Section 29

ARAV Therapeutics and Case Studies

Erica Giles, DVM;
Jeff Baier, DVM;
Thomas Torres, DVM;
Stacey Leonatti, DVM, DABVP
(Reptile & Amphibian)

Moderators
Leukemic Multicentric Lymphoma in a Green Tree Python (*Morelia viridis*) Treated with Prednisolone and L-Asparaginase

Emanuele Lubian, DVM, GPCert(ExAP),
Diana Binanti, DVM, PhD, Dipl ECVP,
Vincenzo Montinaro, DVM,
Massimo Millefanti, DVM

Session #165

*Affiliation:* From Ambulatorio veterinario, Via Galvani 42, Gaggiano, 20083, Italy (Lubian, Millefanti), AbLab veterinary diagnostic laboratory, Via Privata Massa Neri 13, Sarzana 19038, Italy (Binanti), Clinica veterinaria nervianese SRL, Via Lampugnani 3, Nerviano, 20014, Italy (Montinaro), Clinica Veterinaria Città di Vigevano, Viale dei Mille 22, Vigevano, 27029 Italy (Lubian).

*Abstract:* This case report describes a clinical approach, therapy, macroscopic and microscopic examination in a case of leukemic lymphoma with a primary thymic mass. The snake showed a swelling in the cardiac area. A diagnosis of lymphoma was made using ultrasound and cytologic examination. A complete blood count revealed high WBC count suggestive of leukemia. Therapy was planned with prednisolone (2 mg/kg IM q24h) and L-asparaginase (400 U/kg IM in single administration). Before and during therapy the dimension of the primary mass was measured every 4-7 days. After 1 month the snake showed a cloacal prolapse and a stomatitis, so treatment with enrofloxacin (10 mg/kg IM q24h) was started. After 2 months of therapy the animal died and the postmortem showed the presence of neoplastic cells in the kidneys, spleen, trachea, lung, esophagus, stomach, intestine, bone marrow, skin and skeletal muscle.

**Introduction**

In reptile practice, oncology represents a new field yet to be explored, although neoplasia is commonly encountered in these animals, with the highest prevalence in snakes. The present report describes a clinical approach, therapy, macroscopic and microscopic examination in a case of leukemic lymphoma with primary thymic mass.

**Case Report**

A 4-year-old, 620-g, captive bred, female green tree python (*Morelia viridis*) was examined for a swelling in the cardiac area. A diagnosis of lymphoma was made using ultrasound and cytologic examination of the mass. Blood cell count revealed high WBC count suggestive of leukemia. Therapy was planned with prednisolone (2 mg/kg IM q24h) and L-asparaginase (400 U/kg IM in single administration). Before and during therapy the dimension of the primary mass was measured every 4-7 days and it decreased a bit. After 1 month the snake showed a cloacal prolapse and a stomatitis, so treatment with enrofloxacin (10 mg/kg IM q24h) was started. After 2 months of therapy the animal died and the postmortem showed the presence of neoplastic cells in the kidneys, spleen, trachea, lung, esophagus, stomach, intestine, bone marrow, skin and skeletal muscle.
Neoplastic lesions are uncommon in snakes. Among them, lymphoma is the most commonly reported; however, description of possible therapeutic approaches are extremely rare in the veterinary literature. This is the first report of lymphoma in a green tree python (*Morelia viridis*) and the use of the drugs described in this case of lymphoma in a snake.

References


**Devriesea agamarum** Affects Endangered Lesser Antillean Iguanas (*Iguana delicatissima*)

Tom Hellebuyck, DVM, PhD, Dipl ECZM (Herpetology),
Karl Questel,
Frank Pasmans, DVM, PhD, Dipl ECZM (Herpetology),
Leen Van Brantegem, DVM, Dipl ECVP,
Pascal Philip,
An Martel, DVM, PhD, Dipl ECZM (Wildlife Population Health)

**Session #176**

*Affiliation:* From Department of Pathology, Bacteriology and Avian Diseases, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, B-9820 Merelbeke, Belgium (Hellebuyck, Pasmans, Van Brantegem, Martel) and Agence Territoriale de l’Environnement de Saint-Barthélemy, PO Box 683, Gustavia, Saint Barthélemy (Questel, Philip).

