REPTILE MEDICINE – COMMON DISEASES IN COMMON SPECIES

Christoph Mans, Dr. med, vet., MBA, Dipl. ACZM

University of Wisconsin-Madison, School of Veterinary Medicine
2015 Linden Drive, Madison, WI 53706, USA
christoph.mans@wisc.edu

HYPOVITAMINOSIS A

Hypovitaminosis A is a common disorder of semiaquatic turtles, such as red-eared sliders, as well as North American box turtles (*Terrapene* spp.) and insectivorous reptiles such as chameleons and geckos. Replacement of normal cuboidal or columnar epithelial cells (e.g. mucosa, gland ducts) with stratified keratinizing epithelium, which is replaced in increased frequency is the hallmark feature of hypovitaminosis A in reptiles as well as other animals. The occurring multifocal squamous metaplasia and hyperkeratosis of the epithelium of many organs will lead to clinical disease. The continued desquamation of cells leads to the accumulation of desquamated debris and predisposes to secondary infections or the periocular tissue, upper respiratory tract, and oral cavity.

Clinical Signs

Clinical signs attributed to hypovitaminosis A can be unspecific such as reduced growth, lethargy, anorexia, and upper respiratory infections. In semiaquatic turtles, such as red-eared sliders the most common and characteristic signs of hypovitaminosis A, are blepharedema, conjunctivitis, and in chronic cases accumulation of desquamated debris within the conjunctival sacs. Often these periocular lesions are bilateral, and the resultant loss of vision will lead to anorexia. The swelling and closure of the eyelids in particular in turtles and chameleons with vitamin A deficiency occurs secondary to metaplasia and expansion of the anteromedial Harderian gland as well as the posterolateral lacrimal gland. Due to the swelling of the glands, the eyelids cannot be opened properly, and together with increased desquamation, this will lead to the accumulation of debris in the conjunctival sac. Secondary bacterial infections are common, and it is important to identify and correct the primary underlying hypovitaminosis A to resolve the secondary infection. Oral lesions such as ulcerations and plaque formation of the tongue and buccal mucosa, as well as stomatitis and glossitis, have also been linked to insufficient dietary vitamin A intake. In panther chameleons clinical signs associated with a diet low in vitamin A included periocular edema, ocular discharge, swelling of the lips and gular region as well as tail tip necrosis, reduced reproduction, and skeletal abnormalities (i.e. vertebral kinking).

While it has been proposed that the squamous metaplasia of the Eustachian tubes and tympanic membrane due to vitamin A deficiency leads to aural abscesses in turtles, there is currently no evidence to support this assumption. Aural abscesses are likely multifactorial, and the influence of environmental factors is yet to be fully described.

Dysecdysis and hemipenile impactions have also been associated with hypovitaminosis A but are rarely the sole clinical sign of this deficiency.
In severe cases of vitamin A deficiency multifocal metaplasia of the epithelium and subsequent blockage with desquamated debris of the internal organs, such as kidneys, ureters, and pancreas, can lead to systemic disease and organ failure.

Diagnosis
The dietary history and clinical signs are often sufficient to establish the diagnosis of hypovitaminosis A in reptiles. Confirming this diagnosis can be challenging and therefore often response to treatment with beta-carotenes or vitamin A is used to confirm the diagnosis in most captive reptiles. The liver is the major storage site of Vitamin A and liver biopsies can be used to determine the hepatic vitamin A levels. Hepatic vitamin A levels for carnivorous reptiles, such as monitor lizards and snakes have been reported to be greater than 1000 IU/g but can be much lower in herbivorous reptiles such as *Testudo hermanni* (10-80 IU/g). Plasma retinol levels have been investigated in reptiles for the purpose of diagnosing vitamin A deficiency. However, differences between plasma retinol levels between genders as well as differences in methodologies of measurement and reported units can make interpretation of plasma retinol levels challenging.

Treatment
Hypovitaminosis A is virtually impossible to develop in herbivorous reptiles, unless anorexic for several months, which would lead to depletion of the liver vitamin A stores. Therefore, the diagnosis of hypovitaminosis A in herbivorous reptiles should be made very cautiously, and parenteral or oral administration of retinols avoided. In particular in tortoises, administration of retinol should be avoided, due to the high risk of intoxication. Instead increasing dietary carotenoids should be considered.
For omnivorous, carnivorous, and insectivorous reptiles' dosage recommendations for vitamin A have been made largely based on extrapolation and anecdotal reports.
500-5000 IU/kg IM every 7-14 days for up to 4 treatments have been recommended. Oversupplementation with vitamin A can occur regardless of the route of administration and therefore oral administration does not provide a safer alternative.
Secondary infection should be treated accordingly. Accumulated debris in the conjunctival sacs should be removed under sedation.

