dentinal dysplasia, dentinal amelogenesis, and dentinogenesis imperfecta are similar to RO; however, these conditions affect the entire dentition.⁵⁻⁵ RO may also be misdiagnosed as malformed teeth or odontoma. Cases of RO do not have the radiolucent zone of soft tissue around the abnormal tooth structures which is pathognomonic for an odontoma.⁶ Initially this case was thought to be a malformed tooth, but all clinical, radiographic, and histopathologic characteristics were consistent with diagnosis of regional odontodysplasia.²⁻⁵

LITERATURE CITED

GASTROINTESTINAL STROMAL TUMOR: DIAGNOSIS AND FOLLOW-UP IN A SPIDER MONKEY (*Ateles fusciceps*)

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Abstract

Gastrointestinal stromal tumors (GISTs) arise from the intestinal pacemaker cells, interstitial cells of Cajal, and are the most common mesenchymal neoplasm in the gastrointestinal tract. However, they still comprise only 5% of all sarcomas. GISTs have been extensively studied in humans but have only been reported in a few additional species including four species of non-human primates. A 35-yr-old brown-headed spider monkey (*Ateles fusciceps*), was diagnosed with a GIST as an incidental finding when she underwent exploratory laparotomy for an unrelated condition. At the time of diagnosis the nodule was approximately 5 mm in size and was completely excised. The tumor was found to be spindleoid and have a relatively low mitotic index of 5/hpf. As 70-80% of GISTs involve mutations in KIT protein, a tyrosine kinase receptor expressed on the surface of the cells, recommended therapy for GISTs includes surgical excision followed by chemotherapy using tyrosine kinase inhibitors. An oncologist was consulted in this case and due to the relatively low mitotic index, small size of the tumor, and the early detection, it was decided to avoid chemotherapeutics and simply monitor for progression of disease via quarterly abdominal ultrasounds. No evidence of metastasis or recurrence has been found to date (18 mo). This is the first report of antemortem diagnosis and follow-up of a GIST in a spider monkey.

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LITERATURE CITED

MORBIDITY AND MORTALITY DUE TO *Fascioloides magna* IN A CAPTIVE HERD OF NORTH AMERICAN MUSK OX (*Ovibos moschatus moschatus*)

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**Abstract**

Between the years 2000 and 2010 a captive musk ox (*Ovibos moschatus moschatus*) herd at the Assiniboine Park Zoo experienced morbidity and mortality attributable to the liver fluke *Fascioloides magna*. In that time period six adult animals from the herd died or were euthanatized with five of six showing marked pathologic changes due to the presence of this parasite. Post mortem findings on all five affected animals included moderate to severe hepatic changes characterized by hepatic migration tracts with resulting fibrosis, hepatic hemorrhage and accumulation of hepatic iron porphyrin. Other pathologic lesions consistent with this parasitic infection that presented variably in the affected population included: bile duct hyperplasia, anemia, peritonitis and clotting defects. In 2009-2010 two musk ox from this herd presented with vague clinical signs that resolved following treatment with triclabendazole at an estimated 12 mg/kg (Fascinex 10%, Novartis Santé Animale, Rueil-Malmaison, France) for presumed fluke infestation. Bloodwork for these two animals showed hypoalbuminemia and moderate increases in serum AST and GGT. It is concluded that musk ox are susceptible to morbidity and mortality attributable to the liver fluke *Fascioloides magna* and prevention and treatment are warranted in captive populations that may be exposed to this parasite.
DISSEMINATED Cryptococcus neoformans var. neoforms: INFECTION AND TREATMENT IN A SCHMIDT’S RED-TAILED GUENON (Cercopithecus ascanius schmidti)

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Abstract

A 9-yr-old, female, intact Schmidt’s red-tailed guenon (Cercopithecus ascanius schmidti) presented with an acute swelling, consistent with an abscess on her right hip. On physical examination, the animal was mildly febrile (102.8°F), had a leukocytosis (white blood cell count 15,800 cells/µL; reference range 3,406-9,366 cells/µL) with a mature neutrophilia and monocytosis. Cytology, culture, and PCR from material within the abscess and serum titers were all consistent with a Cryptococcus neoformans infection. Thoracic radiographs and computed tomography (CT) revealed a consolidated right caudal lung lobe associated with an endobronchial mass. Systemic and pulmonary fungal disease associated with Cryptococcus was confirmed with positive cytologic brushings and bronchoalveolar lavage (BAL).

Sequential thoracic radiographs, CT scans, bronchoscopy, BAL, serology, and cytology were used to monitor response to therapy. Five months after initial diagnosis, pregnancy was confirmed and the frequency of immobilizations for recheck serology and diagnostic imaging was decreased to lessen radiation exposure and physiologic stress to the dam and fetus.

Culture and sensitivity, MIC values, and serum fluconazole level results were used to develop and monitor treatment efficacy for this animal. Long-term administration of oral fluconazole (6 mg/kg orally once daily) was well accepted and effective at treating local and systemic Cryptococcus neoformans infection in this non-human primate. No adverse effects of therapy were observed and invasive and repeated diagnostics were well tolerated.

Advanced imaging modalities and serum drug levels were critical to assess, monitor and treat this life threatening infection in this animal.

LITERATURE CITED

SIGNIFICANT MORBIDITY AND MORTALITY FINDINGS IN GIBBONS (Hylobates and Nomascus spp.) HOUSED AT THE SMITHSONIAN NATIONAL ZOOLOGICAL PARK

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Abstract

Gibbon apes (Hylobates and Nomascus spp.) are vulnerable or endangered.1,2 Knowledge of medical, husbandry, and nutritional issues in captive gibbons will ultimately aid in global conservation efforts.3 To evaluate significant medical concerns in the Smithsonian National Zoological Park (NZP) collection, a retrospective study was conducted on 68 gibbon apes during 1968-2009. The most common species was Nomascus leucogenys (previously known as H. leucogenys). Thirty-seven animals had incomplete or inaccessible records and were not included in the study. The medical records and necropsy reports on 31 captive gibbon apes were reviewed, and 318 cases of disease were identified. For all diseases and all body systems, the two age categories with the highest number of diseases were the geriatrics (21 to 41-yr-old, 32%); and pubescents (5 to 10-yr-old, 26%). Across all age groups, there were significantly (Fisher’s exact test, P=0.004) more gastrointestinal cases (41%), with parasites as the most frequently identified cause. Musculoskeletal cases accounted for 11% across all age groups, and dental disease accounted for 20% of cases across all age groups except infants. Pathology records of 12 of the 15 gibbons that died at NZP between 1968 and 2009 were reviewed. The age group most represented in this data set was infant gibbons (<2-yr-old), representing 33% of all deaths reported. This information will help in overall captive management of gibbons at the NZP, and will add to the SSP database on captive gibbon health and management.

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LITERATURE CITED

PHOTOSENSITIVE EPILEPSY IN A SQUIRREL MONKEY (*Saimiri boliviensis*)

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Abstract

A male squirrel monkey (*Saimiri boliviensis*) which was suffering from regular fits underwent extensive investigation, including: radiography, blood tests, EEG and an MRI scan. True epilepsy with a photosensitive component was diagnosed. The animal was managed with anti-epileptics and the seizures were fully controlled, but 18 mo later had to be euthanatized for other reasons. The post-mortem examination failed to detect any cause for the epilepsy, thus confirming the clinical findings. As true epilepsy has a familial component, we would like to encourage other collections to investigate cases of fits/fainting which appear to be regularly reported in squirrel monkeys, and take them into consideration when considering breeding decisions for the captive breeding programme.

Introduction

Squirrel monkeys (genus *Saimiri*) are commonly kept in captivity in zoological collections and are also frequently used in biomedical research. Fainting related to hypoglycemia has been reported and fits/seizures have also been observed relatively frequently in captive squirrel monkeys (Jan Vermeer pers. com.). Squirrel monkeys have been widely used as experimental lab models for human epilepsy studies, but as far as the authors are aware there are no reports of epilepsy in squirrel monkeys except one case of seizures due to *Encephalitozoon cuniculi* (*Nosema cuniculi*). This case report describes a case of photosensitive epilepsy affecting a male black-capped Bolivian squirrel monkey (*Saimiri boliviensis*).

Case Report

A 5-yr-old male Bolivian squirrel monkey “Casper” was imported to ZSL London zoo from a collection in France, along with another male of the same age and origin, as part of the EEP (European Endangered Species Programme) captive-breeding programme. During the 6-mo rabies quarantine, when both males were housed in an indoor enclosure with no outdoor or natural light access, there were no major health concerns. Following this, both males were introduced to the female group housed in an outdoor, walk-through, naturalistic enclosure. Four weeks following the move it was reported that the group of females was repeatedly picking on Casper and that he had been observed “sleeping on the path”. Shortly after this he sustained very severe bite injuries that required surgical repair. Therefore, Casper was temporarily separated from the group for post-op treatment and monitoring in an indoor enclosure with no outdoor access, but a large glass window. The following day the keepers reported him holding his head with both hands, falling off a branch, having a short fit and then recovering very quickly. Ten
days later he had another fit and lost consciousness completely. Both fits had similar characteristics: seeking out a particular area near a window, holding of the head, apparent altered awareness, neck ventro-flexion, falling and possible tonic-clonic activity. There was a suspicion that the episodes may have been exacerbated by bright light. As the frequency of these seizure was very close together a full investigation was carried out under general anesthesia and on induction of anesthesia he had another fit. Radiographic examination did not reveal any trauma to the skull or any other part of the skeleton. Full hematology and biochemistry results were unremarkable, serologic screening for *E. cuniculi* and toxoplasmosis was negative. Fecal screening was also negative for any pathologic bacteria, protozoa and parasites.

The fits were becoming very frequent, with at least one fit observed weekly. It was decided to investigate further and the monkey was taken to the Royal Veterinary College (RVC University of London) epilepsy referral clinic for full assessment, brain MRI (magnetic resonance imaging) and an EEG (electroencephalogram).

The MRI revealed normal brain structure. There was normal grey-white matter architecture, no asymmetry or mass effect and normal ventricular system. Digital electroencephalography exhibited some possible spike-wave activity however this was difficult to localise as only a limited number of leads could be placed on such a small skull. The EEG findings were consistent with epileptiform activity.

In light of the clinical signs, MRI, EEG and blood tests results a diagnosis of idiopathic epilepsy with a photosensitive component was made.

As this type of epilepsy seems to be familial, Casper was subsequently castrated as it was decided that he should be taken out of the breeding programme, but still remain part of the group in the future if possible. Casper was kept separated from the main group and put on anti-epileptic treatment. During this time of separation, the other male was taken out of the group to be a companion to Casper.

Casper was treated with sodium valproate oral suspension (Epilim syrup®, Sanofi Aventis, Guildford, Surrey, UK) at an initial dose of 20 mg/kg PO once daily as recommended initially by the neurologist. This dosage did not control the fits and the treatment was increased to 30 mg/kg daily. At this rate the seizures seem to be under control for a short while and a month later he was observed to have a pre-ictal stage that did not go into full seizure and recovered very quickly. A blood sample was taken then to assess possible side effects and measure plasma levels of sodium valproate which were <5umol/L (human values <34.6 umol/L). The treatment was increased to 40 mg/kg and this dose seemed to control the seizures completely. However, a month later plasma levels of valproate were found to be 20 umol/L 24 hours post-administration of the drug. This was perceived as slightly high and the dose was reduced to 35 mg/kg once daily. This dose rate seemed to control the seizures completely for a period of 2 mo when he was observed to have another fit before the new dose was due. The frequency of the treatment was then increased to 35 mg/kg of sodium valproate every 12 hours and with this regime the seizures were fully controlled for the rest of Casper’s life.
During the time that Casper was on anti-epileptic treatment regular blood samples were taken not only to measure sodium valproate plasma levels, but also to assess possible side effects of therapy. The only change observed during treatment was a transient elevation of some liver enzymes, ALT and AST.

Five months after the start of treatment Casper’s epilepsy was under control and it was decided to re-introduce both males to the group of females in the outdoor enclosure. In order to assess fully the effect of full bright sunlight on Casper before the re-introduction to the females, both males were moved to a new enclosure with full outdoor access for a period of 2 mo where they could be fully monitored. During this period both males had amoebic diarrhoea and were treated with paramomycin sulphate (Humatin®, Pfizer S.A., Alcobendas, Spain) at 100 mg/kg daily for 10 days and recovered clinically.

As Casper’s seizures did not recur during the 2 mo of close observation with outdoor access both males were re-introduced back to the group of females. However, during the following months Casper was repeatedly beaten and attacked by the females, sustaining numerous injuries and having to be separated for short periods on several occasions. As the re-introduction to the group of females was unsuccessful and keeping him isolated greatly compromised his welfare, Casper was euthanatized on humane grounds.

Post-mortem examination revealed emaciation and the most relevant histopathologic findings were eosinophilic gastroenteritis due to protozoal infection, thought to be amoebic. No gross or histopathologic lesions were found which could account for the epilepsy, confirming the clinical diagnosis of idiopathic epilepsy.

Discussion

Fainting and fits have commonly been observed in squirrel monkeys. Fainting due to hypoglycemia following periods of starvation has been well recorded (husbandry manual) in squirrel monkeys, however normoglycaemia was observed in all the multiple blood samples from Casper. Seizures due to head trauma and brain neoplasia usually show other clinical signs, such as personality changes or neurologic deficits. There were no behavioural or personality changes observed in Casper and no overt neurologic deficits were observed, although a detailed neurologic examination could not be performed. All the blood tests revealed no significant metabolic abnormalities or infectious disease. The only published case of seizures in a squirrel monkey was due to E. cuniculi, but Casper tested negative to this, and also to toxoplasmosis.

In light of the amoebic enteritis discovered on post-mortem examination the possibility of cerebral amoebiasis as being the cause of the seizures was also investigated, but we were not able to demonstrate this in any of the multiple sections examined from the brain.