Since April 2011 dermatologic disease has been observed in free-ranging, endangered Lesser Antillean iguanas (*Iguana delicatissima*) on the French Caribbean island of Saint Barthélemy. Lesions mainly consist of multiple large cutaneous and subcutaneous abscesses. Cloacal and oral samples collected in 10 Anguilla bank ameivas (*Ameiva plei*), 5 Anguilla bank anoles (*Anolis gingivinus*), 16 *I. delicatissima* and one *I. delicatissima × green iguana* (*I. iguana*) hybrid were submitted for microbiologic culturing. In 8 out of the 16 sampled *I. delicatissima* dermal lesions were observed. From these iguanas swabs and full thickness skin biopsies were collected from the lesions for microbiologic and histopathologic examination. *Devriesea agamarum* was isolated from the skin lesions in all affected iguanas, the oral cavity of 1 affected iguana and the cloaca of 1 healthy iguana and 2 healthy anoles. The histologic features of the affected skin sites where identical to those previously described for *D. agamarum* associated dermatitis and abscesses in captive lizards. The results of this study provide strong evidence for a primary etiologic role of *D. agamarum* in the development of skin disease in free-ranging Lesser Antillean iguanas. Moreover, healthy lizards were identified as asymptomatic reservoirs. The emergence of *D. agamarum* in this population of *I. delicatissima* constitutes a new threat for this endangered lizard species and is the first description of a bacterial disease that poses a conservation threat towards free-ranging squamates.

**References**

Use of Voriconzole in Treatment of *Chrysosporium* spp. in a Bearded Dragon (*Pogona vitticeps*)

Rachel Williams, DVM

Session #038

Affiliation: From Webster Groves Animal Hospital, 8028 Big Bend Blvd, St. Louis, MO 63119, USA.

Abstract: Two female bearded dragons (*Pogona vitticeps*) were presented for dysecdysis. On examination, bearded dragon 1 had an epidermal lesion on the mandible and the other (bearded dragon 2) on the dorsum. The lesions comprised large areas of flaking scales with purulent debris underneath. Cytology revealed mixed inflammatory cells and possible fungal hyphae. When no improvement was seen with Enterderm topical ointment, swabs of the lesions were submitted for culture, and cloacal and lesional swabs were submitted for viral and *Chrysosporium* anamorph of *Nannizziopsis vriesii* (CANV) PCR testing (respectively). Bearded dragon 1 was positive for *Adenovirus* and negative for CANV. The culture showed mild growth of *Staphylococcus*, and potential *Trichophyton* spp. on the fungal culture. This dragon’s condition deteriorated and it was euthanatized. Bearded dragon 2 was negative for both *Adenovirus* and CANV. Its culture showed moderate to heavy growth of *Pseudomonas aeruginosa* and *Citrobacter*. Skin biopsy revealed fungal hyphae and structures reminiscent of arthrospores, considered consistent with CANV, or yellow fungus disease. Treatment with voriconazole was commenced at 10 mg/kg q24h and the dragon was deemed to be clinically normal after approximately 130 days.

CASE 1

An adult female bearded dragon (*Pogona vitticeps*) of unknown age, which was purchased from a pet store, was presented for evaluation of epidermal lesions on the mandible. The owner had noticed small skin lesions on the face at the time of purchase that started spreading approximately 6 months after purchase. The dragon was housed in a 4 × 2 × 2 foot wooden enclosure with a plexiglass front and a screen top. The enclosure also had a 150 watt UVB bulb (Exo terra Solar Glo Mercury Vapor) and a 125 watt infrared heat lamp (Westinghouse R40) used only in the winter or if the room temperature was below 21.1°C. The enclosure was maintained between 24-43°C during the day and 18°C at night. The diet consisted of primarily collard greens and various lettuces, blueberries, Dubia roaches with supplemental calcium powder and reptile vitamins.