Prevention
Omnivorous or carnivorous reptiles should be fed whole prey (e.g. mice, fish) or should be fed a commercial balanced diet (e.g. aquatic turtle pellets). Feeding muscle meat or removing the internal organs of prey should be avoided since the liver is the primary storage site for retinols in the body. Invertebrates contain only low amounts of vitamin A. Therefore, they should be gut-loaded. Offering diets high in carotenes will significantly increase the carotene content of the cricket. However, if the provided carotenes can be converted by insectivorous reptiles into biologically active vitamin A, remains unknown.
Herbivorous reptiles being fed a plant-based diet, are very unlikely to become vitamin A deficient, since plants contain high amounts of carotenoids and herbivorous reptiles can absorb and convert carotenoids into biologically active vitamin A.

DEHYDRATION

Dehydration in reptiles is often correlated with incorrect husbandry, particularly low humidity, and lack of a temperature gradient in the enclosure. Further species that require a moving water source, such as the chameleon, are prone to dehydration if husbandry is incorrect. Variations in water needs occur with variations in natural history, i.e. desert species versus tropical species. Many reptiles require supplemental soaking in captivity. Some will soak voluntarily in their habitat while others will require forced soaking by the owner.

Clinical signs

Signs of mild dehydration are subtle until the animal becomes more dehydrated. Improper ecdysis may be seen. Moderate to severely dehydrated animals are often depressed with sunken eyes, and are anorexic, further contributing to their dehydrated state.

Diagnosis

Diagnosis of dehydration is based on clinical signs. Most anorectic or chronically diseased reptiles can be assumed to be dehydrated. Skin fold testing may be reliable in lizards and snakes. Sunken eyes can also occur in cachexic reptiles and do not necessarily represent dehydration. Plasma electrolytes and uric acid and urea nitrogen might be helpful in the diagnosis of dehydration of reptiles but should be interpreted in conjunction with the clinical findings.

Treatment

To rehydrate, fluids can be given orally in mild cases but usually for initial rehydration the subcutaneous route is recommended. If dehydration is severe, then intraosseous, intravenous, or intracoelomic fluid administration should be performed. The recommended daily maintenance fluid requirements for most reptiles are 10 to 30 ml/kg. Fluids should be warmed to the specific preferred optimal temperature for each reptile patient.

Contrary to common believe and historical recommendations reptile plasma osmolality is similar or higher to that of mammalian or human plasma. Therefore the recommendation to dilute commercial balanced electrolyte solutions, to avoid administration of hypertonic solution, because of the presumed lower osmolality of reptiles intercellular fluid, is unnecessary. All reptile species investigated have similar or higher plasma osmolality compared to humans, dogs, and cats.

Plasma osmolality in bearded dragons is 295 ±9.35 mOsm/kg and 327 ± 3.3 mOsml/kg in green iguanas. In corn snakes *(Pantherophis guttatus)* mean plasma osmolality was higher with 344.5 mmol/L (304.5 to 373.0 mOsm/kg). Therefore commercially available balanced electrolyte solution (e.g. lactated Ringer's solution (272 mOsml/L), Normosol-R® (295 mOsm/L) Plasmalyte-A® (294 mOsm/L)) are suitable for most cases. It needs to be considered that dehydration can lead to increase in plasma osmolality and therefore reference values established in healthy and hydrated reptiles should be used cautiously.

Soaking is also an effective method of treating dehydrated reptiles, in particular for cases of mild dehydration of if not hospitalized for parenteral fluid therapy. Care should be taken

to avoid drowning in debilitated animals. Therefore, water levels should be shallow and supervision should be provided.

Prevention
Provide adequate temperature gradients within the enclosure and a day-night temperature fluctuation, as appropriate for the species. Ensure appropriate humidity and access to water, depending on the species, and consider regular soaking.