Given the clinical signs, investigations carried out at the RVC and the lack of evidence suggesting otherwise the diagnosis of idiopathic or true epilepsy was the most likely.
There was a strong suspicion that the episodes were exacerbated by bright light. The fact that the monkey only started showing clinical signs when it was put in an outdoor enclosure in the summer and that when separated from the group he was observed to have fits when he was sitting by the window further reinforced the possibility of a photosensitive component. Casper seemed to be seeking the sunlight through the window even if this triggered a fit. In children with photosensitive epilepsy, a similar behaviour has been observed; children seem to compulsively seek bright light, flickering lights or nod their heads in front of bright TV or computer screen before a fit is triggered. Casper had previously been reported to be seen “sleeping in the path” of the outdoor enclosure, this was later suspected to maybe have been during a fit or when recovering from one.

This relationship to light made it very suspicious of photosensitive epilepsy which is seen in both human and non-human primates. Photosensitive epilepsy characterized by an abnormal EEG response to light has been reported in several baboon species in captivity as well as in the wild. Although squirrel monkeys have been used extensively as human models for epilepsy, as far as the authors are aware this is the first fully-investigated and reported case of idiopathic or true epilepsy in a squirrel monkey. As idiopathic epilepsy has a genetic or familial component it was decided to castrate Casper and exclude him from the breeding programme. Before these two males arrived at ZSL we rejected another pair of males from a different European collection because one of them was epileptic and we didn’t feel the outdoor naturalistic exhibit was appropriate for him. No investigation or treatment was carried out in this monkey. Investigating Casper’s case it came to light that all these males came from the same blood line emphasising the importance of excluding these males from the breeding programme. At the time of writing, the one remaining male at London Zoo has been reported to have had a fit and we are in the process of investigating it. Therefore we would like to encourage other collections to investigate these cases of fits/fainting and take them into consideration for inclusion or exclusion to the captive breeding programme.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Kate Chandler neurologist specialist at the Royal Veterinary College and the rest of our colleagues at the veterinary department at London Zoo for all her help and support with this case and to the keepers in the Mammals South section that did such an excellent job in looking after Casper.

LITERATURE CITED

AN OUTBREAK OF RANAVIRAL DISEASE IN A SURVIVAL ASSURANCE POPULATION OF BOREAL TOADS (Anaxyrus boreas boreas): DIAGNOSIS AND IMPLICATIONS FOR CAPTIVE AMPHIBIAN MANAGEMENT

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Abstract

Ranaviruses are emerging pathogens that can cause mass mortality in wild and captive amphibians.1 In captivity, the possibility of subclinical infections, a potentially broad host range (including reptiles and fish), and nonspecific lesions can complicate diagnosis and control of ranaviral disease.2 Between April and July, 2010, 90% mortality occurred in a breeding colony of 39 boreal toads (Anaxyrus boreas boreas) housed in a multi-species room in an aquarium. Clinical signs included skin vesicles, ulcers, and hyperemia. Histologically, early-outbreak lesions included hematopoietic, renal, epidermal, and hepatic necrosis, and multiple tissues often contained intravascular necrotic and karyorrhectic cell debris. Cytoplasmic inclusion bodies were identified most frequently in hematopoietic cells, circulating leukocytes, renal tubular epithelial cells, and hepatocytes. Transmission electron microscopy of kidney and skin revealed icosahedral viral particles consistent with Ranavirus. Chronic lesions from late-outbreak mortalities included deep ulcerative dermatitis with bacterial and fungal invasion, and scattered visceral abscesses; inclusion bodies were not observed. Ranavirus infection was confirmed by TaqMan real-time PCR3 on six antemortem oropharyngeal swabs and fourteen post-mortem tissue samples. Sequence data from three genome regions, neurofilament triplet H1-like protein (NF-H1), major capsid protein (MCP), and DNA-Polymerase,4 were consistent with a novel Ranavirus genotype. Two months after the outbreak, Ranavirus DNA was still detected by real-time PCR in samples from four of five healthy surviving toads. These findings illustrate the potential for introduction of novel, highly pathogenic viruses into naïve captive and wild populations, and emphasize the importance of biosecurity in management of captive amphibian conservation programs.

ACKNOWLEDGMENTS

The authors would like to thank Kristin Benson, Jennifer Burchell, Yvonne Cates, Isamara Navarrete, Tammy Tucker, Scott Streiker, and Bethany Bohnsack. This work was funded by National Leadership Grant LG-25-08-0066 from the Institute of Museum and Library Services.
LITERATURE CITED


EVALUATION OF SEROLOGIC AND MOLECULAR METHODS TO DETERMINE DISEASE RISK IN TORTOISES AND IMPLICATIONS FOR DISEASE MANAGEMENT

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Abstract

Upper respiratory tract disease resulting from mycoplasma infection is a primary cause of morbidity and death in desert tortoises (Gopherus agassizii), and diagnostic screening tests are essential for management of mixed-source populations. The two most prevalent and virulent mycoplasmas are Mycoplasma agassizii and Mycoplasma testudineum, both of which can cause debilitating disease or, at least the former, result in prolonged subclinical infections. An ELISA test specific for Mycoplasma agassizii is among the best available methods for detecting exposure of animals but does not detect active infection or pathogen shedding. We recently developed two quantitative real-time PCR assays for Mycoplasma agassizii and Mycoplasma testudineum and used them in conjunction with ELISA serology to screen animals at the Desert Tortoise Conservation Center (DTCC) in Las Vegas to determine the most effective testing protocol for managing the animals. Forty-five desert tortoises that died or were euthanized were necropsied and evaluated using ELISA testing for Mycoplasma agassizii antibodies on ante-mortem serum and PCR for Mycoplasma agassizii and Mycoplasma testudineum on post-mortem nasal flush and nasal mucosa samples.

All PCR assays for Mycoplasma testudineum were negative. ELISA and PCR results for Mycoplasma agassizii correlated in 76% of the cases with 4.5% of cases having positive serology and negative PCR, and 20% of animals having negative serology but positive PCR. Our study showed that Mycoplasma testudineum has a relatively low prevalence at the DTCC and that using both ELISA and PCR assays together is necessary for maximizing management and release strategies.

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LITERATURE CITED


MORBIDITY AND MORTALITY IN A LARGE GROUP OF AMPHIBIANS CONFISCATED FROM THE PET TRADE

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Abstract

Fifty-three species of amphibians were confiscated from an animal dealer that supplies national pet store chains. A total of 696 live individuals were transported to the Detroit Zoological Society and housed in quarantine facilities. At least 85% of the animals were presumed to be wild-caught based on the documented location of packing. On arrival, many animals had symptoms of illness and early mortality rates were high. In this retrospective review, causes of morbidity and mortality were determined by reviewing diagnostic testing results and necropsy findings for the period 12 mo after arrival.

Frozen postmortem specimens were submitted for PCR testing for ranavirus from species with any consistent histopathology findings, including skin ulceration, inclusion bodies or necrosis and/or hemorrhage in liver, kidney, hematopoietic tissue or gastrointestinal tract. Samples submitted were either entire carcass or liver, kidney and skin. TaqMan PCR testing for chytridiomycosis was performed antemortem using skin swab sampling.

The overall mortality rate during the first year was 55%; 275 of 494 anurans and 92 of 168 caudates died. Infectious causes of illness were prevalent and included ranavirus, chytridiomycosis, chromomycosis and parasitism. In some cases, death was caused by aberrant tissue migration of spirurid nematodes, while in others parasite load was deemed high enough to cause mortality. Many animals lacked a specific etiology but showed signs of chronic disease and immunocompromise.

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The authors would like to thank Dr. Dana Tatman-Lilly for assistance with data entry and Drs. Ryan Colburn and Karla Fenton for assistance with necropsies.
REVIEW OF MIDAZOLAM SEDATION IN REPTILES AT THE NATIONAL AQUARIUM, BALTIMORE

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Abstract

The benzodiazepine midazolam is commonly utilized as a sedative and muscle relaxant in veterinary medicine and has been used in a variety of species as a single agent or part of multi-drug sedation or general anesthesia protocols. A benzodiazepine antagonist, flumazenil, is readily available in the United States. Midazolam use has been reported in reptiles, often as part of a multi-drug protocol for general anesthesia, with variable sedative effects as a single agent.1-3

This is a retrospective review of midazolam sedation, excluding general anesthesia, at the National Aquarium, Baltimore between January 1, 2009 and February 1, 2011. There were 32 events in 23 reptiles; 12 turtles, 5 snakes, 5 lizards, and 1 crocodile. Midazolam was used primarily to facilitate handling of animals during diagnostic procedures (e.g. radiographs), wound care, or abscess debridement. Average dosage was 0.3 mg/kg i.m. (range 0.1 – 1 mg/kg). Concurrent use of analgesics (e.g. lidocaine) occurred in 44% of events. Overall, desired clinical sedation was achieved in 84% of events. Duration of sedation was typically 10 to 30 minutes but was not reported consistently. Flumazenil was utilized to antagonize midazolam in 50% of events.

Midazolam alone or with analgesia should be considered to facilitate restraint of reptile for procedures. Clinicians considered it effective in a variety of species. Midazolam use has been well received by husbandry and technician staff and is perceived to reduce stress associated with handling and improve quality of diagnostic procedures.

ACKNOWLEDGMENTS

The authors would like to thank National Aquarium Baltimore Animal Health Department veterinary technicians Christine Steinert, CVT and Sarah McMillen, CVT for their assistance.

LITERATURE CITED

EFFICACY OF INTRATHECAL LIDOCAINE, BUPIVACAINE, AND MORPHINE FOR SPINAL ANESTHESIA AND ANALGESIA IN RED-EARED SLIDER TURTLES (Trachemys scripta elegans)

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Abstract

Intrathecal or spinal anesthesia and analgesia have not been systematically evaluated in reptiles, but the clinical application has been published.1-3 Possible benefits of this technique include shorter post-surgical recoveries and improved analgesia particular in chelonians undergoing surgical procedures of the cloaca or hind limbs.1-3 The aim of this study was to investigate the feasibility and efficacy of spinal anesthesia and analgesia in sedated, male, red-eared-slider turtles (Trachemys scripta elegans) (body weight: 0.49-0.78 kg). Intrathecal injections were performed at the level of the mid- to proximal coccygeal vertebrae using 0.5 ml insulin syringes with a 28 G x 1/2” needle (Tyco Healthcare Group LP, Mansfield, MA, USA). Using preservative-free lidocaine (4 mg/kg, 2%) or bupivacaine (1 mg/kg, 0.5%), complete motor block of the cloacal sphincter, tail and hindlimbs was induced in 60% of all turtles after the initial injection attempt, and in 90% after one repeated injection, 15 minutes after the initial injection if unsuccessful. Mean duration of motor block of the hindlimbs was 67 ± 24 minutes after lidocaine injection, and 121 ± 57 min after bupivacaine injection. Intrathecal morphine (0.1-0.2mg/kg, 4mg/ml) resulted in thermal antinociception of the hindlimbs for up to 48h. These results indicate that intrathecal drug administration is a feasible and effective technique for induction of intrathecal anesthesia and analgesia in sedated, male, red-eared slider turtles. Further research is warranted to evaluate the safety of intrathecal drug delivery, as well as feasibility of intrathecal anesthesia and analgesia in various chelonian species.

LITERATURE CITED

COMPARISON OF ANESTHETIC INDUCTION AND RECOVERY TIMES AFTER INTRAMUSCULAR, SUBCUTANEOUS OR INTRANASAL DEXMEDETOMIDINE-KETAMINE ADMINISTRATION IN RED-EARED SLIDER TURTLES (Trachemys scripta elegans)

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Abstract

Injectable anesthetic drug combinations are commonly used in reptiles and several factors have been reported to affect induction and recovery times, including body temperature and body condition.1-8 Furthermore, the injection of certain drugs into the hindlimbs can lead to lowered plasma levels due to a first pass effect through the liver and/or the kidneys.9,10 In a blinded, randomized, crossover trial, induction times after intramuscular (IM; forelimb) and subcutaneous (SC; forelimb and hindlimb) administration of dexmedetomidine (0.1mg/kg) and ketamine (10mg/kg), and recovery times after IM, SC, and intranasal (IN) atipamezole (1mg/kg), in 14 healthy red-eared slider turtles, maintained at 23-24°C (73.4-75.2°F), were evaluated. IM injection resulted in significantly faster and less variable (16 ± 7 min) induction times than SC forelimb injections (35 ± 22 min, p < 0.01). SC hindlimb injection produced no anesthesia in the majority (> 70%) of the animals. Intranasal administration of atipamezole resulted in similar recovery times (42 ± 22 min, p > 0.05) compared to the IM (41 ± 2 min) or SC (50 ± 23 min) route. The results of this study suggest that IM forelimb injections provide the fastest and least variable means for injectable anesthesia in red-eared slider turtles. However, SC forelimb administration achieved the same depth of anesthesia and therefore should be considered for ease of administration, particularly for the injection of large drug volumes. The intranasal route of atipamezole administration is equally effective compared to SC or IM injection.

LITERATURE CITED


DEVELOPMENT OF A ZOONOSIS TRAINING MODULE FOR AZA INSTITUTIONS

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Abstract

An online training program on zoonoses and infection control was developed for the purpose of educating animal care staff at an Association of Zoos and Aquariums (AZA) institution. An online training tool was chosen in order to train new employees quickly and to account for who has completed the training. The training focuses on specific principles and skills necessary for preventing zoonotic disease transmission in a zoo environment rather than teaching details of specific zoonotic diseases. Course resources include multiple case studies and links to significant professional resources as an aid in the application of industry best practices.1-7

The training covers four major topics including infection control principles, biosecurity, personal habits, and professional responsibility. Key learning objectives include 1) understand basic principles in zoonotic disease prevention including factors necessary for disease transmission, transmission pathways, and rules of infection control, 2) understand importance of effective hand-washing in an animal care environment; 3) have a general understanding of biosecurity measures used in zoos and how to apply them to daily animal care activities; 4) know how to apply principles of cleaning and disinfection, and how to use disinfectants for specific purposes; 5) understand how personal responsibility and habits at work can be used to decrease the risk of disease transmission; 6) understand key preventive measures that animal care staff can take to protect their personal health; 7) understand how personal protective equipment (PPE) is used to reduce the risk to animal care staff from zoonotic diseases in the zoo animal care environment.

