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Metabolic Bone Disease

Metabolic Bone Disease (MBD) is a disease that plagues various ages of adult herbivores and insectivores and nearly all juveniles (herbivore, insectivore, and carnivore). MBD has many different names that mean slightly different things. MBD itself refers to any problem that causes bone weakening. Nutritional secondary hyperparathyroidism (NSHP), rickets, fibrous osteodystrophy (FOD) are commonly used as synonyms for MBD when each points toward a specific cause of MBD. Many things induce MBD, including calcium and/or vitamin D3 deficient diets, high phosphorus diets, lack of exposure to ultraviolet light, and kidney disease.

A brief discussion of reptile calcium metabolism is necessary to understand this complex disease. Calcium is necessary for mineralization of the skeleton, muscle contraction, stabilizing the nerves from uncontrollable firing, and for the clotting cascade (forming normal blood clots). Blood calcium is maintained relatively constant by the interplay of calcium intake and absorption from the intestines and lysis of the bone when intake is inadequate or unbalanced with phosphorus. When blood calcium is low, tetanic seizures will occur to some degree. These small seizures will occur until the parathyroid gland senses the low calcium and secretes parathyroid hormone (PTH). PTH acts on the bone (causes bone destruction) to free up bound calcium. When the calcium is released by the bone into the blood, the tetanic seizures stops at least until the new calcium is utilized.

When the parathyroid gland is constantly stimulated to produce its hormone, MBD results from Nutritional Secondary Hyperparathyroidism (NSHP). The parathyroid gland is also stimulated when dietary phosphorus is relatively high with respect to the calcium (this is what happens when feeding herbivores a carnivore diet, carnivores calcium deficient diets, and having kidney disease). A ratio of calcium to phosphorus between 1.5:1 to 2:1 is the ideal maintenance ratio. Chronic NSHP results in Fibrous Osteodystrophy (FOD) where strong bones are gradually replaced by fibrous connective tissue (cartilage). Low blood calcium (hypocalcemia) may also be caused from lack of vitamin D3 induced by lack of exposure to unfiltered ultraviolet UV rays or lack of dietary supplementation with this vitamin.

MBD manifests itself by many clinical signs ranging from lethargy, anorexia, paresis to paralysis (rear legs affected from fracture of lower back or a spinal chord swelling), fine intention tremors of the muscles (noticed in no weight-bearing phalanges first), pathologic fractures of any bone, fibrous osteo-dystrophy (cartilaginous tissue replacing bone), soft facial bones (particularly the lower jaw), intestinal prolapse, renal disease, to full-blown tetanic seizures. MBD has multi-factorial causes and is not simply a lack of calcium in the diet. Prevention of MBD depends on the owner's expertise and knowledge of the specific reptile interplaying with the individual behavioral idiosyncrasies of the reptile's feeding and sunbathing



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habits. Good common sense and compassionate forethought on the owner's behalf will prevent the disease.

Here is a quick summary of nutritional aspects of a healthy, captive Green Iguana (MBD's poster child) diet. Herbivores need high quality plant material. Green leafy vegetables such as kale, collard greens, mustard greens, turnip greens, dandelion greens fit this category. Please note that none of these staples end in lettuce. Head lettuce is particularly bad for young herbivores due to its high water content and overall low nutritive value. No growing herbivore needs to be put on a diet. Do not feed head lettuce to your reptile. Small amounts of a mixed assortment of carrots, peas, green beans, corn, squash, etc. can also be added to the diet, but are not as important and should not replace the greens. A small amount of this should be fed to your reptile (less than 30% by weight). Flowers can be added to spice up the diet. Hibiscus flowers and leaves seem to be enjoyed particularly.

Carnivorous reptiles also need special dietary attention.

Small snakes and various insectivores require special dietary attention as they commonly suffer from MBD related to calcium deficient food consumption. Pinky mice and improperly fed insect prey (cricket, mealworms, etc.) are nearly always calcium deficient. When a diet of these prey items is not supplemented properly, it results in stunting and clinical MBD. Insects should be gut loaded with dog food and vegetables when fed to insectivores. Powdered supplements can be used to coat the insects using the "shake and bake" method in a baggie. Pinkie mice should be allowed to nurse for 3 days before being pulled for prey items in order to obtain better calcium to phosphorus ratio.

The important aspect of nutrition that many reptile owners overlook is not about the food that is offered. Most owners have obtained that information by minimal pre-purchase reading on basic husbandry and nutrition (the owners who don't have the message have not looked). It is about the quantity of food offered, and which foods are actually eaten. If reptiles are fed so much vegetables, fruits, flowers, etc., that they cannot eat the entire amount, they will often only eat their favorite foods. If these foods are nutritionally incorrect (too much phosphorus, too little calcium), gradual weakening of the bones will take place.