OBESITY

Obesity is a concern in captive reptiles when energy intake is greater than energy requirements. Free access to food can cause overconsumption with a lack of expenditure of energy. Further food items high in fat will promote obesity. In general larva forms of insects contain significantly more fat than adults (e.g. worms vs. beetles). For example, beetles of superworm *(Zophobas morio)* and mealworm *(Tenebrio molitor)* contain more protein and ½ to 1/3 the fat content as the larva of the same species, while having similar mineral contents. In contrast, earlier stages (nymphs) of cockroaches as well as crickets usually are higher in protein and lower in fat compared to larger (older) animals.
Lack of hibernation in captivity has been proposed as a cause of obesity in some captive reptiles.

Clinical signs
Excessive intracoelomic fat storage may lead to coelomic distension. This should be differentiated from disease processes such as ascites or tympany or from physiological hyperinflation of the lungs and air sacs in certain lizard species, during handling. Fat stores in reptiles as in other animals can be subcutaneous, intracoelomic and parenchymal. Obese reptiles often have increased fat over the vertebral column and certain gecko species store fat in their tail (e.g. leopard geckos). Fatty infiltration of parenchymal organs, such as the liver may occur (i.e. hepatic lipidosis).

Treatment and Prevention
Given the influence of the environment on metabolic rates, feeding the correct amount without the correct preferred optimal temperature zone or overfeeding. Significant variation in metabolic rate is seen with changes in reproductive status, body mass, seasonal cycles, light cycles, diet, and many other factors. Essentially very little is known about real-life needs for a given species in captivity and weights should be monitored closely at home to ensure correct feeding amounts as well as for weight loss as a sign of disease processes. Small enclosures with a sedentary lifestyle exacerbate the problem.
Just as for any species, remedying the problem requires both a dietary change and increasing exercise. Carnivores should be fed very lean prey. Herbivores should have an increase in dietary fiber. A thorough work-up to rule out concurrent health problems before attempting weight loss is recommended.

ANOREXIA AND CACHEXIA

Anorexia leading to starvation and cachexia can be due to a variety of causes, in particular incorrect husbandry should be considered. Inappropriate food items, stress (e.g. due to overcrowding, frequent handling, lack of hiding places) and inappropriate environmental temperatures are common environmental causes for anorexia in captive reptiles. Many female gravid reptiles will show physiological temporary anorexia. Reduced food and consequently caloric intake will lead to a loss of muscle and fat tissue and will lead to dehydration unless water intake is maintained. Mobilization of body fat can lead to increased accumulation of fat within the hepatocytes, leading to hepatic lipidosis, which may further contribute to anorexia.

Clinical signs

Anorexic reptiles may present without any clinical abnormalities, but with prolonged anorexia and/or underlying disease processes loss of muscle and body fat is evident, by prominent vertebral processes and iliac crests. The eyes may be sunken in cachexic lizards and chelonians. Frequently dehydration can be noted on physical exam. Depending on the underlying cause affected reptiles can be bright and alert or lethargic and depressed.

Diagnosis

A thorough review of the husbandry and diet is critical, because of the common occurrence of environmental causes leading to anorexia and cachexia in reptiles. Ruling out infectious and non-infectious causes should be performed as appropriate for the species. Clinical pathology and diagnostic imaging should be utilized to establish a diagnosis if an environmental cause has been ruled out. Assessment of the liver by computed tomography, ultrasonography or laparoscopy, and tissue biopsy should be considered, to rule out hepatic lipidosis.

Treatment

Dehydration, which is present in most anorexic and cachexic reptiles, should be corrected before initiation of nutritional support. Providing general guidelines for nutritional support of anorexic and cachexic reptiles is challenging, due to the diversity amongst common captive reptiles and caloric requirements depend on age and underlying disease processes.

Enteral feeding of anorexic reptiles can be accomplished by orogastric gavage using ball-tipped catheters or flexible feeding tubes. Single or repeated feedings can be performed in most lizards and snakes using orogastric gavage and manual restraint. In chelonians, in particular tortoises, proper restraint for orogastric gavage might be challenging without sedation and repeated restraint and gavage are likely stressful. Therefore, the placement of an esophageal feeding tube should strongly be considered to allow the administration of nutrients, but also medications via the enteral route. Volume recommendations for orogastric administration of enteral feeding formulas range between 2-10% of body weight. The energy density of fiber content of the used formula will affect the amount being administered. It is recommended to initially administer smaller amounts of feeding formula, and monitor for fecal output, before administering larger amounts of feeding

formula. A variety of enteral feeding formulas are available for veterinary use and should be chosen based on the reptile species dietary requirements. Overfeeding of starved reptiles can lead to a condition called refeeding syndrome, which is characterized by life-threatening hypokalemia and hypophosphatemia. Therefore Too rapid increase in amount of food provided to starved reptiles should be avoided and plasma electrolyte, phosphorus and glucose levels should be monitored.