LITERATURE CITED


RISK ANALYSIS TO EXAMINE POTENTIAL ZOONOTIC DISEASE TRANSMISSION IN 'PETTING ZOO' EXHIBITS

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Abstract

Zoos and aquariums often have exhibits which encourage visitor contact and interaction with various animal species. These exhibits are very popular with our visitors, but present challenges for the institution. We must balance safety for visitors and the animals, while providing a fun and educational experience. Of utmost concern is the risk of zoonotic disease transmission in these interactive settings.

How can an institution systematically evaluate the risk that these exhibits may pose to visitors? Risk Analysis is a tool that can be used to assist institutional decision-makers to understand both the likelihood of occurrence and the consequences of an adverse event, such as transmission of a zoonotic pathogen. This presentation will review the basic elements of risk analysis, focusing on the World Organisation for Animal Health (OIE) qualitative model. A risk analysis will be presented, which examines risk of visitors contracting an enteric pathogen in a ‘petting zoo’ setting. By taking this organized documented approach, institutions can assess their current practices, and identify management and educational strategies that can decrease the likelihood of zoonotic disease transmission.
RODENTS ON ZOO GROUNDS: THE RISK OF ZOONOTIC PATHOGEN TRANSMISSION

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Abstract

Rodents are common vertebrate pests on zoo grounds. These wild rodents present many challenges for zoos including hygiene issues, competition with collection animals for food, and the transmission of disease pathogens to collection animals and / or humans. As a group, rodents are probably the predominant natural reservoirs for pathogens that cause disease in humans (Table 1). In addition to wild rodents on zoo grounds, many zoos have rodent species within their collections, with a number of these species used as contact animals. Disease issues in these zoo animals are also of concern as they may serve as reservoirs of exotic zoonotic pathogens. The zoo veterinarian should be familiar with rodent-borne zoonotic pathogens both within their region and regions where collection rodents originate, risk of zoonotic transmission, methods to control wild rodents, and preventive measures that minimize the risk of zoonotic pathogen transmission to zoo staff and visitors.

Table 1. Zoonotic pathogens of rodent species.

<table>
<thead>
<tr>
<th>Viral</th>
<th>Bacterial</th>
<th>Parasitic</th>
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<tbody>
<tr>
<td>Encephalomyocarditis</td>
<td>Borrelia burgdorferi</td>
<td>Cryptosporidium parvum</td>
</tr>
<tr>
<td>Hantavirus</td>
<td>Coccidioidomycosis.</td>
<td>Echinococcus spp.</td>
</tr>
<tr>
<td>Hemorrhagic viruses</td>
<td>Francisella tularensis</td>
<td>Sarcoptes scabiei</td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis virus</td>
<td>Leptospira interrogans spp.</td>
<td>Taenia taeniaeformis</td>
</tr>
<tr>
<td>Monkeypox</td>
<td>Rat bite fever (Streptobacillus moniliformis and Spirillum minus)</td>
<td>Toxoplasma gondii</td>
</tr>
<tr>
<td>Rabies</td>
<td>Salmonella spp.</td>
<td>Trichophyton spp. (ringworm)</td>
</tr>
<tr>
<td>Reoviruses</td>
<td>Yersinia pestis</td>
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CONTEMPORARY HUMAN AND ANIMAL INFECTIONS WITH COWPOX VIRUS: RECOMMENDATIONS FOR PREVENTING ZOONOTIC TRANSMISSION

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Abstract

Cowpox was long considered enzootic in cattle with occasional transmission to humans.1 Today the virus is known to infect a broad range of species throughout Europe and Western Asia. The first case of human cowpox in the United States was recently reported. Although this infection was acquired in a laboratory setting, the 2003 US monkeypox outbreak serves as a reminder that cowpox could enter the US via importation of infected animals. The numerous reports from Europe of cowpox in zoologic collections and companion animals indicates that veterinarians, zoo personnel and wildlife professionals would be among the first to encounter cowpox virus and therefore should be familiar with cowpox epidemiology, transmission, clinical signs, and personal protective measures. Wild rodents are considered the reservoir, but the species appears to differ based on geographic location.4 The virus is usually transmitted to humans through direct contact and infections are typically self-limiting in immunocompetent hosts. Clinical disease typically manifests as dermal lesions in animals and humans; however, a pulmonary form has been described in felids.2,3 Clinical cowpox has been recognized most often in Felidae sp., namely the domestic cat, but has also been described in elephants, okapis, anteaters, and others.5-7 In these instances, infections are often more severe and more frequently fatal than what is seen in the domestic cat. Early recognition of disease, adherence to quarantine procedures and the use of gloves when handling rodents and animals with skin lesions may diminish risks for human infection.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

LITERATURE CITED

Cryptococcus gattii: REVIEW OF AN EMERGING PATHOGEN OF HUMANS AND ANIMALS IN THE PACIFIC NORTHWEST

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Abstract

Cryptococcus gattii has long been known to cause disease in both humans and animals, but was historically considered to be restricted to tropical and subtropical regions. Recently, infections have been recognized in other areas of the world, particularly in the Pacific Northwest of North America. C. gattii can infect humans and other mammals as well as birds and reptiles and has been positively identified in many species so far. While not considered zoonotic, veterinary and human cases frequently occur in the same geographic regions. The pathogen itself can be dispersed from one area to another via mechanical vectors such as water and soil and has been shown to be anthropogenically transferred. The emergence of the organism into temperate climate zones as well as its apparent increased virulence in North America is a concerning issue for human medical and veterinary professionals.

Introduction

Cryptococcus gattii is a basidiomycetous yeast found in the environment, sometimes in association with various plants and/or animals. It is closely related to Cryptococcus neoformans and these two species are responsible for the majority of cryptococcal infections. Though closely related to C. neoformans, C. gattii differs in a number of important aspects including natural habitat, ecology, manifestation of disease, and epidemiology. Additionally, C. gattii has been classified as a primary pathogen, affecting both immunocompetent and immunosuppressed hosts. In comparison, C. neoformans has historically been considered an opportunistic pathogen affecting mainly immunocompromised hosts, though evidence for this may be stronger in humans than in animals. Previously, it was thought that C. gattii was found only in tropical and subtropical regions, such as Australia, South America, and Southeast Asia, with most historical research coming from Australia where the organism appears to be associated with eucalyptus trees and koalas. The distribution of C. gattii has now expanded to include much of the world, with a recent emergence of two apparently highly virulent strains in the Pacific Northwest of North America. While much is still unknown about this organism, a great deal of research has been done in recent years. This paper will summarize the current information on C. gattii and its relevance to zoo veterinarians.

Pacific Northwest Outbreak

The current Cryptococcus gattii outbreak started in 1999 on Vancouver Island, British Columbia, Canada and spread to mainland British Columbia by 2004. From there, it continued to move south into Washington and Oregon. This region has a temperate climate, which was previously
thought to be outside of the ecological niche of C. gattii,9 thereby prompting investigation into the organism and the epidemiology behind it; however, the origin of this unusual outbreak remains unknown.2,5

Molecular studies have identified four molecular types of C. gattii: VGI, VGII, VGIII, and VGIV.2 Most C. gattii isolates identified in the outbreak region (human, veterinary, and environmental) are VGII.2,10 VGII comprises three molecular subtypes, VGIIa, VGIIb, and VGIIc, with VGIIa appearing to be the most virulent form causing the majority of C. gattii outbreak-associated infections.1,5,9 Interestingly, this isolate is different from the strains identified in endemic areas in other countries such as Australia, where VGI is the most common molecular type identified.5,27 The subtype VGIIc (which behaves similarly to the virulent VGIIa), has thus far only been found in the United States.2

Various types of virulence testing have been performed to investigate the apparently altered pathogenesis of the outbreak strains of C. gattii affecting North America. To address this question, several groups have examined melanin production, mitochondrial morphology, intracellular proliferation rate, and virulence in murine models.2,9,21 The details of this research are beyond the scope of this paper; however, these results have shown that the outbreak strains of C. gattii (specifically VGIIa and VGIIc) are in fact more virulent, although the exact factors involved have not yet been identified.2

It is unknown how these virulent strains moved from Vancouver Island to mainland British Columbia and then to the Northwestern United States, but a number of theories exist. One hypothesis is that the organism has been present in the environment for a number of years and that recent environmental changes have allowed for an ecological shift to occur resulting in the organism being either more common or more pathogenic.1,10,22 A few C. gattii VGIIa isolates have been identified from older samples (one from a human patient in Seattle in the early 1970’s, one from an environmental sample in San Francisco, California in 1990, and one from a patient with HIV infection in Southern California), which may support this theory.2,26,29 The California isolates are similar to but genetically distinct from the outbreak isolates and it is not known if one strain originated from the other or if they are a result of genetic drift or some other mechanism.2 The Seattle sample, which is identical to the outbreak strains, suggests that VGII has been present in the environment for decades; however, this cannot be proven since the travel history of the patient is unknown and no environmental samples were taken at the time.2,11

Another theory is that since C. gattii has been cultured from asymptomatic animals, it is possible that migrating “carrier” wildlife may bring the organism from one place to another.12 C. gattii has also been shown to colonize soil, trees, fresh and sea water, and it can be cultured from air samples.5,11 There is evidence suggesting that humans may play a role in dispersal of C. gattii from one of these environmental sources to another location. One study showed that C. gattii can survive on wheel wells and shoes (sometimes for extended periods of time of up to several months or even years) and be transported to new locations via these mechanical vectors.12 This study also found that the highest concentrations of C. gattii were isolated in areas with heavy human traffic, particularly popular outdoor parks, again implicating a human role in dispersal.4,12
Furthermore, it was found that any disruption of soil or trees contaminated with *C. gattii*, such as construction, deforestation, and even gardening, greatly increases the concentration of *C. gattii* isolated from the surrounding air.\(^{12}\) Other research has shown that the disturbance of soil or trees in *C. gattii* endemic areas is a major risk factor for animals to acquiring *C. gattii* infection.\(^7\) When trees contaminated with *C. gattii* are cut down and processed into by-products such as woodchips, the organism can survive in these materials for long periods, potentially even after they’ve been shipped to other locations.\(^{12,22}\) The theory that the organism may be imported with plant species has not yet been proven but is still plausible given the rest of these findings.\(^9,12,22\)

Human cases of *C. gattii* infection became notifiable in BC in 2003.\(^5\) In the US, although surveillance began in Washington and Oregon in 2005, coordinated national surveillance at the CDC began only in 2008, as a collaboration between the CDC and state health authorities and the BCCDC.\(^3\) Since *C. gattii* became reportable in Washington and Oregon only in 2011, it is likely that many past cases of *C. gattii* were not identified.\(^3,5\) To date, 86 human cases and 65 veterinary cases have been reported in the United States.\(^3\) It has been identified as a cause of disease in many mammalian species, ranging from dogs and cats to porpoises and dolphins.\(^6,24,28\) However, the number of veterinary cases has almost certainly been underestimated for a number of factors; primarily that animals with severe disease are more likely to be euthanized without complete diagnostic testing.\(^18\) Additionally, it is impossible to know how many wild animals have been affected. One study investigated nasal colonization of wild mammals in British Columbia and found a 2% incidence in the animals sampled, similar to what had been found in domestic animals at the time; however further research in wild animals is needed.\(^6\) Overall incidence of *C. gattii* is likely at least somewhat underreported, since historically clinical cryptococcal cases have not been routinely identified to the species level with most cases reported simply as *C. neoformans*.\(^3,5\)

**The Disease**

The disease caused by *C. gattii* is similar to other cryptococcal diseases. It is primarily acquired via inhalation of desiccated yeast cells or spores, though the infectious propagule of *C. gattii* is still unknown.\(^2,5\) After being inhaled, the organism settles mainly in the upper and lower respiratory systems and not uncommonly invades the central nervous system.\(^5,8,18\) This results in various clinical signs, but typically pneumonia is the result of respiratory infection and meningitis the result of CNS infection. *C. gattii* may remain localized in the lungs or other organ systems or it may become disseminated.\(^5,16,18,27\) It also tends to form cryptococcomas (mass-like lesions) more readily than other cryptococcal species.\(^5,27\) Since monitoring and surveillance efforts in the US have been increased, there has been an ~35% case fatality rate among humans.\(^3\) The case fatality rate is reportedly higher in animals, however, this is difficult to substantiate since many veterinary cases in domestic animals and wildlife have likely gone unnoticed and companion animals may be euthanized without attempting treatment.\(^6\)

Diagnosis of *C. gattii* is similar to any other cryptococcal or fungal disease in general. Diagnosis may be made via characteristic cytology (large capsule, narrow based budding, many organisms present, etc.), culture, serum or CSF antigen titers, urine antigen test, or histopathology.\(^18\) While
growth on CCB (L-canavanine, glycine, 2-bromothymol blue) agar can differentiate *C. gattii* from *C. neoformans*, routine testing performed in most labs will not speciate the two organisms. Molecular typing is necessary to identify molecular type and genotype.

In both humans and animals, early detection of the disease and aggressive antifungal therapy provides the best chance for survival. Since early signs can be non-specific, veterinarians and human medical doctors need to have a high index of suspicion for *C. gattii*, yet another reason why increased awareness of the disease is critical. Like most other fungal diseases, long term treatment is required (months to years). In human treatment protocols, the treatment depends on whether or not there is CNS involvement. In veterinary species, treatment is often cost prohibitive and animals may be alternatively euthanized therefore it is difficult to assess which treatments are effective. Most sources recommend amphotericin B as a first line agent, often in combination with other antifungals. When cryptococcomas have formed, surgical excision or debulking may be recommended as well.

**Discussion and Relevance to Zoo Veterinarians**

Many medical and veterinary professionals are still unaware of the existence of *C. gattii* or the current outbreak and much is still largely unknown about its incubation period, evolution to hyper-virulence, and drivers of dispersal. Furthermore, with evidence indicating that *C. gattii* may live for long periods of time in the environment and may be transported from one location to another via plant material, by-products, or by humans acting as mechanical vectors, there is a significant need for increased awareness of this pathogen.