The initial physical examination revealed necrosis and loss of some scales on the right side of the mandible with purulent discharge underneath. The dragon was determined to be underweight at the time. Cytology of the lesions revealed red blood cells, inflammatory cells, and probable fungal organisms (Figs 1 and 2). Topical Enterderm (nystatin-neomycin sulfate-thiostrepton-triamcinolone acetonide ointment, MWI, Boise, ID) was instituted once daily. The lesions did not respond to this course of treatment.

Figure 1. Cytology (image courtesy of Allen Weltig, DVM; 100x magnification).
The dragon, over approximately 5 weeks’ time, became progressively anorexic and the lesions spread to the ventral inguinal area and dorsal aspect of the left hind foot. In light of the progressive course of the lesions, cloacal swab PCR testing was sent out to Avian and Exotics Clinical Pathology Lab for *Adenovirus*, swabs of the lesions were sent for PCR CANV testing, as well as bacterial and fungal cultures of the mandibular lesion. Results of the adenovirus PCR were positive, the CANV DNA PCR was negative, and culture of the mandibular lesion showed moderate fungal growth that was described as probable *Trichophyton* species. The Gram’s stain of the lesion revealed 100% gram-positive cocci.

The dragon developed complete anorexia and diarrhea over the next week despite treatment with Entederm and syringe feeding with Carnivore Care (Oxbow Animal Health, Murdock, NE). The owner elected to humanely euthanatize her due to poor prognosis. Necropsy was not performed.

**CASE 2**

An adult female bearded dragon (*Pogona vitticeps*) of unknown age was purchased at the same time and from the same source as CASE 1. The dragon was housed in the same enclosure with bearded dragon 1, and fed the same diet. CASE 2 presented at the same time as CASE 1 for evaluation of a small dermal lesion affecting approximately 10% of the skin on the right side of her back. The dragon’s attitude and appetite were normal at the time and she weighed 450 g. Over the next 4-5 months, scale loss, darkening and crusting of the skin, and spreading of the lesion to approximately 50% of the right side of her back occurred. Purulent discharge was noted underneath the scales that remained (Fig 3). Cytology of the lesion revealed the same as Case 1, and topical Entederm once daily was instituted.

The lesion continued to worsen over the next 5 weeks, although the patient’s general demeanor and appetite remained the same. Cloacal swab PCR’s were submitted for *Adenovirus* testing, and swabs of the lesions were submitted for CANV DNA to Veterinary Molecular Diagnostics (Milford, OH), as well as bacterial and fungal cultures of the dorsal lesion to Avian and Exotics Clinical Pathology Laboratory. Both PCR tests were negative. The bacterial culture showed moderate-heavy growth of *Pseudomonas aeruginosa*, and moderate growth of *Citrobacter*. The fungal culture was negative. A Gram’s stain of the same lesion showed 90% gram-positive cocci, 1% gram-negative rods, and 9% gram-positive rods, and bacterial growth was listed as heavy by the laboratory.
Due to the progressive deteriorating nature of the lesion, lack of response to treatment, culture results and clinical suspicions, a skin biopsy under sedation was elected. (Fig 4) The dragon was sedated with a combination of intramuscular butorphanol, (Dolorex, Merck Animal Health, Summit, NJ) midazolam (Akorn, Inc., Lake Forest, IL), ketamine (Zetamine, MWI, Boise, ID) and dexmedetomidine (Zoetis, Kalamazoo, MI). A full thickness skin biopsy was taken and sent in formalin to Antech Clinical Pathology Laboratory (Irvine, CA). Results revealed fungal hyphae and structures reminiscent of arthrospores considered consistent with CANV, or yellow fungus disease.

In light of this finding, a treatment trial with voriconazole was commenced. The selection of voriconazole was based on a previous study in bearded dragons by Waeyenberghe et. al. In this study, voriconazole at 10 mg/kg had the most positive clinical outcome when compared with itraconazole. Two 200-milligram voriconazole tablets were obtained from online pharmacy Health Warehouse (healthwarehouse.com, Florence, KY) and compounded to 40 mg/ml in sugar syrup. Dosing regimen was instituted at 10 mg/kg orally q24h for approximately 50 days. The patient’s skin was looking clinically much improved at the end of this treatment regimen. Length of treatment was based on clinical response of the patient to the treatment and previously published clinical trials (Fig 5).