In young iguanas with little to no calcium reserves in the bone, the clinical signs will be lethargy, paresis, and mild to moderate tetanic spasms. Neonate iguanas require near-perfect calcium to phosphorus ratio in their diets due to their lack of bony reserve. It is hard to over-supplement calcium in the diet of young growing iguanas. Supplementation of phosphorus-free calcium is critical to the typical captive iguana whose lighting, food, and the ability to thermoregulate is suboptimal (compared to the wild).



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The ability for every reptile to thermoregulate is imperative to nutrition. Most reptiles exist in a state of homeostasis when their temperatures are kept within a preferred range known as the preferred optimal temperature zone (POTZ). This zone is species specific. Having the ability to thermoregulate entails the reptile being able to behaviorally decide where he or she chooses to be within the defined area of the cage to control its own temperature. Reptiles digest food more efficiently when kept in conditions conducive to thermo-regulating in their POTZ. Iguanas cannot efficiently absorb dietary calcium at temperatures below 80 degrees Fahrenheit. If kept at a temperature below the minimum of 85 degrees, most iguanas will suffer from MBD.

Lack of exposure to unfiltered ultraviolet light also will cause MBD. The exact mechanism of action of vitamin D₃ production is not known in reptiles, but is assumed to be the same as in mammals. We feel strongly that temperature regulation is more important than exposure to UV light with respect to MBD. However, UV light does have positive behavioral, reproductive, and feeding effects on reptiles. Increased feeding response will cause more calcium to be eaten due to sheer increase in food intake (assuming that the diet is balanced). Vitamin D₃, the desired beneficial product from exposure to UV light, is essential to dietary absorption of calcium. Vitamin D₃ is also available in some oral calcium supplements. The right combination of UV light and calcium/D₃ supplementation is essential in captivity with respect to preventing MBD. The more reptiles are exposed to natural sunlight or black lights, the less oral D₃ is needed. Oral vitamin D₃ can be over-supplemented in the adult, resulting in metastatic mineralization of some soft tissues including the stomach, intestines, kidneys, skin, etc. Therefore, we recommend routine sunbathing during adequate climatic conditions through outside caging and/or walks. Sunbathing is appropriate anytime the temperature is above 70 degrees Fahrenheit. Outside caging is very good as long as the reptile is not in direct sunlight and can be cooled down (setting up a drip system is a good idea). When exposure to the sun is impossible, oral supplementing with calcium is essential. Young iguanas (1.5 years) should be supplemented only once or twice weekly. Cherry flavored Tums tablets can also be used as a calcium supplement and do not have D₃ in them. Older lizards do well on Tums and also enjoy the taste.

Renal disease also can cause MBD. The kidneys excrete phosphorus. If the kidneys are hypo-functional, elevated phosphorus stimulates the parathyroid gland the same way dietary phosphorus does. If the kidney disease is chronic, clinical signs of kidney failure are yellow urates, pale mucous membranes, straining to defecate, and constipation.

Egg bound females will often present in muscle fasciculations to acute tetany related to hypocalcemia. The blood calcium is utilized to calcify the eggs. A salpingectomy/ ovariectomy may be a necessary treatment once the patient's calcium level is stabilized.



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Most reptiles are solitary animals that will try to minimize social interaction with owners as well as with cage mates. Cage paired iguanas nearly always have subclinical to clinical metabolic bone disease. One reptile is nearly always more aggressive. The more dominant iguana has first access to the food and the better basking place. As a result, the second place subordinate iguana will often be much smaller and have MBD. Stress plays a large part in this disease as well. Secondary bacterial infections are common with MBD and stress.

The suggested clinical workup for iguanas with MBD includes a blood chemistry profile, PCV/TP, and radiographs.

Treatment

Treatment for clinical MBD depends on the severity of the disease and may take as long as 6 months to resolve. Mild cases respond quicker. Some reptiles lose the ability to eat due to softening of jawbones. Treatment consists of heavily supplementing with calcium at 200-500 mg calcium BID per os, intracoelomic, or intramuscular for at least 2 weeks. If the reptile is still eating, daily oral calcium on the food is sufficient. Force-feeding with an appropriate carnivore/herbivore baby food diet is simple and effective. The dose we use is 15 ml per kg BID until the reptile is self-feeding. Injectable vitamin D₃ should also be given. The dose for Injacom was .07 ml per 100 grams body weight. However, this drug has recently been pulled from the market. Exposure to unfiltered ultraviolet light and temperature regulation are also very important. We recommend removing all cage perching and other decor in the cage on which the lizard may break a leg or fracture its back. Understanding the husbandry deficiencies of the reptile owner is essential and self-evident upon historical questioning.

Pathologic fractures are common with MBD. Long bone limb fracture, as well as back fracture, complicates the treatment of MBD. Tape splinting or simply leaving the reptile alone are the options that are based upon the veterinarian's personal judgment and level of expertise. Tape splinting will do harm if not properly placed or the reptile is allowed too much free roam time. General small animal splint application knowledge should be applied. Internal fixation should return to rear leg function. If the rectal tissue is flaccid, and/or the reptile cannot urinate properly, then euthanasia is often recommended.