While few studies have examined the impact of *C. gattii* on zoos specifically, there are a number of relevant issues that zoo professionals should be aware of. Since *C. gattii* has the ability to cause potentially fatal disease in a wide spectrum of species and in immunocompetent individuals, many animals housed in zoos are potentially susceptible. Due to what is currently known about how the organism can be dispersed, the potential exists for it to be imported with animals or plants from distant countries, or imported locally via wood chips used in many parks and zoos for landscaping and animal enclosures. Travel-associated cases of *C. gattii* have also been diagnosed, which is especially relevant to zoo veterinarians given the amount of movement of animals between zoos and importation of wild-caught animals. There have been clinical cases of *C. gattii* in zoo animals, several in wild and captive koalas, one of which was housed at a zoo in Japan in 2002. This animal had been imported from Australia and it is assumed that the animal acquired the infection prior to it’s relocation to Japan. Several more cases in zoo animals have been identified recently in North America and reports are currently in preparation (J. Sykes, pers. comm.). Given these cases and the high virulence of the Pacific Northwest strain, zoo veterinarians should not only be aware of the disease but consider preventative actions when appropriate. For example, testing animals for *C. gattii* colonization prior to relocation from endemic areas, and particularly the Pacific Northwest, may be warranted. Regardless, if an animal shows signs suspicious of cryptococcal disease, rapid response is necessary and state veterinary officials should be notified. Every effort should be made to
speciate any confirmed cryptococcal infection for better understanding of C. gattii and its true presence and impact.16

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LITERATURE CITED

SUSPECTED BORRELIOSESIS IN A CAPTIVE ADULT CHIMPANZEE (Pan troglodytes)

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Abstract

An 18-yr-old female captive-born chimpanzee at the Maryland Zoo in Baltimore presented with clinical signs of inappetence, lethargy, and lower limb stiffness for 10 days, which then waxed and waned for 10 days prior to clinical workup. No notable abnormalities were found on exam or CBC and biochemistry. 2 Due to the nature of the clinical presentation, serum was sent out for Ehrlichia canis, Rickettsia rickettsii, and Borrelia burgdorferi. Testing was negative for E. canis and R. rickettsii, but was strongly positive via IFA for B. burgdorferi, with a titer of 1:10240. Titers of this level in dogs are frequently associated with clinical disease, per the reporting laboratory. Western blot was also strongly positive for the B. burgdorferi organism at this time point. Treatment with doxycycline (100 mg BID x 28d) was initiated and a clinical response was seen within one week. 3 Clinical signs have not returned since completion of treatment. Convalescing serum collected two weeks after finishing treatment exhibited a rising titer at 1:81920, consistent with recent immune response to disease. Banked serum was sent out on several chimpanzees in the current troop, as well as on this chimpanzee from previous exams. While some low positive titers were present and likely indicative of past exposure, no titer was near that of the affected chimp during her course of disease. To the authors’ knowledge, this is the first report of borreliosis in a great ape species and originates from an area of the country with a high incidence of human borreliosis. 1

LITERATURE CITED

INVESTIGATION AND MANAGEMENT OF SEVERE RESPIRATORY TRACT DISEASE CAUSED BY HUMAN RESPIRATORY SYNCYTIAL VIRUS AND Streptococcus pneumoniae IN A GROUP OF 30 CAPTIVE CHIMPANZEES (Pan troglodytes)

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Abstract

Chimpanzees (Pan troglodytes) are susceptible to anthroponotic diseases. Concurrent infections of Human Respiratory Syncitial Virus (hRSV) and Streptococcus pneumoniae have been associated with high levels of morbidity and mortality in this species. This case describes an outbreak of acute respiratory disease in 30 captive chimpanzees. Nasal and oral swabs were taken from three conscious, compliant individuals for molecular tests (Micropathology Ltd, UK) and the presence of Human Respiratory Syncitial Virus (hRSV) and Streptococcus pneumoniae were confirmed. Routine bacteriology confirmed the antibiotic sensitivities (Liverpool University, UK). Treatment included antibiotics, NSAIDs and supportive care, but three animals had died by day eight post index case. The surviving chimps showed complete resolution by day 17. All three post-mortem examinations revealed severe diffuse subacute suppurrative bronchopneumonia. Molecular and bacteriologic testing of respiratory tissues confirmed concurrent hRSV and S. pneumoniae infections.

Anthroponotic infections are the probable cause of this respiratory disease outbreak and disease surveillance amongst staff will aid epidemiologic studies of similar outbreaks in the future. Based on relevant literature, biosecurity protocols were improved, with emphasis on hand-hygiene and the wearing of gloves and face-masks during food preparation and enclosure cleaning. Vaccines are successful in preventing pneumococcal disease in humans, though their safety and efficacy in chimpanzees is not well studied. To the authors’ knowledge, this is the first reported case of ante-mortem diagnosis of hRSV and S. pneumoniae in chimpanzees. This enabled a rapid, targeted response to the outbreak, reducing mortalities, and these techniques are suitable for disease surveillance in the future.

LITERATURE CITED

METAPNEUMOVIRUS AND HERPESVIRUS: ANTHROPOZOOONISES OF MOUNTAIN GORILLAS

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Abstract

In March 2007, a stomatitis outbreak occurred in a group of juvenile orphaned Eastern gorillas. Histopathologic examination of lesion biopsies suggested a herpesvirus etiology. Consensus primers amplified a herpesvirus present in a nasal swab with 98% identity to HSV-1 and 94% identity to HSV-2. Further sequence analysis of a 341 nt amplicon demonstrated 100% sequence identity with HSV-1, and 89% for HSV-2. Results are strongly consistent with the presence of HSV-1 in these animals. Results have implications for the potential release of these orphans into the wild.

In June 2009, a respiratory outbreak occurred in Hirwa group ( a group of 12 mountain gorillas, habituated for tourism). Two animals, not treated, died: an adult female and a male infant born to a symptomatic mother. The adult female was first observed coughing and lethargic but feeding; four days later she worsened and died a day later. The 3-day old infant died without exhibiting clinical signs. Its mother exhibited severe clinical signs for 2-3 days peripartum. Analysis by PCR revealed human metapneumovirus (HMPV) in multiple tissues, including serum and lung from the adult gorilla, and lung from the infant. Streptococcus pneumoniae and Klebsiella pneumoniae were detected in respiratory tissue of the adult, but not the infant. The metapneumovirus was most closely related to a South African strain that had not yet mutated, suggesting recent entry of this virus into the gorilla population. This points to the importance of strict enforcement of human-gorilla proximity rules.

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LITERATURE CITED

USING SCIENCE TO UNDERSTAND ELEPHANT WELFARE

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Abstract

The practice of housing elephants in zoos has been a topic that has received significant media attention in recent years. Despite this, no comprehensive scientific assessment of the welfare status of elephants in North American zoos has been conducted. In a study funded by the Institute of Museum and Library Services, a multi-institutional partnership is working to document the current condition of all elephants in AZA zoos and to determine the environmental, management, and husbandry factors that are most influential to their welfare. This unprecedented 3-yr study is breaking new ground in the field of welfare assessment by documenting welfare across a wide array of components and by utilizing measures of both positive and negative welfare. Beginning in 2011, data will be collected on a variety of facility-based input variables (e.g., training program, enclosure size, enrichment) and animal-based outcome variables (e.g., reproductive, adrenal, metabolic and nutritional hormones, social behavior, body condition, and veterinary medical exams) for African and Asian elephants at AZA institutions. Data on each elephant will be collected via archival specimen reports, questionnaires, and laboratory analysis of biological samples. In addition, the study will include documentation of activity budget and walking distance of elephants housed at a representative cross-section of the participating zoos. Results of this study will identify the facility-based measures that most closely relate to welfare outcomes, providing critical information to elephant managers. The welfare assessment process developed in this study is expected to serve as a model from which welfare evaluation tools for other zoo species can be created. Members of the research team will be on-hand to answer questions and facilitate data collection planning with staff present from participating institutions.

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EEHVINFO.COM: A MODEL FOR USING THE INTERNET TO COMMUNICATE RECENT ADVANCES IN EMERGING INFECTIOUS DISEASES

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Abstract

Emerging infectious diseases, such as elephant endotheliotropic herpes virus (EEHV), are an important part of conservation medicine and the veterinary management of in-situ and ex-situ conservation programmes. Advances in knowledge and management of these diseases currently rely on updates through journals, conference proceedings and summaries in textbooks. However due to the lag phase between submission, acceptance and publication the time from submission to publication can be up to 2 yr. Textbooks are often out of date at the time of publication and do not take into account current advances in veterinary management. Using electronic media, information can be communicated as it occurs. However, managing the quality and reliability of such information is difficult and results in a challenge for a clinician looking for internet based resources.

eehvinfo.com represents a novel concept that marries together epidemiologists, virologists, veterinarians, elephant managers, researchers and interested lay professionals. At the 7th Annual International EEHV workshop it was clear that clinicians were not aware of certain advances in the management of EEHV. As a result a web based resource was created with the aim to provide a peer reviewed website dedicated to communicating current information on all aspects of EEHV to both veterinarians, animal husbandry staff and any other interested parties that care for both captive and wild elephant species.
UPDATE ON ELEPHANT TB GUIDELINES AND YEAR ONE SEROLOGIC TESTING RESULTS

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Abstract

The National Tuberculosis Working group for Zoo and Wildlife Species released the first Guidelines for the Control of Tuberculosis in Elephants in 1997. The Guidelines have been modified in 2000, 2003, 2008, and 2010. These Guidelines are now reviewed and revised by a Scientific Subcommittee of the TB Committee of the United States Animal Health Association (USAHA) and approved by the USAHA. They are recommended by USAHA to the USDA as the industry standard for Veterinary Care for elephants relating to the testing and treatment of tuberculosis in elephants. The 2008 Guidelines incorporate a licensed serologic test (ElephantTB Stat-Pak assay®, Chembio Diagnostics, Inc., Medford NY USA) in addition to the trunk wash culture. The first year of testing including the serologic assay has been completed. Within regulated facilities, 398 of 451 elephants were tested. Of those tested, 95 were reactive on the Stat-Pak and of those 37 were reactive on the MAPIA, a confirmatory test (Chembio).
DIAGNOSIS AND MANAGEMENT OF TUBERCULOSIS (*Mycobacterium tuberculosis*) IN AN ASIAN ELEPHANT IN AUSTRALIA

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Abstract

In 2006 five Asian Elephants were imported to Taronga Zoo, Australia from Thailand. Pre-import tuberculosis screening and initial post-arrival screening was by trunk wash (TW). In April 2009 the ElephantTB Stat-Pak® (SP, Chembio) was used to screen the elephants. A 15.5-yr-old pregnant cow was reactive. TW frequency for this cow was increased to every 3 mo. TW culture and PCR remained negative on all elephants. In February 2010, this cow reacted on the Dual Path Platform Vet®TB test™ (DPP, Chembio). All other elephants were non-reactive. With concern about the effect of antituberculous drugs on her foetus and ongoing negative TW’s, screening continued every 3 mo and treatment was not initiated.

The cow gave birth on 2 November 2010. A routine TW on 24 November 2010 was culture positive for *M. tuberculosis*. Although previous shedding could not be ruled out, reactivation of latent infection due to parturition was suspected. Enhanced infection control, repeat staff screening and staff education sessions were implemented.

Treatment with isoniazid, pyrazinamide, rifampicin and ethambutol commenced. The isolate was susceptible to these drugs and genotyped as a Beijing strain. Retrospective serum from Thailand (2004) and Australia (2006) were positive on SP and DPP.

TW, SP and DPP screening frequency increased to monthly for the positive cow. Monthly serum chemistry indicated drug induced hepatitis. Drug pharmacokinetics was conducted to ensure therapeutic levels were achieved. TW and blood collection training of the infant calf was initiated. For all other elephants, TW and SP screening increased to every 3 mo.

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SERUM VITAMIN D AND CALCIUM METABOLISM IN ASIAN ELEPHANTS SEROLOGICALLY REACTIVE AND NON-REACTIVE TO TB

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Abstract

Tuberculosis is a serious re-emerging disease affecting humans and domestic and wild animals, particularly captive elephants. Vitamin D and calcium metabolism has recently gained prominence in the evaluation of human tuberculosis patients. Research has indicated that vitamin D plays a critical role in the production of cathelicidin, important in killing intracellular mycobacteria. Other studies support the conclusion that vitamin D is important in the treatment and prevention of tuberculosis and its deficiency is associated with higher rates of infection. In this study, serum was collected from 15 captive elephants in Nepal reactive on the Elephant TBStat-Pak® and/or MAPIA tests (Chembio Diagnostics, Medford, NY) and from 15 age and sex matched non-reactive controls. Samples were analyzed via ICP-MS for phosphorus, chloride, magnesium, potassium, bicarbonate, cobalt, copper, iron, manganese, molybdenum, selenium, sodium, and zinc. Ionized calcium was measured using an ion-sensitive electrode. Calcidiol (25-hydroxyvitamin D₃) and calcitriol (1,25-dihydroxyvitamin D₃, the active form of Vitamin D₃) were measured by radioimmunoassay. Average calcidiol levels were 2.20 nmol/L (range 0-10). Average serum calcitriol was 28.52 pmol/L (range 13.9-53.7). Calcitriol was significantly different between reactive and non-reactive elephants (p = 0.017) The average calcitriol was 31.5 pmol/L in TB non-reactive elephants and 25.6 pmol/L in TB-reactive elephants. Copper also differed significantly between TB non-reactive and TB reactive elephants (p = 0.004). Copper in TB non-reactive elephants was 1.00 and in TB reactive elephants 1.13 µg/ml. Other values did not differ significantly between groups. These data indicate that variations in vitamin D metabolism are significantly associated with TB status.

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AN UPDATE ON INDIRECT OSCILLOMETRIC BLOOD PRESSURE MEASUREMENT IN AFRICAN (Loxodonta africana) AND ASIAN (Elephas maximus) ELEPHANTS

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Abstract

The few literature citations involving blood pressure (BP) measurements in elephants have utilized direct arterial measurement of anesthetized or stationary conditioned animals.2-5 This project was expanded from an initial investigation comparing cited direct arterial measurements to indirect oscillometric BP measurement of systolic, diastolic, mean arterial pressure (MAP), and heart rate (HR) in four African elephants6 to data collection from 22 captive African elephants, 32 captive Asian elephants, and 30 captive working Asian elephants in Nepal. Blood pressure measurements were obtained in elephants ranging in age from 1 to 72 yr old.