Approximately 14 days after the end of the course of treatment, a repeat full thickness skin biopsy was taken and sent in formalin to Antech laboratory. While initial histology results were negative for any presence of fungal organisms, the fungal staining showed a very low presence of fungal organisms consistent with CANV. Treatment with voriconazole was re-instituted for another 50 days at the same dose.

At approximately 15 days into the second course of treatment, it was noted that the lesion appeared to be darkening in color and it was feared that the disease was worsening (Fig 6). Eventually the entire lesion flaked off, revealing dry normal scales underneath. The treatment was discontinued at approximately 50 days, and the dragon was reexamined approximately 3 weeks after discontinuation of the treatment. At the time of examination, the skin was clinically normal (Fig 7), and further histopathology was declined by the client.
Discussion

*Chrysosporium* spp. are a large group of contagious fungal pathogens that are uncommonly implicated in cases of severe and life-threatening dermatitis in multiple orders of wild and captive of reptiles. The syndrome is commonly referred to as yellow fungus disease by bearded dragon breeders and fanciers. Lesions commonly start out as focal areas of crusting and scale loss and progress to more widespread deep, necrotic dermal lesions, that are commonly found on the face, inguinal region and digits (if present). Damage to the skin may eventually progress to infect the bone underneath, and thus can cause loss of digits, decreased appetite, or even decrease the animal’s ability to apprehend food due to osteomyelitis in the jaw. These symptoms can lead to progressive wasting and potential dissemination of the organisms to the internal organs, as well as potential septicemia from secondary bacterial infection.

Some unusual aspects of this case highlight potential pitfalls when testing for and diagnosing yellow fungus disease: CASE 1 testing positive for *Adenovirus* while CASE 2 was negative despite being housed in the same enclosure and being purchased from the same location. Potential reasons for a negative test in this case are error in sample collection or shipping of the sample, lab error, and variance in sensitivity and specificity of the test, or a true negative.

It is also unusual that both dragons were cloacal PCR-negative for CANV while being confirmed histologically for CANV (although not speciated). A potential reason for the negative result could be that the PCR was run for a species of *Chrysosporium* that was not the species that the patient had, thus delivering the negative result.
Recent research has reclassified what was once labeled CANV (or the cause of yellow fungus disease into many species-specific isolates of *Nannizziopsis*; *Paranannizziopsis* and *Ophidiomyces*, the bearded dragon isolate being labeled *Nannizziopsis guarroi*, although recent case reports have mentioned other species causing disease in bearded dragons. The dragon’s fungus in this report was not speciated, so it is not known which isolate caused the infection.

CASE 2 had a fungal-positive culture that was identified as a *Trichophyton*. *Chrysosporium* species can be difficult to identify from many other species of fungus as their conidia look similar to the microconidia produced by *Trichophyton* species. This may have caused the misidentification.

This case also highlights the need to confirm a clinical cure with histopathology. It was shown that a patient can look clinically normal and still have low numbers of fungal organisms.

Side effects of voriconazole in humans include visual disturbances (hallucinations), gastrointestinal issues, hepatic toxicity, fetal toxicity in pregnant women, and electrocardiac disturbances. Side effects seen in dogs include increased AST levels, liver enlargement, and significant impacts on other drugs that are metabolized by the liver. Side effects in cats include azotemia, anorexia, lethargy, weight loss, cutaneous drug reactions, hind limb paresis, ataxia, paraplegia, visual signs, arrhythmias, and hypokalemia. Elevations in AST have been reported in bearded dragons, pigeons, mice, rats, dogs and African grey parrots on voriconazole.

It is unclear whether specific side effects can be attributed to the treatment with CASE 2 of this report, except that the patient did not like being medicated, became more reclusive, with decreased frequency of basking. The owner at the time attributed this to the bearded dragon’s natural instincts to go into seasonal brumation as it was wintertime, and now has noticed a reversal of these behaviors as it is spring; however, we cannot rule out at this time that these observations were not side effect of the medication. There were no other observed clinical abnormalities.