SOFT FECES AND DIARRHEA

Fecal consistency varies physiologically between reptile species and is mainly dependent on their diet. It is therefore important to be aware of the species-specific normal fecal consistency, to avoid misinterpretation of normal fecal consistency as diarrhea. Soft feces or diarrhea is common in particular in herbivore reptiles being fed an inappropriate diet low in fiber and/or high in fermentable simple carbohydrates. Malnutrition, large numbers of easily digestible carbohydrates, such as fruits in herbivorous species, may lead to diarrhea and tympany. Environmental factors such as low temperatures lead to decreased GI motility and disturbances. Endoparasites are a very common associated. Other infectious causes which are much less common in captive reptiles include viral, fungal, and bacterial etiologies.

Clinical Signs

Herbivorous reptiles with diarrhea due to an inappropriate diet might show no other clinical signs or may show unspecific clinical signs such as lethargy, reduced food intake or dehydration. Tympany and other gastrointestinal disorders might be present.

Diagnosis

The diagnosis in most cases can be made based on a thorough review of the husbandry and in particular diet. Physical examination and fecal parasitology (direct fecal wet mount, fecal flotation) should be performed to rule out non-dietary causes of diarrhea. Diagnostic imaging, clinical pathology and endoscopy of the gastrointestinal tract should be considered if deemed appropriate to rule out non-dietary causes.

Treatment and Prevention

Treatment of diarrhea in reptiles is dependent on the underlying cause. High numbers of endoparasites should be treated, even though they might not be the primary cause. Dehydration and environmental problems, such as inadequate husbandry need to be corrected. Appropriate amounts of fiber should be fed, and fermentable sugars contained in fruits should be avoided, unless appropriate for the reptile species.

CONSTIPATION

The causes of irregular defecation, fecal retention, and constipation are a multitude. Lack of fiber, or inadequate exercise is common causes of constipation. Chronic dehydration due to inappropriate environmental temperature (lack of temperature gradient, lack of

day:night temperature difference), insufficient or inappropriate water sources, low humidity, long-haired prey, hard-shelled insect prey, or ingestion of indigestible substrates such as sand, gravel, or bark have been reported. Metabolic causes such as hypocalcemia should be considered. Differentials for constipation unrelated to diet or husbandry, should include chronic systemic disease (e.g. kidney disease, anemia) and intestinal neoplasia. Extramural causes include kidney enlargement due to nephritis in lizards, uroliths, cloacoliths, neoplasia, abscesses, narrowed pelvic canal in lizards and chelonians due to healed fractures or reproductive disease, and the presence of eggs.

Clinical signs

Lack or reduction of fecal output with or without straining is common in reptiles suffering from constipation. Depending on the severity of constipation, anorexia, dehydration, and lethargy may be noted. Coelomic palpation in lizards and snakes may reveal excessive amounts of ingesta and fecal material in the large intestine.

Diagnosis

Radiographs or computed tomography are usually diagnostic. Contrast radiography can be used to rule out obstructive conditions. Plasma biochemistry will help to rule out metabolic causes (see NSHP).

Treatment and Prevention

The primary focus of therapy should be to correct the identified underlying cause, such as insufficient fiber content or too low environmental temperatures. Correct dehydration, optimize humidity and environmental temperatures, correct metabolic causes, increase fiber content in the diet of herbivorous or omnivorous reptiles and increase enclosure to provide more exercise. Enteral fluid therapy is considered the most effective method for the relief of constipation, by rehydrating fecal material and ingesta and promoting gastrointestinal motility. Lizards and snakes can be administered fluids via gastric gavage. However, in chelonians, particularly tortoises, repeated administration of fluids via stomach gavage is stressful and labor extensive. Instead consider the placement of an esophageal feeding tube, to allow easy and repeated enteral fluid and drug administration.

Enemas or cloacal washes are very effective ways to relieve rectal constipation and should be considered particularly in lizards. Use warmed tap water and a red rubber catheter or ball-tipped gavage needle. The risk of entering the urinary bladder, instead of the rectum is high in lizards, which have a functional bladder. However, bearded dragons do not have a functional bladder, and therefore enemas are very effective. Great care should be taken to avoid iatrogenic damage and careful placement of the tube or catheter after lubrication should be performed. Daily soaking in warm tap water may also aid in rehydration and promote defecation in many reptiles.

