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Laboratory Testing for Kidney Disease in Birds, Reptiles, Amphibians, and Fish

Diagnosing kidney disease in birds, reptiles, amphibians, and fish can be challenging, and there are fewer tools available for laboratory evaluation compared to those for mammals. The blood analytes associated with the kidney also differ depending on the habitat, diet, and in some cases on additional factors including season. There are therefore no standard kidney analytes that can be used in all species, and reference intervals must also be interpreted carefully. In this newsletter, we will discuss the individual relevant analytes and factors influencing blood values to provide an overview of how laboratory testing can aid with your kidney patients.

Let's start with the differences in the ecology of various species and why this has such an influence on the kidney-associated analytes. For animals adapted to arid habitats, excretory products must be removed from the system using as little water as possible. In lizards, snakes, tortoises, and birds from such habitats, this is **uric acid**. Some amphibians, such as some tree frogs, also produce uric acid.
In geckos and agamas, for example, this is found as dry white crystals in their droppings (Figure 1).
The more humid the natural habitat of the animal, the more the end product of purine metabolism changes from uric acid to **urea**, which is excreted with more water causing excretions to change from solid to pasty to liquid. This is the case e.g. in pond turtles, alligators, and some amphibians.
Animals that live completely in water also excrete **ammonium**, e.g. sea turtles, some crocodiles, fish, and amphibians. The end product of purine metabolism therefore differs depending on the ecology and physiology, and the most suitable analytes to evaluate kidney function vary accordingly.
Ammonium and ammonia are very volatile and must therefore be determined as quickly as possible in a blood sample to obtain accurate values, which is why correct measurement is not possible if the sample must be sent to a laboratory. In mammals there are a number of additional analytes that are

Fig. 1: Faeces from a leopard gecko (*Eublepharis macularius*) with uric acid accumulations *Image source: Laboklin*

used to evaluate the kidney function such as creatinine, symmetric dimethylarginine (SDMA), cystatin C, indoxyl sulphate, fibroblast growth factor (FGF23), and, in humans, N-acetyl-β-d-glucosaminidase (NAG). **Creatinine** is produced and excreted by reptiles and birds only in small, very variable amounts, making it unsuitable as a reliable diagnostic marker in these species. In birds, the precursor creatine phosphate is excreted in the urine. There are several studies on **SDMA** in exotic animals available. A study in Hermann´s tortoises (*Testudo hermanni*) (Lehmann et al. 2022) showed that SDMA is measurable in this species and established reference intervals. Unpublished internal studies by Laboklin showed that SDMA increases with rising uric acid levels in Hermann's tortoises with kidney disease. Another study was able to establish reference intervals for SDMA in Hispaniola amazons (*Amazona ventralis*) and quaker parrots (*Myiopsitta monachus*) (Moreno et al. 2024), but there are still no data on clinically ill animals.
Cystatin C has been tested as a marker for acute kidney damage in chickens (Konopska et al. 2013). There are several studies on **NAG** in birds, indicating this could be suitable as a marker for

acute kidney damage (Wimsatt et al. 2009; Dijkstra et al. 2015). However, in most clinical cases involving birds and reptiles, chronic kidney disease is more common (Figure 2), making these markers only moderately suitable. There are currently no studies available on other possible kidney analytes in birds and reptiles. Laboratory diagnostics for kidney disease in amphibians and fish are also still in their infancy.

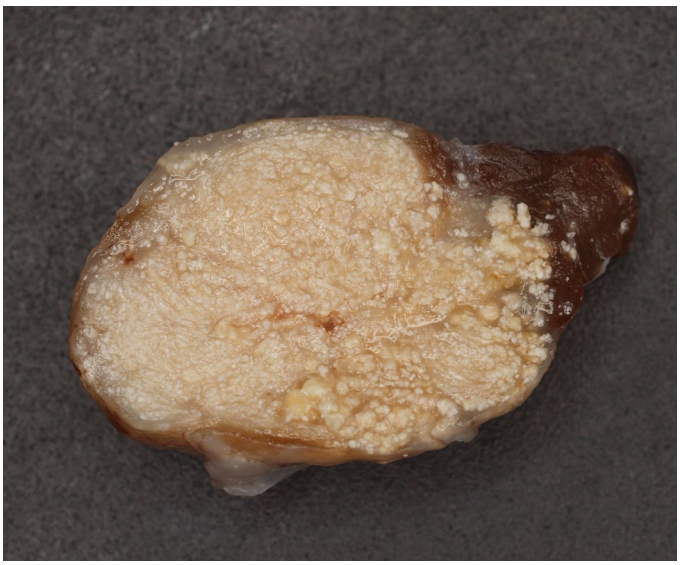

Fig. 2: Kidney of a corn snake (*Pantherophis guttatus*) with renal gout and massive uric acid deposits

Image source: Laboklin

In addition to the limited number of analytes available for evaluating kidney function in birds, reptiles, amphibians, and fish, the blood values of known kidney-related markers are also affected by various factors. Urea and ammonium are influenced by hydration status, food intake, liver function, and kidney function. In some desert animals, urea is physiologically higher in the blood than in species from more humid habitats. Uric acid also increases due to dehydration, food intake (especially in carnivorous species), and decreasing ambient temperatures in reptiles. On the other hand, anorexia, reduced or no food intake, massive liver disease, and treatment with allopurinol lead to reduced blood uric acid concentrations. The age of an animal (Stacy et al. 2000), the sex (Leineweber et al. 2019; Stacy et al. 2000), the type of husbandry (Padilla et al. 2011) and the season (Laube et al. 2016; Leineweber et al. 2019; Yang et al. 2014) can also influence the concentrations of kidney-associated analytes in the blood.

The blood analysis should therefore be carried out on animals that have fasted, are normothermic, and before or after fluid therapy depending on the dehydration status of the animal.

Kidney disease often leads to azotemia and hyperosmolality. It may also cause hypercholesterolemia, hyperphosphatemia, hypocalcemia, hyperchloremia, hyponatremia, hyperkalemia, and increased aspartate aminotransferase (AST) levels. In some cases, gamma-glutamyltransferase (GGT) levels may also be elevated, and some affected animals may be anemic.

In species that have a urinary bladder, such as European tortoises, urine can be obtained by cystocentesis and analysed. However, it is important to note that urine from the ureters does not enter the bladder directly but passes through the cloaca first, which can introduce contaminants that affect the results. In addition, in chelonians, for example, water is both reabsorbed from the bladder and absorbed and stored via the cloaca during bathing, which influences the specific gravity of the urine.

Conclusion:

The diagnosis of kidney diseases in birds and exotic animals is challenging. The selection of appropriate blood analytes for laboratory testing depends on the lifestyle and physiology of the respective species.

Dr. Christoph Leineweber

Our services for exotic animals

- Avian screening
- Reptile screening (small and large)
- Amphibian screening
- Fish screening
- Additional individual analytes

The scientific literature cited in this text is available here: Simply scan the QR code!