*Chrysosporium* spp. is a large group of fungal pathogens of reptiles that can cause severe disease, and be clinically challenging and expensive to diagnose. Cheaper methods of diagnosis such as PCR may not be accurate, and may lead to a delay in proper diagnosis and initiation of treatment. Histopathology is currently the gold standard for diagnosis of this disease. Concurrent illnesses such as adenovirus may decrease prognosis, and diagnostic testing prior to beginning treatment is imperative to case selection.

**References**


Complete Edentulism in a Green Tree Python
(*Morelia viridis*)

Bradley J. Waffa, MSPH, DVM,
Drury Reavill, DVM, Dipl ABVP (Avian), Dipl ABVP (Reptile and Amphibian), Dipl ACVP,
Stephen L. Barten, DVM,
Scott Echols, DVM, Dipl ABVP (Avian)

Session #141

Affiliation: From Churchland Animal Clinic, 6030 High Street W, Portsmouth, VA 23703, USA (Waffa),
Zoo/Exotic Pathology Service, 6020 Rutland Drive #14, Carmichael, CA 95608, USA (Reavill), Vernon
Hills Animal Hospital, 1260 Butterfield Rd, Mundelein, IL 60060, USA (Barten), and the Medical Center
for Birds, 3805 Main Street, Oakley, CA 94561, USA (Echols).

A 5-year-old captive-bred female green tree python (*Morelia viridis*) was presented with a 2-week history of
inappetence and concern for respiratory disease due to audible respiratory sounds. Aerobic culture/sensitivity
of a tracheal wash sample revealed a *Pseudomonas* respiratory infection that was sensitive to and ultimately
responded to treatment with ceftazidime. It also was discovered in the course of the work-up that the snake had
lost its entire polyphyodont dentition with no other apparent oral pathology, a phenomenon that to the best of the
authors’ knowledge has not been previously reported in the literature. High-resolution images and bone-density
data generated using micro-CT were used on this case and compared with skulls from normal green tree python
heads. All the heads and representative tissues were evaluated histologically.
Microspordial Keratoconjunctivitis in a Bearded Dragon (*Pogona vitticeps*)

Anna Martel-Arquette, DVM, Sue Chen, DVM, Dipl ABVP (Avian), Julie Hempstead, DVM, Dipl ACVO, Rebecca Pacheco, DVM, Natalie Antinoff, DVM, Dipl ABVP (Avian), Leandro Teixeira DVM, MSc, Dipl ACVP

Session #200

Affiliation: Gulf Coast Veterinary Specialists, Houston, Texas, 77064, COPLOW - University of Wisconsin-Madison, Madison, WI 53706, USA.

Systemic microsporidiosis has been documented in bearded dragons.¹ However, to the authors’ knowledge, there is no case of isolated, primary ocular protozoal infection in bearded dragons in the literature, nor any cases of successful treatment of microsporidiosis in reptiles.¹⁻² A four-month old bearded dragon (*Pogona vitticeps*) presented with unilateral conjunctivitis that was not responsive to treatment with topical antibiotic therapy and oral and topical anti-inflammatories. Culture and sensitivity results indicated the presence of *Salmonella* species, which was sensitive to prescribed antibiotics. A biopsy of the conjunctival tissues was performed secondary to non-resolution of symptoms. Histopathology of the conjunctival tissue demonstrated Microsporidium (protozoal) organisms. Fenbendazole (50 mg/kg PO q24h for 5 days), systemic itraconazole (5 mg/kg PO q24h for 30 days), and topical itraconazole (1% ophthalmic ointment applied to left eye q24h until directed otherwise) was prescribed. The conjunctivitis continued to progress despite medical therapy and because of this, the eye was enucleated. Post enucleation, itraconazole was continued for an additional 3 months and fenbendazole was repeated (50 mg/kg PO q24h for 5 days, then q7days for 3 additional doses). Computed tomography was used to monitor tissues for potential central nervous tissue infection post enucleation. The patient remains asymptomatic 9 months post enucleation. This report documents the first successful treatment of microsporidiosis in a reptile. Microsporidiosis should be a differential diagnosis in keratoconjunctivitis cases that are not responsive to antibiotics.