Medical therapy has been suggested for the treatment of constipation of reptiles should be considered if enteral fluid therapy and correction of environmental causes have not resolved constipation or it has reoccurred. Psyllium is an indigestive fiber and acts as a bulk laxative. Sufficient hydration and water intake should be ensured before administration. Prevention of constipation should focus on appropriate diet and husbandry.

PERIODONTAL AND DENTAL DISEASE

Periodontal and dental disease is predominately encountered in agamids (e.g. bearded dragons, uromastyx) and chameleons. Periodontal disease is an umbrella term for various disorders including gingivitis, gingival recession, periodontitis, and periodontal abscesses as well as osteomyelitis of the associated mandibular and maxillary bones.

Agamids and chameleons have acrodont teeth, which is unique amongst reptiles. Acrodont teeth consist of only dentin and are directly ankylosed to the crests (biting edge) of the maxilla and mandibular bone. Acrodont teeth are not replaced throughout life or after loss, like in other reptiles. Therefore progressive wear with age will occur. An exception in the dentition of agamids and chameleons are the teeth on the rostral tip of the upper and lower jaw which are pleurodont. Almost all other lizards have pleurodont teeth, which arise from the lingual aspects of the mandibles and maxilla the gingiva closely connects to the teeth.

The gingival attachment is markedly different between lizards with acrodont teeth compared to lizards with pleurodont teeth, providing a possible explanation for why periodontal disease is much more common in lizards with acrodont dentition. In reptiles with acrodont teeth, the gingiva is attached laterally directly to the bone of the upper and lower jaw and the gingival margins do not reach the maxillary and mandibular crests, leading to exposure of mandibular and maxillary bone surface.

The etiology of periodontal disease in reptiles is not known but is presumed to be related predominately to diet and possibly to age. Formation of bacteria plaque supragingival as well as subgingival is promoted by lack of abrasive diet in captivity. Bacteria plaque formation promotes gingival inflammation and recession. Fungal periodontal osteomyelitis has been associated with periodontal disease in chameleons and bearded dragons. Therefore, careful exploration of any bone involvement and rule out of a fungal infection, by cytology or histopathology is critical to avoid treatment failures.

Periodontal disease may be subclinical and is frequently diagnosed in clinically normal animals during physical examinations. Intraoral findings can include gingival erythema, consistent with gingivitis, which often progresses to focal or generalized gingival recession, resulting in abnormal exposure of mandibular bone. Further dental calculus accumulation, gingival hyperplasia, purulent discharge from gingival pockets, and infection of the periodontal bones are frequently seen. The diagnostic workup includes careful exploration of any gingival pockets or bone lesions under sedation or general anesthesia, dental radiography, and collection of diagnostic samples for cytology and/or histopathology. Aerobic bacterial culture should be interpreted cautiously as the normal oral flora of many reptiles can harbor opportunistic pathogens, and periodontal disease is usually caused by the normal oral and periodontal microflora. The prognosis for periodontal disease, particularly with associated osteomyelitis is guarded to poor, and aggressive treatment measures are usually required.

Treatment should include the supra- and subgingival removal dental calculus, which should be repeated prophylactically every 6-12 months once periodontal disease has been established. Periodontal pockets should be debrided and lavaged. Infected bone should be debrided and resected if possible. Antibiotic selection should consider the high likelihood of anaerobic bacteria involved in periodontal infections. 3rd generation

cephalosporins (i.e. ceftazidime) are most commonly used. Topical repeated (q24-72h) application of 0.2% chlorhexidine solution is recommended to reduce the recurrence of bacterial plaque formation, and this topical treatment can be performed by reptile clients using cotton-tipped applicators. For the treatment of fungal periodontal osteomyelitis azole compounds (e.g. voriconazole) and terbinafine have been successfully used by the author, but multi-drug resistant fungal isolates have been reported in bearded dragons with oral osteomyelitis and therefore antifungal susceptibility testing should be considered. Pulse therapy should be considered to minimize possible side effects due to antifungal drug use. Treatment duration of periodontal osteomyelitis is often extensive, and recurrence or persistence of infection is not uncommon. Frequent recheck examinations and repeated therapy are necessary in most cases of periodontal disease of agamids and chameleons.