A standard occlusive BP cuff and unit (CardellTM, CAS Medical Systems, Inc. Branford, Connecticut 06405 USA) was utilized. The width of the cuff should approximate 40% the circumference of the tail of the elephant, in accordance with general recommendations for obtaining BP measurements in domestic animals.1 Cuff placement was at the distal extent of the caudal tail fold. Five sets of BPs, heart rates, and respiratory rates were obtained on three different occasions in each elephant, for a total of 1,260 readings.

Interpretation of initial results obtained indicate that infant animals have higher HRs and lower BPs, whereas adult animals of both species have lower HRs and higher BP readings. In addition, semi-wild Asian elephants appear to have overall lower BPs than their captive counterparts.

Use of an indirect oscillometric measuring device for obtaining BP measurement in elephants may prove to be an easily applied ancillary diagnostic tool when evaluating cardiovascular parameters without the need for sedation or immobilization.

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The authors appreciate the contributions and access to elephants at the Kansas City Zoo, Houston Zoo, Indianapolis Zoo, Riddles Elephant Sanctuary, Dickerson Park Zoo, Ringling’s Center for Elephant Conservation, and Feld Entertainment. Special thanks to Dennis Schmitt, Susan Mikota and the Nepal Government for coordinating access to elephants as well.
LITERATURE CITED


EVALUATION OF ANTI-MÜLLERIAN HORMONE/INHIBIN B ENZYME-LINKED IMMUNOSORBENT ASSAY TO PREDICT REPRODUCTIVE STATUS IN ASIAN ELEPHANTS (Elephas maximus)

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Abstract

The ability to accurately identify individual Asian elephants with fertility impairments using anti-Müllarian hormone (AMH) and Inhibin B assay could, if successful, assist in identifying if an elephant would be a good candidate for artificial insemination or semen collection. This project examined the extent of ovarian reserve in female Asian elephants and reproductive status in males utilizing anti-Müllarian hormone and inhibin B enzyme-linked immunosorbent assays (ELISA). Five categories of female and six male reproductive statuses were categorized utilizing serum samples obtained primarily from one Asian elephant herd. Categories included pre-pubertal, reproductive adolescents, mature reproductive, aged and post-reproductive for females and pre-pubertal, puberty, mature, aged, post-reproductive and castrated for males. Anti-Müllarian hormone concentrations appear to be a good candidate for reproductive monitoring in Asian elephants. Mean (± SEM) serum AMH was notably higher in males than females with overall mean of 44.7973 ng/ml and 0.0522 ng/ml respectively. Levels of AMH peaked in females during reproductive adolescent (0.0693 ± 0.0089 ng/ml) and decreased once post reproductive (0.0300 ± 0.0058 ng/ml). In males, concentrations were highest in pre-pubertal (80.255 ± 19.354 ng/ml) and decreased with age reaching low concentrations once post-reproductive (2.200 ± 0.350 ng/ml).
LAUNCHING AUSTRALIA'S ASIAN ELEPHANT BREEDING PROGRAM: MANAGEMENT OF REPRODUCTION, PREGNANCY AND PARTURITION IN FIVE NULLIPAROUS COWS

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Taronga Zoo, Taronga Conservation Society Australia, Mosman, New South Wales, Australia; Melbourne Zoo, Zoos Victoria, Victoria, Australia; Taronga Western Plains Zoo, Taronga Conservation Society Australia, Dubbo, New South Wales, Australia; Institute for Zoo Biology and Wildlife Research, Berlin, Germany

Abstract

Eight Asian elephants were imported from Thailand to Australia in November 2006. Five cows produced healthy calves within 4 yr of their arrival. These pregnancies and births provided an opportunity to obtain detailed data on reproductive parameters through behavioural and physical observations, serum progesterone analysis and ultrasound examinations. Through this process we were able to challenge and add to previously documented elephant reproductive parameters.

The success of an elephant pregnancy and birth relies on detailed planning, staff, visitor and media management and cooperation and coordination between and within Zoo Departments. Flexibility in management and less prescriptive plans allowing for adaptive changes based on actual circumstances and events is important. Decision making should be consultative and efficient to avoid prolonged debate that may impact on the cow and calf. Fit, healthy cows in appropriate body condition on a good plane of nutrition prior to and during pregnancy are important. Nulliparous elephants must be bred early (8-12yrs). The management of individual cows during labour and parturition depends on individual circumstances however allowing more freedom and choice and the presence of other cows and calves appear advantageous. Regular ultrasound examinations are invaluable in assessing reproductive tract status and position of the calf leading up to parturition and guiding management decisions. Minimal disturbance and interference during labour, parturition and the immediate neonatal period appear advantageous. Areas for further investigation include calcium status monitoring and management, factors that influence calf size, and transfer of immunity.

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We thank Gary Miller (Taronga Zoo) and Dave McKelson (Melbourne Zoo) and their respective elephant teams and the many other people who contributed and participated in this program.
MULTI-YEAR ANTIBODY TITERS FROM A SINGLE-DOSE PZP VACCINE IN CAPTIVE AFRICAN ELEPHANTS (Loxodanta africana)

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Abstract

African elephants are locally overabundant in parts of southern and East Africa, where they often come into conflict with humans. Controlling numbers by culling is increasingly unacceptable, which leaves contraception as the most attractive option. Immuocontraception has great potential to control fertility, but conventional porcine zona pellucida (pZP) vaccines require annual boosters, which limits application to populations in small game reserves. For example, in the Makalali Private Game Reserve, South Africa, 82% of the female elephants have received pZP vaccinations annually since 2001, and 2 yr after initiation of these trials, 0% population growth was achieved.1 ImmunoVaccine Technologies (IVT) in Halifax, Canada, produces SpayVac®, the only pZP vaccine with proven single-dose, multi-year contraceptive efficacy, which makes it practical and economical for broad-scale field application.2 In this study, we inoculated captive African elephants with one of two SpayVac® formulations and then followed antibody titers for several years.

Seven non-reproductive captive African elephants were given a 2-ml intramuscular injection of SpayVac®/Modified Freund’s Adjuvant (MFA) aqueous emulsion (n=3) or SpayVac®/MFA non-aqueous (n=4). Serum was collected prior to vaccination, then weekly for 2 mo, bi-weekly for another 2 mo, every 4 weeks for 5 mo, and then annually. Serum titers of pZP antibodies were determined by ELISA. The non-aqueous vaccinates had significantly higher antibody titers than did the aqueous vaccinates (p<0.0001), and titers were sustained for several years post-vaccination. Field research to test contraceptive efficacy of the SpayVac®/MFA non-aqueous formulation is planned.

ACKNOWLEDGMENTS

The authors thank staff at the Nashville Zoo, Cheyenne Mountain Zoo, Bowmanville Zoo, Sedgwick County Zoo, San Antonio Zoo, and Wildlife Safari for collecting samples and participating in this study. This research was supported by grants from the International Elephant Foundation and Elephant Care International.

LITERATURE CITED

Measurements of serum osmolality and plasma colloid oncotic pressure are becoming increasingly valuable in veterinary medicine. These measurements can be used to assess patient hydration status, electrolyte balance, response to fluid therapy, and evaluation of patient status in states of renal disease, hepatic disease, shock, vasculitis, and toxicity. Although elephant species are under public focus, much still remains to be understood of their physiology. Both African and Asian species are often compared physiologically to equids, however, recent research has elucidated several differences that indicate elephants are even less similar to equids than previously recognized. In this research study, the serum of twenty Asiatic elephants was evaluated by vapor pressure osmometry, freezing point osmometry, calculated osmometry, and colloid membrane oncometer. Serum osmolality was determined to be a measurable value with a consistent reference range in the Asian elephant (Elephas maximus) when measured by freezing point osmometer. The normal serum osmolality value for the elephant was found to be significantly lower than in other species. Colloid oncotic pressure was determined to be a measurable value with a consistent reference range in the Asian elephant. This information is valuable to the practicing veterinarian in properly assessing elephant health and preventing erroneous diagnosis of a hypo-osmolar disorder in this species.
VALIDATION OF A RADIOIMMUNOASSAY FOR ASIAN ELEPHANT (*Elephas maximus*) INSULIN

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Abstract

Insulin is a principle mediator of metabolic and reproductive function and could provide an indicator for health status in elephants as in humans, equines and other species. This study was intended to validate a radioimmunoassay for insulin in Asian elephants (*Elephas maximus*). Four Asian elephant cows (age 11-39 y) at the Fort Worth Zoo were fed coastal hay only overnight, then offered no meal (baseline) or a meal providing 4 or 8 g/kg BW0.75 hydrolysable carbohydrate at approximately 0900 h. On each day of the test, a single blood sample was collected 2, 4 or 8 hours after the meal. Plasma samples were analyzed for glucose and insulin to determine meal response patterns. For insulin assay validation, elephant samples were analyzed for repeatability and serial dilutions were compared to dilutions of porcine insulin standard and equine plasma. Overall elephant insulin concentrations were low (median 5.9 mIU/L, max 31.9 mIU/L). Assay precision was good (CV 12%, standard deviation 1.1 mIU/L). Assay of serial dilutions of elephant plasma demonstrated parallelism with porcine and equine samples and were highly correlated to expected insulin outcomes (R² = 0.98). Glycemic response at 2 h was small and was returning to baseline by 4 h. Glycemic and insulinemic responses were proportional to glycemic load as anticipated. These results demonstrate that a radioimmunoassay can be used to measure insulin in elephant plasma and could be used as a tool to begin evaluating metabolic status in captive and wild Asian elephant populations.
LIVER LOBE TORSION IN DOMESTIC RABBITS (*Oryctolagus cuniculus*)

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Abstract

A recent publication outlined the successful outcome of hepatectomy as treatment for liver lobe torsion in four domestic rabbits.1 Nine cases of liver lobe torsion have been diagnosed in rabbits at Angell Animal Medical Center since 2007. Data from these cases, previously reported cases of hepatic torsion in rabbits, as well as archived pathology data from Northwest ZooPath and Zoo/Exotic Pathology Service will be discussed. Typical clinical presentation of rabbits with liver lobe torsion is non-specific and can mimic generalized ileus. Bloodwork and ultrasound are helpful for diagnosis of liver lobe torsion in rabbits. Prompt diagnosis and hepatectomy are recommended to ensure the best chance of a positive outcome.

LITERATURE CITED

SOME POSSIBLE RISK FACTORS ASSOCIATED WITH CARDIOMYOPATHY IN OPOSSUMS (Didelphis)

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Abstract

As the only North American marsupial, opossums are commonly used in educational programs in U.S. Zoos and Aquariums. Opossums (Didelphis virginianus) can be trained for a variety of commands; however, with an average lifespan of only 1-2 yr in the wild, and 3-4 yr in captivity, opossums are not equipped for a long career in our zoological facilities. Anecdotally, opossums as well as other small mammals are known for having a relatively high incidence of heart disease. This exact incidence rate is unknown, and risk factors for heart disease have not been evaluated for this species. At two independent zoo pathology services, the relative prevalence of cardiomyopathy in opossums was determined to be approximately 17%. This is considered high compared to data collected on domestic dogs,1 northern fur seals,2 African hedgehogs,3 and meerkats.4 In domestic cats, cardiomyopathy is also common, being found in 16% of healthy cats.5 Taking this into account, it appears that opossums may be similar to cats in overall prevalence of cardiomyopathy. However, while cats predominantly display hypertrophic cardiomyopathy (HCM) with histologic characteristics of concentric ventricular hypertrophy, opossums tend to have degenerative cardiomyopathy being characterized histologically by multifocal degeneration of myocardiocytes, or dilated cardiomyopathy (DCM), similar to the lesion seen in some dogs breeds, domestic ferrets, and giant anteaters. This paper will outline the signalment and possible risk factors associated with the high relative incidence of cardiomyopathy in North American opossums. Moreover, we recommend evaluating cardiac function during annual examinations to assist in early diagnosis and potential treatment in this species.

LITERATURE CITED

A RETROSPECTIVE AND PROSPECTIVE STUDY OF MEGAESOPHAGUS IN PARMA WALLABIES (Macropus parma)

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Abstract

The San Diego Zoo parma wallaby collection has had a 19.2% prevalence (23/119 animals) of megaesophagus over the last 25 yr. A retrospective review included 23 necropsy records and 61 clinical records. Records were reviewed for evidence of megaesophagus including regurgitation, swelling in the cervical region, weight loss and dilation of the esophagus on radiographs or necropsy along with histopathologic findings. A prospective study included eight animals in the current collection that were immobilized for routine exam, CBC/Chemistry, acetylcholine titer, lead levels, toxoplasmosis titers, mineral panels, and contrast esophagrams. To determine the prevalence of megaesophagus amongst other institutions, a survey was sent out to 30 zoos. The retrospective study did not identify a cause but did elucidate presenting clinical signs for affected animals and that clinical signs are not seen until the disease is advanced. Necropsies ruled out vascular anomaly as a cause. The prospective study revealed megaesophagus and severely delayed esophageal transit time in all eight animals examined. Myasthenia gravis, lead, toxoplasmosis and thyroid disease were ruled out as possible causes. One other institution reported a single case of megaesophagus which is currently under treatment. In conclusion, myasthenia gravis, lead toxicity, hypothyroidism, toxoplasmosis and vascular ring anomaly have been discounted as possible causes of disease in our parma wallaby collection. Parma wallabies often have no clinical signs until severe and chronic dilation of the esophagus is present.
SUCCESSFUL RESOLUTION OF ADENOMYOSIS ASSOCIATED WITH RECURRENT ANEMIA AND COLLAPSE IN A SOUTHERN THREE BANDED ARMADILLO (Toplypeutes matacus)

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Abstract

A 10-yr-old, nulliparous, female southern three banded armadillo (Toplypeutes matacus) with a history of episodes of weakness and mild anemia, was presented for acute collapse. On ultrasound, a 3 x 3 cm heterogeneous mass was noted caudodorsal to the urinary bladder. Exploratory laparotomy revealed an enlarged, firm uterus, and ovariohysterectomy was performed. Histopathology of the uterus revealed irregular, well-differentiated glands extending to a regular, finite, and visually-defined depth into the myometrium, and occasional hemorrhage within these glands. Microscopic findings were consistent with adenomyosis.