References


Reproductive and urinary diseases are common presentations for captive chelonian species. Dystocia and urinary calculi are examples of such diseases that may develop from poor husbandry. Medical management may be possible for some cases, but surgical intervention often is unavoidable. The presence of the shell makes coelomic access difficult; however, there are multiple ways to access the reproductive and urinary organs. Endoscopic evaluation of the cloaca and urinary bladder via a cloacal approach is less traumatic, allows visualization of the bladder and therapeutic intervention in some situations. For larger calculi or egg removal, surgical approach either through the pre-femoral space or with a plastronotomy may be performed. The pre-femoral approach provides a limited amount of visualization and surgical access, compared to the plastronotomy, but is far less traumatic and requires shorter healing time.

This case of a radiated tortoise (*Astrochelys radiata*) provides examples of these techniques for a case of dystocia and complications. Use of both endoscopic and traditional surgical techniques used in conjunction can be useful in correction of egg binding. Both of these have risks and examples of such occurred in this case. Repeat endoscopy, after a pre-femoral correction of retro-pulsed eggs into the urinary bladder resulted in perforation of the bowel. Following a plastronotomy to address the perforation and perform an oophorectomy, a communication from urinary bladder to the plastronotomy site was diagnosed weeks later; however, in both cases they were identified and appropriately addressed, resulting in a positive outcome for the patient.
A female Hermann’s tortoise was presented with a deep lesion in the caudal part of the carapace. Myiasis and bacterial infection were found and treated. Several weeks after the therapy, increased subcarapacial tissue growth was detected. No pathological changes were found in blood analysis. Tissue samples were taken under general anesthesia and submitted for bacteriological, mycological and pathohistologic examination. A squamous cell carcinoma was diagnosed. Tumor growth increased rapidly after sampling. A CT scan was performed to assess the complete tumor size and to rule out metastases. Percutaneous radiotherapy was performed for seven weeks using a linear accelerator (LINAC). Each week, five consecutive days of treatment were followed by two days without radiation. 60 Gy have been applied via photons of the LINAC (6 MV) homogenously in the area of the carcinoma including parts of the carapace. The therapy stopped tissue growth successfully and led to drying and mild shrinking of the tumor, but did not result in complete remission. The animal tolerated the therapy well. Several months later, the tortoise was euthanized due to severe myiasis. This is the first description of the use of radiotherapy in squamous cell carcinoma in a tortoise. Although the therapy did not cure the animal, the observed effects and the good tolerance indicated that this treatment approach is promising. In future cases, surgical removal of tumor tissue before radiation may optimize the therapeutic effect.
Cloacal Prolapse, Colonic Adenocarcinoma, and Hypercalcemia in a Ball Python (*Python regius*)

Danielle K. Tarbert, DVM, Ricardo de Matos, LMV, MSc, Dipl ABVP (Avian), Dipl ECZM (Avian), Dipl ECZM (Small Mammal), Elizabeth Buckles, DVM, PhD, Dipl ACVP

Session #157

Affiliation: From the Department of Clinical Sciences, Section of Zoological Medicine (Tarbert, de Matos) and the Department of Biomedical Sciences, Section of Anatomical Pathology (Buckles), College of Veterinary Medicine, Cornell University, Ithaca, NY 14853, USA.

Abstract: An approximately 12-year-old male intact ball python (*Python regius*) was presented for a recurrent cloacal prolapse. The prolapsed tissue, determined to be colon, had significant necrosis and included a firm, thickened region. A resection and anastomosis of the colon was performed using an external approach. Ionized hypercalcemia was documented at the time of surgery. Histopathologic evaluation of the resected tissue revealed colonic adenocarcinoma. The snake recovered quickly and did well at home for at least 1 month. Colonic adenocarcinoma should be considered as a differential for cloacal prolapse in ball pythons, and evaluation for hypercalcemia of malignancy should be considered in ball pythons diagnosed with neoplasia.