Adenomyosis is a common condition of multiparous women and has occasionally been reported in domestic and non-domestic species.1-6 Clinical signs in women include dysmenorrhea and menorrhagia, which may correlate with the clinical signs of recurrent mild anemia and collapse seen in this armadillo. These episodes of anemia and collapse resolved after ovariohysterectomy and the animal has remained clinically normal for 1.5 yr post surgery.

LITERATURE CITED

BILATERAL CALCIFICATION OF THE FILTRATION ANGLE IN A DOMESTIC RABBIT (*Oryctolagus cuniculus*)

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Abstract

A 10-yr-old domestic rabbit (*Oryctolagus cuniculus*) presented to the University of Saskatchewan for inappropriate urination. Physical exam was unremarkable other than the eyes. The left eye was buphthalmic with secondary glaucoma due to suspected dystrophic bone in the filtration angle. The right eye had normal pressures, but there were some changes in the filtration angle. The left eye was removed and bony changes to the filtration angle were confirmed on histology. The right eye was closely monitored and 6 mo later the bony changes had advanced to the point where glaucoma had developed. Enucleation was performed however the rabbit died under anesthesia during the surgery. Calcification of the filtration angle has been reported in guinea pigs\(^1\) and a dog\(^2\) but this is the first report in a rabbit. Calcification of the filtration angle should be considered a differential in rabbits with glaucoma.

LITERATURE CITED

ETHICS IN WILDLIFE MEDICINE

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Abstract

Component wildlife ethics includes two aspects: an understanding of ethical principles, and skills in ethical deliberation. Ethical principles reviewed here include utilitarianism, deontological ethics, environmentalism or respect for nature, virtue ethics, relational ethics, care ethics, and reverence for life ethics. Other processes and tools that take into account human sociology, behavior, and subconscious functioning in moral decision making include narrative ethics, socioscience, listening and communication skills, and needs-based ethics. By instituting ethical practices and programs within our wildlife and conservation management plans and organizations we improve our ability to care for ourselves, other humans, wildlife, and ecosystems.

Introduction

Wildlife veterinarians encounter a plethora of moral and ethical dilemmas, which can lead to social conflict as well as burnout and stress. Daily choices are made to proportion care to patients, staff, themselves, species, ecosystems, and to the people who live in the communities around them. This choosing process between interests of self and others is what we know as ethical deliberation. As one ethics professor once said, "Life is full of tragic choices. There is no correct ethical stance over another, only the presence of one another to support us as we engage to make difficult decisions in our life."

Getting support for component ethical deliberation is no easy task. Veterinary students often get only brief exposure to ethics, and some none at all. This presentation is meant to support the wildlife veterinarian by first giving an overview of ethical principles, and then suggesting tools that support the process of ethical deliberation.

Principal Ethical Approaches

Learning ethics happens best when situated in real-life situations in which the participant is enmeshed. The following situation exemplifies various ethical principles, which the reader can use as they deliberate upon their own situation involving wildlife that caused some confusion, conflict, or emotional reaction. Ethics is best practiced when we choose real life circumstances that engage our moral sensibility. The example I portray is that of avian conservation where we captive breed birds for reintroduction into the wild.
Utilitarianism

Utilitarianism bases decisions in terms of better or worse. You are basically approaching a case as a cost versus benefit analysis. You are also looking to maximize good, which means considering the needs of humans. Whatever decision you make can be justified because the final outcome causes less harm than if you had not acted. The end result justifies the means.

In this case of threatened populations of parrots, the stress and possible negative welfare of caging birds is mitigated by the greater good of keeping a species from going extinct. Some individuals will suffer in captivity, while others experience stress and death after release, but it is all for the greater good.

Deontological Ethics

This approach on the other hand lifts up the worth and dignity of every individual as the ultimate good. This is known as Kantian ethics, named for Immanuel Kant. He said that humans have an intrinsic worth that is dignity and should therefore be treated always as an end and never merely as a means. The same applies for nonhumans. Basically this is a rule based on that one can say, "We never treat another in this way under any circumstances." Animals are not a means to an end.

In the case of having wild birds in captivity, and then releasing their young into the wild, one could say that under no circumstances is it worth keeping a nondomestic bird in a cage, or to release a relatively naïve bird into a situation with a fair likelihood of predation, or even starvation. It is never okay to harm an individual, even for the greater good.

Environmentalist/Respect for Nature

Sometimes at odds with both deontological and utilitarian ethics is environmentalism or "Respect for Nature." In this approach, humans have duties to species, not just to individual animals. Our moral concern is not whether a wild animal can live according to its evolved set of behaviors (deontological ethics says the individual animal has absolute integrity which cannot be violated) or what might cause the greatest harm to individuals or a group of individuals (utilitarianism). What we hold up as ultimate value is the preservation of a species.

Virtue Ethics

In virtue ethics we relate to animals in ways that makes us a virtuous person, or the best person we can be. For instance, we say that a virtuous veterinarian cares for all animals. In the case of the parrots, we might elect to release only intensively trained and physically robust birds into the wild because a virtuous veterinarian protects species and also is caring for individuals so as to minimize harm.
Relational, Care, and Reverence for Life Ethics

These are three approaches that are similar in some ways to virtue ethics because how an animal is cared for depends on how humans relate to the animal. In relational ethics, if we see our relationship to animals as stewards or as veterinarians, then we are inclined to take care of the individual birds as well as possible. However, relational ethics does not tell us how to care for the bird, and does not take into account the individual bird. It is our relationship to the bird that matters most. With care ethics, we draw on our empathy and say if an animal suffers, then we are obligated to do all we can do to care for them.

The term "Reverence for Life" comes from Albert Schweitzer, who said, "In this sense, reverence for life is an absolute ethic. It does not lay down specific rules for each possible situation. It simply tells us that we are responsible for the lives about us. It does not set either maximum or minimum limits to what we must do."

Similar to reverence, Tomas Regan writes of inherent worth. For him, every species has a distinctive kind of value that is inherent in their existence. They are a cup that is precious in its own right, no matter what we might fill the cup with our definitions of "animal" or "species". No matter how we see the species, or imagine their thinking, feeling, behavior, and capacity to suffer, all species are valuable and have inherent worth. It is not what our thinking, current philosophy, or cultural constructs that determine our care, but the existence of the animal her or himself.

Hybrid Ethical Views

"The opportunity to combine elements.....does not, however, make it easier to formulate a plausible, logically consistent account of human duties to animal."5

No matter which ethical principles we eschew, in a very real, pragmatic, and tragic sense we compromise our values consistently. In fact, the only consistent approach to ethics is that we all are inconsistent. Because of this it behooves us to emphasize the process of ethical deliberation which gives us skills to challenge our assumptions, take into account the "subconscious decision process," and bring people together for sustained ethical deliberations. The following are ethical processes and tools which can aid the wildlife veterinarian.

**Ethical Processes and Other Tools**

**Narrative Ethics**

In narrative ethics, stories are told about ethical choices. While speaking the teller is able to clarify their own needs and values, as are the listeners. These stories take the form of case examples that highlight moral guides to living the good life, not just in practice of medicine but in all aspects of one's life. These narratives of witness with their experiential truth and passion, compel re-examination of accepted medical practices and ethical precepts, which in turns allows
us as a community to develop our ethical abilities. Using narrative ethics which emphasizes
communication does not preclude the use of principle ethics. Indeed, both contribute to
understanding moral life and the process of ethical decision making in health care situations.²

Socioscience

Mark Twain once said, "The physician who knows only medicine, knows not even medicine." Socioscience guides the veterinary team member in knowing more than medicine.¹ It is similar to narrative ethics in that those in science and medicine take time out to examine the ethical implications of their work through intentional periods of presenting and discussing ethical case reports. During these case reports, socioscience stresses morality and ethics as well as the interdependence between science, medicine, and society. It focuses on growing the individual through relational challenges that focus on complex ethical situations, and that involve science and human communities. Relational skills and growth are paramount because habits of mind may suffice for decisions and actions initiated by an individual, but do not suffice for real-life complex situations in today's world where the veterinarian strives for flourishing of self, family, staff, nonhuman animal, broader communities, global society, and earth habitats full of other species.

Listening and Communication as an Ethical Art in Empathetic Discourse

Full listening helps us attune to others and their internal states. When another person feels heard and receives empathy, they in turn are in a better place to listen to you, as well as to recognize their own emotional state without it being overridden by concerns of threat from without. We can use communication and empathy in a process known as transformational reasoning. This occurs when one can clearly internalize and articulate the thoughts, arguments, or position of another. One’s reasoning becomes integrated with that of another.⁶ In socioscience processes, we begin with the presentation of controversial science or medical case studies and then participants take turns arguing various viewpoints. It is important to repeat back what one has heard and to argue the case you don’t agree with. In this process of “pretending” to take the other side, one actually gains in empathy for other positions, and grows in sophistication with one’s newly acquired and more integrated ethical approaches. Participants can also be urged to build consensus regarding the issue to further expand their abilities in discourse.

Needs Based Ethics and Compassionate Communication

In needs-based ethics we integrate our mind's conscious and subconscious functions by discussing the needs of all individuals and species. It is an ethic of compassion in that we bring our feelings to the situation of ourselves and others so that we can empathize with others' needs.

By equally considering the needs of all involved we can come up with creative, synergetic solutions that deliver the best care possible to the broadest constituency. This happens because keeping "all needs on the table" allows us to break free from ideologic stances or cultural
constructs that might normally restrain us, such as animal rights versus animal welfare, or domination versus mutualism.

**Where Do We Go From Here - Next Steps**

Competent ethical discourse cannot be achieved by just one period of focus, or by one individual. The following action steps support individuals and organizations by setting up research, study, and practice together.

1. Organize a study group which reads and discusses relevant texts
2. Organize an ethical practice group to develop skills and confidence in ethical deliberation (and to challenge your unchecked assumptions)
3. If you belong to an organization, do #1 and #2 within your group
4. If you are individual, seek companions who will join you, or alternatively find a partner with whom to learn and confide
5. Present and discuss ethical case reports within your medical team
6. As AAZV, we can present ethical and human dimension lectures at meetings and provide opportunities to practice ethical deliberation at conferences and symposiums
7. As AAZV we can form an ethical guidance committee to support these processes within the organization and to support members

**LITERATURE CITED**

Canadian wildlife welfare and legislation: Where does it start and end?

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Abstract

Dealing with the various levels of governmental bureaucracy is normally very complicated and usually convoluted in Canada. Working within the area of wildlife rehabilitation or management requires that an organization or individual become aware of a huge amount of federal and provincial legislation that has been instituted. When invoking wildlife legislation a governmental agency rarely seeks counsel from those who are given the responsibility to look after the welfare of wildlife. These organizations constantly have to make daily decisions dealing with euthanasia, impact of urbanization on the species involved or keeping wildlife in captivity among many others. Veterinarians are often involved in wildlife rehabilitation as many constantly offer their services for free or at cost.

The topic of Canadian wildlife legislation at all levels (federal, provincial, municipal) will be briefly described and examined as to how they affect the many wildlife organizations or individuals caring for wildlife in captivity. Regulations or areas of responsibility are often complicated by where the jurisdiction of one level of government ends and another begins. As well, legislation often singles out species who have been designated as endangered or threatened which often leads to veterinary care, treatment protocols or rehabilitation management for those which would not be afforded to a species that is considered to be common or a ‘nuisance’. The practical application of the various legislation will be described using actual cases or examples of complicated governmental legislation.
GIRAFFE WELFARE

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Abstract

There have been approximately 20 giraffe deaths in the United States between September, 2009 and April 2011. Husbandry, nutrition, or management decisions accounted for over 75% of these deaths, suggesting many were preventable. Other giraffes have suffered with overgrown hooves which affected their gait, cold stress from inadequate housing, serious injuries sustained during transport, or from exhibit design-related problems.

Giraffes have specialized dietary and housing needs which must be met to ensure welfare of these animals. They tend to have more complications and anesthetic-related deaths than other Artiodactyla. Applying training-based methods to deal with overgrown hooves, solving thermoregulation-related problems using appropriate housing and inclement weather turn-out protocols, and ensuring the specific nutritional requirements of giraffes are met would help to improve their quality of life and may help to decrease the alarming mortality rate seen in recent years.

LITERATURE CITED

THE GREAT APE PROTECTION ACT: A MISNOMER?

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Abstract

The “Great Ape Protection Act” (GAPA) is proposed federal legislation that has been introduced annually from 2007-2010. The authors of this abstract believe that the Act’s provisions are unlikely to improve primate welfare, and may, in fact, negatively impact the welfare of the species it purports to protect. The Act prohibits testing of any drugs and many medical procedures considered to be routine. Thus, veterinary protocols for contraception, cardiovascular research, and other strategies for promoting animal health and welfare may be hindered. Provisions restricting contraception contradict the legislation’s (mandated) breeding moratorium. This moratorium effectively eliminates a large and largely untapped gene pool that could contribute materially to ex situ conservation efforts if planned breeding is permitted. A mandate for group housing fails to accommodate the needs of individual animals with varying social skills, as well as of those typically solitary in the wild (orangutans, Pongo spp.) The legislation initially targeted the welfare of “retired” laboratory chimpanzees (Pan troglodytes). However, by including all great apes the focus of the bill was altered, potentially targeting all captive ape facilities. The bill stipulates $10,000 fines for violations of its provisions. This could materially limit veterinary intervention in instances where standard veterinary care may be considered inconsistent with the Act’s provisions as written. Of greater concern, the Act lacks provisions for professional standards of care. In addition, sources for funding of mandated programs are absent from the bill. Thus there is real potential for animal welfare to be compromised rather than enhanced by this legislation.
THE PACHYDERM PODIATRY WORKSHOP: EXTENDING ANIMAL WELFARE BEYOND THE ZOO’S GATES

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Abstract

Elephant management and care has become an intensely sensitive subject for the zoo community. Opinions on welfare and what constitutes health have been extremely varied and diverse. Animal activists, welfare groups, and elephant managers have set up alternate and often conflicting standards of care. In 2007 and 2008 the Phoenix Zoo set up an elephant foot care workshop that openly and collaboratively advanced the discussion of elephants and their management into a public arena.