Introduction

Cloacal prolapses in reptiles may involve the gastrointestinal tract, reproductive organs, or urinary bladder. Identification of the prolapsed organ as well as the inciting cause is essential for successful treatment. Prolapsed colonic tissue can be differentiated from the bladder, phallus (chelonians and crocodilians), or hemipenes (squamates) by the presence of a lumen. A prolapsed oviduct will also contain a lumen; however, in most cases the colon can be identified by the presence of fecal material, either passed directly through the lumen or aspirated through a catheter. Colonic prolapse is usually the result of tenesmus, with the most common causes including constipation, bacterial enteritis, and parasitic enteritis. Constipation associated with colonic adenocarcinoma has been reported in a corn snake (*Elaphe guttata guttata*), although prolapse did not occur in that case. This case report describes a colonic prolapse in a ball python (*Python regius*) secondary to colonic adenocarcinoma. Additional findings included hyperuricemia and hyperphosphatemia. Ionized hypercalcemia was present suggestive of hypercalcemia of malignancy. To the authors’ knowledge, this is the first report of colonic adenocarcinoma in this species, and the first report of colonic neoplasia as the primary etiology in a cloacal prolapse. Antemortem diagnosis and treatment of the adenocarcinoma is discussed, as well as considerations for future research into the mechanisms of calcium homeostasis in reptiles.

Case Report

An approximately 12-year-old male intact ball python (*P regius*) was presented for evaluation of a cloacal prolapse which had occurred within the previous 5 days. The snake had a history of a previous prolapse 1 year before which had resolved with manual reduction by a local veterinarian. The owner also reported gradual weight loss over the past year. The snake had last eaten 3 weeks prior to presentation.
Physical examination revealed thin body condition and dehydration. A 5-cm diameter spherical mass was observed protruding from the vent. The proximal aspect of the mass was pink and edematous; the distal aspect was covered in a gray layer of fibrinonecrotic tissue. A lumen was found within the tissue; upon examination, feces were found within the lumen resulting in identification of the prolapsed tissue as colonic in origin. A sexing probe was passed into the hemipenial lumen to the level of the 10th subcaudal scales, confirming the snake was male. Following administration of topical and systemic analgesics as well as antibiotics, the exposed tissue was lavaged and the necrotic cap debrided. Whole body radiographs were unremarkable. A fecal wet mount and direct smear showed no evidence of parasites. The snake was placed under general anesthesia for further evaluation of the prolapse. The dorsal aspect of the prolapsed colonic tissue was markedly thickened and firm. After further debridement of necrotic material, most of the prolapsed tissue was determined to be devitalized. An external resection and anastomosis was performed using previously described techniques. The resected tissue was submitted for histopathology.

Cardiocentesis was performed prior to recovery from anesthesia. Results of an in-house plasma chemistry panel revealed hyperphosphatemia (8.3 mg/dl, reference interval 1.4-7.3 mg/dl) and hyperuricemia (12.2 mg/dl, reference interval 0.8-8.3 mg/dl). Total calcium was 17.5 mg/dl (reference interval 10.4-19.3 mg/dl). Results of an ionized calcium measurement were 2.09 mmol/L. Packed cell volume was measured at 14% (reference interval 10.4-33.4%) with a total solids of 5.4 g/dl (reference interval 3.6-9.0 g/dl).

The python recovered well from anesthesia and was discharged the following day with prescriptions for subcutaneous fluids, anti-inflammatories, and antibiotics pending biopsy results. Histopathology revealed a transmural colonic adenocarcinoma in addition to necrosis of the mucosa with heterophilic colitis and fibrin thrombi. The neoplastic cells extended to the borders of the examined issues. The snake did well at home with good appetite and no further prolapses for at least one month before being lost to follow-up.

In the case described in this report, the identity of the prolapsed structure was readily determined based on the species, sex of the patient, and examination of the tissue. As all snakes lack a bladder, the tissue was immediately known to be either reproductive or colonic in origin. Confirmation of male sex via probe eliminated prolapsed oviduct as the source of the tissue, while the presence of fecal material confirmed the structure to be colon. Two common causes of colonic prolapse, constipation and intestinal parasitism, were ruled down based on results of the radiographs and fecal analysis. The unremarkable initial diagnostics and firm texture of the prolapsed tissue prompted submission for histopathology.

In acute cases of colonic prolapse, the tissue can be manually reduced and held in place with cloacal sutures until the underlying cause of the prolapse is resolved. However, if the venous return from the tissue is compromised, the resulting edema may make the prolapse difficult to reduce. A coeliotomy may be required in order to apply sufficient traction to the prolapse; with this method, a colopexy can be performed concurrently. In cases where the prolapsed colon becomes devitalized, resection and anastomosis is required. Although this can be performed via coeliotomy, an alternative external approach has been described. This approach utilizes a stent (such as a plastic syringe case) to hold the lumen of the colon open while mattress sutures are placed circumferentially in healthy tissue. The colonic tissue is then transected distal to the sutures, creating an inverting end-to-end intestinal anastomosis. In this case, the duration of the prolapse (up to 5 days) in addition to the presence of neoplastic tissue likely contributed to the edema and necrosis. The external approach to resection and anastomosis allowed rapid surgical resolution without opening the coelomic cavity.

Colonic adenocarcinomas have been reported in several colubrids as well as in a Burmese python (Python bivittatus). To the authors’ knowledge, this is the first report of a colonic adenocarcinoma in a ball python.
In previous reports of snakes with colonic adenocarcinomas, no evidence of metastasis was found.\textsuperscript{5-6} However, metastatic disease from other enteric adenocarcinomas has been reported, such as from an intestinal papillary adenocarcinoma in an emerald tree boa \textit{(Corallus caninus)}.\textsuperscript{7} Although signs of metastasis were not seen on radiographs in the present case, metastatic lesions may be present in organs whose parenchyma is not well evaluated on plain film radiographs, such as within the liver, kidneys, or coelomic wall.\textsuperscript{7} Additional diagnostic modalities such as ultrasonography, computed tomography, or endoscopy should be considered in monitoring for metastasis in snakes.

A recent study evaluating the effects of ultraviolet light on calcium metabolism in ball pythons generated an ionized calcium reference interval of 1.67-1.94 mmol/L.\textsuperscript{8} The ionized calcium level of 2.09 mmol/L in the ball python described in this report was therefore considered elevated, with the total calcium at the high end of the reference interval. Although total calcium levels in reptiles are known to vary with physiologic status, ionized calcium levels should be consistent.\textsuperscript{9} Furthermore, most elevations in total calcium are associated with vitellogenesis in females.\textsuperscript{9} Differentials for hypercalcemia in a male snake include vitamin \(D\) toxicosis, renal disease, primary hyperparathyroidism, pseudohyperparathyroidism (hypercalcemia of malignancy), and osteolytic bone disease.\textsuperscript{9} Vitamin \(D\) toxicosis and osteolysis were ruled down in this snake based on history and radiographs, respectively. Primary hyperparathyroidism was ruled down based on the concurrent hyperphosphatemia.\textsuperscript{10} Renal disease may have been present in this case based on the hyperuricemia and hyperphosphatemia; however, in domestic species, renal disease is more commonly associated with low to normal ionized calcium values.\textsuperscript{10} The elevated renal values may also have been associated with dehydration, post-renal obstruction from the prolapse, or injury from circulating calcium levels.\textsuperscript{10} Although to the authors' knowledge hypercalcemia of malignancy has never been confirmed in a reptile, it was considered the most likely etiology of the hypercalcemia in this case.

Measurement of parathyroid hormone and parathyroid hormone-related protein can be utilized to definitively diagnose hypercalcemia of malignancy.\textsuperscript{10} The previously available two-site immunoradiometric assay for measurement of parathyroid hormone was not useful in reptiles; however, new technology has recently become available.\textsuperscript{10} Further studies are warranted to evaluate and, if possible, validate the use of commercially available parathyroid hormone assays in reptiles. This will allow more accurate diagnosis and monitoring of neoplastic and renal diseases as well as other diseases common in captive reptiles such as nutritional secondary hyperparathyroidism.

\textit{Disclosure Statement}: The authors have no conflicts of interest to disclose.

\textbf{References}