The workshops were set up for elephant keepers, curators, managers, and veterinarians from institutions with elephants. Participants for the combined workshops represented 31 North American and 3 Mexican zoos, plus one participant from India. Consulting veterinarians from the USDA, two animal welfare activist groups, and two faculty members from North American schools of veterinary medicine also attended. The 2007 course was only advertised through the AZA elephant manager’s list server. The 2008 session was openly advertised to groups interested in elephant management, including some animal advocacy groups. Letters of support and commendation were received from two internationally known animal activist groups.
CIBZ: ONE HEALTH IN SOUTH AMERICA FROM THEORY TO PRACTICE

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Abstract

South America has high wildlife diversity, characterized by the scarcity of diseases data and of enough professionals trained for health management, which could pose a risk to the future occurrence of epidemics originating from the same, which maybe affect public and wild/domestic animal health. Buin Zoo Conservation and Research Department (CIBZ) was created in 2010 with "One Health" paradigm in their philosophy, and the mission to address the wildlife health management based in scientific issues. We plan to be tool to answer questions such as What, Who, Where and When through wildlife diseases research and, on base of this, develop management proposals; all this covered by interdisciplinary and interinstitutional working networks. We created three programs: wildlife health education and training, wildlife disease surveillance, and sanitary issues for endangered species action plans. After 1.5 yr of work, through the first program we have accessed more than 200 students and professionals in the region in reproductive, nutrition, pathology, epidemiology, imagenology, clinical Issues in zoo / wildlife animals. Through the second program we establish a serum bank and develop health screening for more than 300 captive wild mammals for different infectious pathogens (Brucella abortus, Canine Distemper Virus, Mycobacterium avium paratuberculosis, Leptospira interrogans, Toxoplasma gondii) through serologic and molecular techniques. Currently we are work for providing information on health issues for the conservation of two endangered mammals’ species in the region. Through these efforts we pursue higher standards levels of wildlife health management in natural and artificial environments in South America.
LIFE EXPECTANCY IN ZOO MAMMALS: WHAT A ZOO VETERINARIAN SHOULD KNOW

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Abstract

Recently several scientific publications have appeared related to the topic of longevity in mammals with a special focus on zoo animals. This presentation summarizes the findings and highlights facts which are of importance for a scientific discussion, especially when data from zoo animals are compared with data from free-ranging conspecifics. Special emphasis is given to the definition of parameters used to quantify longevity, such as survivorship, maximum longevity and mean or relative life expectancy.

An above-average life expectancy is considered a sign of successful management of zoo animals, a goal that every modern zoo strives for. Zoos enjoy a public perception that animals in their care have a “good life” free of predators, supported by veterinary care and living longer than their free-living counterparts. This assumption is supported by the fact that longevity records are most often held by zoo animals1, which has ironically led to criticism resulting from the problems inherent in an increasing number of geriatric animals.4

However, scientific analyses of life expectancy in zoo animals, and whether species in zoos generally live longer than their wild counterparts have been sporadic. In several species, it has become apparent that current life expectancies in captivity may indeed be less than those of free-ranging populations. Species investigated include African and Asian elephants (Loxodonta africana and Elephas maximus), roe deer (Capreolus capreolus), moose (Alces alces), orca (Orcinus orca) and walrus (Odobenus rosmarus).3,5,7

Zoo veterinarians are perceived as experts by the general public in evaluating the management of zoo animals and will therefore be answering questions regarding life expectancy in captivity, as well as comparisons to free-ranging conspecifics. It is therefore important that zoo veterinarians are be able to give objective answers regarding life expectancy.

It has been hypothesized for several species that reduced longevity is influenced by the captive diet. For Asian elephants, obesity appears to be a problem, and browsing ruminants such as roe deer and moose may not receive adequate fiber sources in captivity. Müller et al.6 found that the life expectancy of captive female non-domestic ruminants in general correlated with the percentage of grass in a species’ natural diet, suggesting that the needs of species adapted to
grass can be more easily accommodated than those adapted to browse. Another impact on life expectancy is related to reproductive physiology, where captive male non-domestic ruminants of monogamous species demonstrate higher life expectancy than polygamous males, which matches observed differences of sexual bias in life expectancy in free-living populations and thus supports the ecological theory that the mating system influences life expectancy. But it should also be emphasized that Müller et al.\textsuperscript{6} found life expectancy to be higher in non-domestic ruminants managed by international studbooks when compared with species not managed in this way.

Results on longevity cannot always be easily compared because different parameters are used. Table 1 summarizes the main parameters that are measured.

Studbook data and the International Species Information System (ISIS) represent excellent compilations of data that can be used to investigate longevities for captive animals. Data for wild populations are less available, as many fewer species have been studied in the wild for the long time spans necessary to assemble comprehensive demographic data.

In conclusion, there is no doubt that the general assumption that zoo animals live longer than their conspecifics in the wild is not entirely valid, even though studies have involved a limited number of species. It is to be expected that this pattern will continue as additional taxa are analyzed. Certain species represent a challenge for captive management and further research is required. Differences between species may be related to biological adaptations that may directly influence husbandry (such as adaptations to the natural diet), or to biological adaptations in terms of life history, which will not change in captive specimens. These differences are of importance since they emphasize different directions for further investigation.

Finally, it should be recognized that longevity is only one of many parameters by which husbandry success can be quantified.\textsuperscript{5} High longevities are a side-effect of good husbandry coupled with sufficiently available space for maintaining geriatric animals. A long life as such may, strategically, not be as desirable in itself as a healthy population (and meta-population) with a pyramidal age-structure. However, reduced longevity can serve as an important warning parameter.

LITERATURE CITED


Table 1. Commonly used parameters used to define population management success in zoo animals (modified from Clubb et al., 2008 and Clauss et al., 2010).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Definition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survivorship</td>
<td>%</td>
<td>1. Mortality: proportion of cohort that is alive at a defined point in time.</td>
<td>Allows comparison within species; comparisons between species must take differences in longevity into account.</td>
</tr>
<tr>
<td>Mortality</td>
<td>%</td>
<td>1. Survivorship: proportion of cohort that has died at a defined point in time.</td>
<td>Allows comparison within species; comparisons between species must take differences in longevity into account.</td>
</tr>
<tr>
<td>Maximum longevity</td>
<td>years</td>
<td>Published age record.</td>
<td>Data for a single animal, not representative for a population.</td>
</tr>
<tr>
<td>Life expectancy or mean life expectancy</td>
<td>years</td>
<td>Number of years an individual is expected to live; can be determined for different age classes.</td>
<td>Allows comparison between populations of same species.</td>
</tr>
<tr>
<td>Relative life expectancy</td>
<td>%</td>
<td>Life expectancy of a population as a proportion of the longevity record of the species.</td>
<td>Excludes allometric influences and allows comparison between populations of different species.</td>
</tr>
</tbody>
</table>
HUMAN DIMENSIONS OF AVIAN CONSERVATION

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Abstract

Conservation teams are increasingly focusing on the human dimensions of avian conservation. Research in and application of human dimensions include conservation psychology, ethnoornithology, and social and emotional intelligence. Conservation psychology takes into account the science of human behavior and then coaches people to care by integration cognition, emotions, and behavior. Ethnoornithology studies the relationships between humans and birds, and uses this information to form more inclusive and effective conservation teams. Social and emotional intelligence emphasizes communication skills, empathy, and cognitive integration. Examples are given of all three fields used in the author's avian conservation practices. Though it is not possible for everyone involved in wildlife to become proficient with the sociologic aspects of human and wildlife relationships, there is much merit in forming multidisciplinary teams that include social scientists or facilitators to help us navigate the complexity of human thinking and behavior.

Introduction

Fully instantiated, care includes cognitive, affective, and behavioral components. In order to care, people must be informed, people must feel, and people should act in ways that will express both their knowledge and their emotions.1

Up to 30-50% of conservation projects in Mexico fail not due to funding restrictions or characteristics of the species or habitat, but due to interpersonal conflict and lack of social capital.6 Furthermore, socioeconomic issues impacting the quality of life of humans correlates with the ability of individuals and communities to partner in conservation plans. Since science and conservation does not exist in a vacuum without human agents or human culture, increasingly conservation teams incorporate social scientists in their multidisciplinary teams. Three fields of study employed by such professionals, conservation psychology, ethnoornithology, and social and emotional intelligence offers tools for avian conservation.

Conservation Psychology

The field of conservation psychology takes what we know about the science of human behavior and the interdependence between humans and nature and then seeks to promote a healthy and sustainable relationship between them.1 Conservation psychology persistently and deeply asks what is the human place in nature, and what is nature's place in the human being? These questions are asked so that we can sustain care. Conservation psychology coaches people to care by integrating cognition, emotions, and behavior. Given that 60% of the earth’s ecosystems
being used unsustainably, led Clayton and Myers to urgently ask, "Where are the psychologists on conservation research teams?"1

If they were present they would guide others in understanding the intersection between behavior and values, attitudes, value orientation, ideologies, and a plethora of cognitive constructs. Although cognition is an important aspect of their work, how people think may not be the key influence on any specific behavior impacting the environment or animals. Instead, emotion drives moral behavior, and reason comes in afterwards in what we would call "rationalization." Research suggests that emotion is an important indicator of sustainable behaviors. For example, by encouraging students to "try to imagine how a bird feels" researchers were able to increase emotions associated with empathy, and this empathic response in turn correlated to a greater willingness and obligation to help nature.1 Empathy is the ability to put ourselves in the place of conspecifics or hetrospecifics.

Human structures of values also impact our behavior, often subconsciously, and "understanding every human group's structure of values is a prerequisite for conservation work."1 Findings suggest that "values related to conformity, tradition, security, and self enhancement support utilitarian views toward wildlife, while values related to openness to change and self-transcendence support more protectionist, aesthetic, and mutualistic views toward wildlife."3 These values then orient in different combinations, of which two are prominent in North America: domination, and mutualism or egalitarianism.4 "The stronger one's domination orientation, the more likely he or she will be to prioritize human well being over wildlife, accept actions that result in death or other intrusive control of wildlife, and evaluate treatment of wildlife in utilitarian terms. A mutualism wildlife value orientation, in contrast, views wildlife as capable of living in relationships of trust with humans, as life-forms having rights like those of humans, as part of an extended family, and as deserving caring and compassion." Differences in these orientations result in conflict and difficulty in developing conservation strategies that address different needs and desires.

Conservation psychology helps us understand and normalize why we are different and then helps us engage in individual and social processes that enable us to work together. These processes help people communicate and hence gain knowledge, feel, and integrate cognitive and emotive functions with behavior. One process of behavioral change is Applied Behavioral Analysis (ABA), popular with companion birds as well as with humans. If people can be given frequent positive feedback in discrete small steps, their behavior can change.1

Other processes include environmental education (including offering practical and doable actions to care for animals and ecosystems), practice in ethical and moral course, such as socioscience6 and wildlife ethics, learning and applying emotional and social intelligence, promoting Autonomy Supportive Environments,1 promoting opportunities for meaning making and hope, and studying societal structures such as group identity, power differences in wealth, politics, privilege, biophilic and spiritual tendencies, and knowing and using local knowledge of birds (ethnoornithology).
Ethnoornithology of Conservationists in Central America

Ethnoornithology "explores how peoples of various times and places seek to understand the lives of the birds round them." It studies the relationships between humans and birds. Research methods include collecting copious notes of events, as well as conducting interviews and surveys while being immersed in the culture. To understand how the people working in the complex and often discouraging situation of conservation in Central America thought of birds, I conducted ethnoornithologic research targeting conservationists working in Central America in 2009-2011. My goal was to see what motivated them to do this work, how they made meaning of their work, and how we could use this understanding to support and improve our efforts.

I found that the major meaning activity was the work itself (collecting data and applying knowledge to improve the lives of birds) and the times when team work was most manifest. Meaning making also happened frequently around meals when stories were told of the work and experiences. Also, meaning evolved during the collection and review of media, such as photographs and videos. While watching media, the gathered partake in both silent storytelling as well as spoken meaning making as they talk about what they are seeing. Meanings that frequently surfaced regarding their efforts included: love, conversion, calling, insiders/outsiders, interconnection, death, hope, end times (eschatology, apocalypse), sacrifice, service, suffering, compassion, worth and dignity, awe, wonder, social justice, prophetic voice, resistance, solidarity. Having time for meaning making activities allowed the team to work together more affectively across differences of class, ethnicity, language, gender, religion, age, values, and behavior patterns.

Social and Emotional Intelligence

Each conservation area requires particular strategies that fit the species, people, cultures, ecosystem, and limiting factors in the environment and human communities. Conducting location specific research in the fields of ethnoornithology and psychology adds to our understanding of limiting factors as well as potential resources to guide behavior. Behavior that we often elect to change includes use and misuse of environmental resources, trapping and hunting of birds and other wildlife, and social relationship skills.

Improving relational skills and the way we communicate aids conservation teams to work with greater satisfaction and effectiveness. For instance, human physicians experience high rates of burn out and the number of malpractice suits is correlated to impaired communication and shorter patient visits. Spending time with staff and patients decreases the chance for compassion fatigue. Superb leaders in human services are not those with greater knowledge or technical skill, but those with highly developed interpersonal skills like empathy and conflict resolution. Medical staffs perform better when they feel they have a secure base to work from, such as an organization that operates with a high level of social intelligence. Social intelligence is the ability to act from understanding our interior lives (intrapersonal skills) and our lives in relationship to others (interpersonal skills). The more attentive we can be to the emotions and status of another person or animal, the more likely we are able to respond with greater care, in more ambiguous...
situations, and more quickly. To be more attentive to another person, we strive to understand them, as well as ourselves.

Social intelligence also contributes to organizational management of conservation teams. Cutting edge business leadership models focus on empathy and deep listening within the organization to improve success. The shift is from producing results to producing the growth of people who produce great results. 3 Success depends on both intrapersonal and interpersonal skill development, which grows businesses and relationships. Life giving relationships are the powerful engine of successful organizations, and compassion and empathy are great tools for increasing power in organizations. Positive emotions make a difference in a work place as do expectations and clarity of how we are to “treat one another” on a day-to-day basis. Practices that produce positive emotional encounters result in individuals with higher commitments to the organization.

Application

In the avian conservation projects with which I work, I recruit several human dimension aspects to the conservation plan. For instance, I offer training in social and emotional intelligence focusing mostly on a communication system known as Nonviolent Communication.5 This training happens for all members of the team to improve relationships, commitment, and synergistic creativity, as well as give them tools to work with the multitude of human communities with which we interact. We do this so we can improve communication, bring all constituents fully engaged to the planning table, and positively impact behavioral patterns that are ultimately harmful to individuals, communities, birds, and the ecosystems. I also plan time for meaning making activities, including discussion, so that we can grow our empathy towards one another, construct shared meanings, engage in ethical discourse, and normalize and constructively utilize any overt or hidden conflict. Finally, I stress the importance of social science research in our conservation plans, often conducting this work myself.

Invitation

To escape ecological destruction we must overcome our fear of authentic psychological development and attend to the human dimensions of our work. Using social intelligence to communicate and become increasingly self-reflective can also lower the high risk of addiction, suicide, and stress persistent in veterinary medicine. For our own sakes and for the planet’s, I invite us as a profession and organization to learn and utilize human behavior, or collaborate with those that do, so that we can train ourselves to take better care of one another and the human communities and birds whom we serve.

LITERATURE CITED

IMMUNE-MEDIATED HEMOLYTIC ANEMIA IN WESTERN LOWLAND GORILLAS (Gorilla gorilla gorilla)

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Abstract

Immune-mediated hemolytic anemia is an uncommon finding in gorillas. ZSL has lost two male gorillas through an unidentified disease that presented as a non-specific malaise with severe hemolytic anemia and marked hemoglobinuria.

Our current male has exhibited intermittent, milder, bouts of malaise and hemoglobinuria. Extensive diagnostic tests have been performed. The more common causes of hemolytic anemia have been ruled out. Consequently, immune-mediated hemolytic anemia, triggered by an unknown pathogen, was considered most likely. As all three males had mated the same female, sexually transmitted diseases were also investigated.

During the investigation most of the gorillas were found, surprisingly as all the gorillas are captive-bred, to have circulating antibodies to dengue fever. Dengue fever is not present in the UK, a vector-free country. Cross-reaction to anti-Brucella spp. antibodies can occur. Thus a sero-survey for Brucella antibodies was performed. All animals showed titres to Brucella spp. Using archived samples, both dead males also demonstrated very high titres (IgG >1000). PCR analysis, currently being sequenced, of tissues from one dead male and genital swabs from the current male and the female mated by all males confirms the presence of a Brucella spp. The group has been treated for brucellosis with a rifampicin/doxycycline combination. At the time of writing the new male has had no further episodes. We believe this is the first time a Brucella spp. has been diagnosed and associated with disease in apes. Given the zoonotic potential of brucellosis we urge all colleagues to consider testing their collection.
MULTIPLE VIRAL INFECTIONS IN CONFISCATED WILD BORN SEMI-CAPTIVE CHIMPANZEEs (Pan troglodytes schweinfurthii) IN A SANCTUARY IN UGANDA: IMPLICATIONS FOR SANCTUARY MANAGEMENT AND CONSERVATION

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Abstract

Infectious agents/diseases from non-primates in particular have caused a number of new human diseases leading to calls for international surveillance to monitor the human-nonhuman primate (NHP) interface. Hence, confiscated 42 wild-born semi-captive chimpanzees living in a sanctuary on Ngamba Island, Uganda were screened for a broad range of viral pathogens to determine the prevalence of specific viral infections some of which may be cross reacting with human viruses using specific polymerase chain reactions (PCR) and serologic assays. The viral infection prevalence in chimpanzees was 82.4%, 73%, 60.5% and 32.4% for adenoviruses, simian foamy viruses, gammaherpesviruses and hepatitis B virus, respectively. They were negative for simian/human immunodeficiency virus (SIV/HIV), human T-lymphotropic virus types I and II (HTLV-I and HTLV-II) antibodies, hepatitis C virus (HCV), hepatitis E virus (HEV), flavivirus, human-metapneumovirus (HMPV), and Chikungunya viruses. These results indicate that wild-born captive chimpanzees are infected with multiple viral pathogens with potential for inter- and intra-species transmission. The data has implications for sanctuary management and conservation efforts and implies the usefulness of incorporating sanctuary primates into emerging infectious disease research programs.

Newly emerging diseases can become major threats to public health and animal reservoirs are implicated as the major sources of these emerging diseases1,4,11,24. Indeed, approximately 75% of emerging human infectious diseases are zoonotic from wildlife, livestock or their products.26,27 Primate-associated zoonotic diseases have received dramatic global attention after emergency of HIV 1 and 11 from a simian variant of the virus SIVcpz7,10,12,19 and caused global HIV/AIDS pandemic. More recently, a novel HIV-1 lineage (HIV-1 group P) distinct from HIV-1 groups M, N, and O closely related to gorilla simian immunodeficiency (SIVgor) was discovered in a Cameroonian woman.20. At the same time great ape populations are being driven to extinction by emergence of infectious diseases in great ape populations some of which are of human origin.8,14 Human respiratory syncytial virus (HRSV) and meta-pneumovirus (HMPV) caused mortalities in chimpanzees in Tai Forest in Cote d’Ivoire15 following habituation for research. 49% of chimpanzee deaths documented during 47 yr of study at Gombe, Tanzania, were attributed to respiratory diseases.25 Other confirmed transmissions of potential pathogens from humans and
domestic animals to wild primates have been documented. For example, gorillas and chimpanzees in Uganda have recently been shown to be infected with human strains of bacteria. The unprecedented high levels of primate-human interactions through forest destruction, bush meat; illegal trade in infant apes is implicated in recorded emerging infectious diseases. The high levels of interactions between human and NHPs primates is even higher in established 20 Pan Africa Sanctuaries Alliance (PASA) sanctuaries in Africa with continuous high influx of orphaned/rescued primates at an average of 56 arrivals per year. PASA sanctuaries house a variety of primates with 15 sanctuaries caring for the endangered chimpanzees with population of more than 855 chimpanzees with numbers projected to increase to 1800 individuals in 20 yr. The primate orphans in sanctuaries are result of bush meat trade where adults are killed for meat and the surviving infants sold as pets and other commercial business, the majority of which are confiscated by relevant authorities and brought to sanctuaries. This presents different levels of primate-human interactions with potential risks of disease transmission. Disease management is not or not well addressed in sanctuaries often overshadowed by other ethical and welfare requirements of the rescued primates and other conservation roles. Hence the management of these sanctuaries presents a risk of disease transmission that exposes naïve population of primates to human pathogens and vice versa. The study was undertaken on chimpanzees on Ngamba Island to understand the dynamics of diseases transmission and highlight the role of sanctuaries in monitoring potential pathogens that may lead to emergence of infectious diseases and cross-species transmission of dangerous pathogens to humans.

Blood and fecal samples were taken from 42 captive wild-born chimpanzees on 43 hectares of forest on Ngamba Island on L. Victoria during the annual health checks under general anæsthesia. All samples were stored at –80°C until transported on dry ice to the Robert Koch Institut, Berlin, Germany for analysis.

Qualitative enzyme immunoassay kits were used for detection of antibodies against human T-lymphotropic virus types I and II (HTLV-I and HTLV-II) on 42 chimpanzee serum samples (Murex Biotech Limited, Central road, Temple hill Dartford DA1 5LR, UK) as previously shown to detect STLV-1 effectively in wild chimpanzees. SIV/HIV antibody detection was performed using Murex HIV-1.2.0 kit (Abbot Murex Boitech limited) and GENESCREEN HIV 1.2 version 2 (BIO-RAD) by enzyme immunoassay while Enzygnost Anti-HBc monoclonal (Dade Behring Marburg GmbH, Germany) was used for qualitative determination of antibodies to Hepatitis B (core)-Antigen in serum as per manufacturer’s instructions.

Single and Multiplex PCR were performed on extracted nucleic acids (DNA, RNA) extracted from chimpanzee blood and feces to indentify a number of viruses: Simian Foamy viruses, Herpesviruses, adenoviruses, Hepatitis Viruses (B,C, E), Flaviruses, Human-metapnuemovirus, and Chikungunya viruses. Established non-invasive methods were also used for analysis both genomic DNA and proviral RNA extracted from fecal samples of individual chimpanzees.
Our results revealed that the wild-born semi-captive chimpanzees screened in study were infected with multiple viruses including novel viruses in some individual chimpanzees. We report for the first time results of extensive study using both PCR and ELISA methods for detection of viral pathogens and antibodies from chimpanzees in sanctuaries in Africa with viral prevalence of 82.4%, 73%, 60.5% and 32.4% for adenoviruses, simian foamy viruses, gammaherpesviruses and hepatitis B virus respectively. The screened samples were negative for SIV/HIV, human T-lymphotropic virus types 1 and 2 (HTLV-1 and HTLV-2) antibodies and Hepatitis C virus (HCV), Hepatitis E Virus (HEV). Interestingly, all samples were negative for adenovirus on PCR from genomic DNA extracted from blood compared 82.4% positive on PCR performed on DNA extracted from fecal samples. For gammaherpesviruses, only three (3/21) were detected on DNA extracted from feces. For HBV, Mika was both infected on the analysis of genomic DNA from feces and blood. This confirms applicability of some non-invasive diagnostics/methods for the investigation of the viral pathogens in great apes. Statistical results using 1-sided Fisher’s exact test and Exact logistic regression did not reveal any effect/association of identified viral infections with age, sex and origin except for HBV (1-sided fishers exact analysis (P=0.004)) where HBV was more prevalent in adults than non-adults. There was also no link or effect of infection of one virus on another virus indentified in the same individuals. No evidence of SIV and STLV infections was found chimpanzees in contrast to other studied captive and wild chimpanzees mainly from central and west Africa in which these viruses are known to be enzootic. Hence it is surprising that all 42 wild-born chimpanzees of eastern P t. schweinfurthii, were negative for both SIV and STLV antibodies. This can probably explained by the fact that most of the apes in sanctuaries were taken out of the forests when they were still young, well protected by their mothers and most likely not have encountered any aggressions risky for transmission of these viruses. This may not be true with other sanctuaries and care needs to be taken to establish the status of all primates in sanctuaries. With the most recent findings that SIVczp, the immediate precursor of HIV-1, is pathogenic in free-ranging chimpanzees and identification of a new human immunodeficiency virus (HIV-I group P) in a Cameroonian woman closely related to SIVgor highlights the significance testing all rescued primates on arrival and presents new challenges to the management of sanctuaries. Our study reveals multiple viral infections in most of the individual chimpanzees screened with at least more than one virus including a novel herpes virus. This shows that chimpanzees and other apes harbor multiple viruses some of which are still unknown. This is exemplified by recent documentation many novel viral pathogens in primates: 2 novel gammaherpesvirus in captive primates; 10 betaherpesviruses in wild great apes; 30 adenoviruses from apes; 3 adenoviruses from macaques and a novel gammaherpesvirus in chimpanzee.

The documented viruses in chimpanzees in this study with zoonotic potential plus other already described viral pathogens in primates might be transmitted to humans given the current levels of interactions. Contact between the donor and receipt hosts is a precondition for virus transfer affected by geographic, ecological and behavioral factors. Trade in wildlife, bushmeat hunting, human population expansion, environmental factors like deforestation and agriculture expansion promote viral emergence and viral host switching from animals to humans and vice versa. Animal husbandry practices in sanctuaries are critical in this case to disease transmission as daily routine welfare brings about daily interactions with staff especially through feeding and
rehabilitation processes. In some sanctuaries like Ngamba, human interaction has extended to tourists through walking/carrying infant chimpanzees through the forest as part of rehabilitation, raising awareness and funding for the sanctuary. This promotes high level of interaction during rehabilitation of newly rescued infant apes and in other sanctuary cases with domesticated animals like dogs and cats. All these behavioral/management practices are being done by individuals without the knowledge of the potential risks of infectious disease acquisition and transfer between the animal and persons undertaking rehabilitation process.

Periodic health checks post quarantine should be undertaken preferably 2 to 3 yr and should include complete physical examination, body measurements, full blood count, kidney and liver functional tests, urinalysis, TB screening, screening for helminthes and protozoa and samples submitted to appropriate laboratories for screening major viral and bacterial pathogens of concern. The information generated from these examinations will help in performing disease risk analysis, management of group dynamics (re-socialization and integration) and planning for conservation programs like re-introductions. Likewise, all employees working in direct contact with primates should be vaccinated and monitored for infectious pathogens of zoonotic potential. The results from this study presents the first extensive study for viral pathogens carried by wild-born-captive chimpanzees within sanctuaries and provides baseline data for a wide range of diseases to be monitored in sanctuaries during the entire process of quarantine, routine management, re-introduction and post-reintroduction and by wild great ape health monitoring projects.

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LITERATURE CITED


ALVEOLAR ECHINOCOCCOsis IN LOWLAND GORILLAS: A THREAT FOR THE EUROPEAN CAPTIVE POPULATION?

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Abstract

Alveolar echinococcosis (AE) was diagnosed in seven lowland gorillas (Gorilla g. gorilla) originating from a Swiss zoo from 1999-2011. Four gorillas died of the disease.3 Three clinical cases were diagnosed using imaging techniques and serology.2,5 These asymptomatic individuals are continuously treated with albendazole (Valbazen 10%, Pfizer AG, CH-8052 Zurich Switzerland). No cases have occurred in the orangutans (Pongo pygmaeus), but one chimpanzee (Pan troglodytes) was tested serologically positive. All three species of the great apes are housed under similar conditions and direct contact to the main host of Echinococcus multilocularis in Europe, the red fox (Vulpes vulpes), can be excluded. The incubation period of the disease in humans is 5-15 yr and infection may also remain undetected in gorillas for years. It is assumed that food or other material which was brought into the enclosure was contaminated with fox feces and infected the gorillas. Possible sources were evaluated, but no specific cause was identified. Preventive sanitary measures for the preparation and storage of introduced food and materials including treatment with low heat may help reduce AE infections.4 It is hypothetized that lowland gorillas run an increased risk of becoming aberrant hosts and of developing AE as compared with other great ape species or humans. Rabies control programs have increased the red fox population in rural and urban areas in Central Europe and up to 50% of the red foxes are known to host Echinococcus multilocularis.1 Therefore, zoos in Europe that keep gorillas have to be aware of the disease and should take preventive actions.

LITERATURE CITED