Basic Avian Clinical Pathology Testing

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Diagnostic testing is a very important part of the clinical examination of both the well and sick bird. Great advances in avian clinical pathology has given us a wide range of tests to choose from. The important parts of laboratory testing is to know what test to run, when to run it, and how to interpret the results for each individual patient. This is not always as straightforward as it sounds. There are complications ranging from the small sample size, the lack of normal ranges for some species, and the non-specific nature of avian plasma enzymes. Despite this, clinical pathology testing still remains the most important diagnostic tool we have for all of our patients. In this article, I review basic blood testing in the avian patient. Specialized tests like those for psittacosis and viruses will be discussed in another article.

I. Collection of Samples: Venipuncture

There are several methods/sites from which to collect blood in the avian patient: the leg vein (medial metatarsal vein), the wing vein (cutaneous ulnar vein) the jugular vein, and the toenail clip. The toenail clip has the advantage of being easily accessible, but is a painful technique and can potentially contaminate the blood sample if the nail has feces or food on it. Toenail cuts tend to bleed slowly (unless cut very short) and often result in samples with red blood cell rupture. Some practitioners use this site for the collection of blood samples without major patient complications. However, because of the pain and stress factor, I will only clip a toenail for a quick assessment test where only a small drop of blood is needed. The wing vein and the leg vein vein are good sites for small samples, but they collapse easy and may prolong the sampling time (not a good idea in a stressed patient). Large blood samples can be taken easily from the jugular vein. In most species, the right jugular is significantly larger than the left and the preferred side for venipuncture. The jugular vein can be seen in a feather-less tract of skin just above the crop on the right side of the neck. Jugular venipuncture is possible in most bird species, (even small birds like canaries and budgerigars) but difficult in pigeons and doves who have more of a diffuse venous plexus than a discrete vein. Jugular venipuncture requires some manual dexterity, but is the preferred site for the collection of large blood samples in the psittacine bird.

II. The Complete Blood Count (CBC)

The CBC refers to the evaluation of the red and white blood cells that make up the cellular component of blood. The avian red blood cell is large and has a short lifespan of 28-45 days (over 100 days in the dog and cat). This means new blood cells are made just about every 4-6 weeks, which is helpful if the bird happens to lose a large amount of blood. The normal packed cell volume ("PCV") for most psittacine species ranges from 37-50% with juvenile birds on the low end of the range. Values below 37% are considered anemic. Values below 15% might indicate the need for a blood transfusion. The white blood cell component of blood provides the body with a defense system. For example, pus formation is the result of certain types of white blood cells fighting infection. There are several different types of white blood cells and when a CBC is performed, these cells are microscopically evaluated and counted. A high white blood cell count occurs most commonly in birds from disease. Stress in some birds can also elevate the white cell count, and juvenile parrots (less than 6 mos of age) can have a slightly higher white cell count than adults. Low white blood cell counts are occasionally observed with severe viral infections, particularly psittacine circovirus (beak and feather disease virus) infection in young birds. The clinician must use the clinical history and signs to interpret the white cell counts and to follow trends in blood results. Most white cell counts are performed manually so there is the potential for error in some cases. The clinician can minimize artifact by proper sample handling, storage temperatures, and shipping.

III. Select Plasma Biochemistry

Enzymes are produced by cells in the various organs of the body. There is a usual baseline level of enzymes produced by normal cell turnover. When there is an excessive amount of cellular damage, some enzymes are released or "leak" out into the bloodstream. These levels are measured as part of routine blood chemistry panel. Some of these enzymes are discussed below.

CPK or creatine kinase is primarily located in muscle cells and most elevations are related to muscle injury like rough handling, trauma, injections, and muscle wasting. Athletes like homing pigeons can have elevated values after a long flight.

AST or aspartate transaminase (also called **SGOT**) is nonspecific for the liver but is considered to be the "liver enzyme" in birds. Normal range for most species is up to about 330 IU/L. Elevations occur most often from damage to liver cells and skeletal muscle cells. AST results should be interpreted along with the CPK to help differentiate muscle from liver disease. CPK has a much shorter half-life than AST and may return to normal range before AST.

Uric acid is the main nitrogenous waste in avian species and elevations occur following significant disease in the kidneys (normal range 2-11 mg/dl). The common kidney values measured in people and other mammals (like blood urea nitrogen and creatinine) are not useful in the determination of kidney conditions in birds. False elevations may be seen with toenail-derived blood samples if the nail is contaminated with droppings.

Blood glucose levels in the bird are significantly greater than in the cat and dog (200-400 mg/dl) and can go higher transiently with stress. Diabetes mellitus is uncommon in birds but is associated with glucose levels persistently above 900 mg/dl. Blood glucose levels below 150 mg/dl should be considered serious and life threatening.

Calcium measurement is often in the normal range (8-12 mg/dl) despite a clinical picture of calcium deficiency (poor X-ray bone quality, weakness, egg-laying, poor diet, e.g.). African grey parrots are unique in their susceptibility to hypocalcemic weakness and tetany. Calcium assays are sensitive to artifacts and dilution and may be falsely low. High calcium levels are common in reproductively active females where plasma calcium values can be as high as 25 mg/dl.

Total protein includes albumin and the globulins. Most normal bird values are approximately half that of mammalian values (3.0-5.5 mg/dl). Standard albumin measuring methods do not work well with avian albumin, so most reported lab values for albumin and globulin are inaccurate. The best method for quantifying the total protein fractions is by use of electrophoresis (see below).

Plasma protein electrophoresis divides total protein into five fractions: prealbumin, albumin, alpha-, beta-, and gamma- globulins. Different species have slightly different normal ranges for each fraction and some species have little or no pre-albumin. The alpha and beta globulins are considered the acute phase proteins and the beta and gamma are the immune globulins. Elevations in the beta and gamma globulins usually indicates activation of the immune system and is most often due to infection, and rarely from cancer. Conditions like aspergillosis (fungal infection), psittacosis (bacterial infection), and mycobacteriosis ("tuberculosis") are some common causes of immune globulin elevation. Pneumonia, and deep skin infections can also elevate the immune proteins. The EPH can be useful as an initial screen of health and then as a follow-up test in sick birds on therapy.

Bilirubin testing does not have diagnostic value in most species. This means that birds do not become jaundiced (skin and eyes turning yellow). Birds lack the enzyme which converts the bile pigment biliverdin into bilirubin. Birds with liver disease will therefore have excess levels of biliverdin. Biliverdin does not accumulate in tissues; it is rapidly excreted in the urine. Green/yellow urates represents biliverdin in the urine and can be loosely considered the bird equivalent of jaundice. Birds do not become "yellow" from jaundice like people or other small companion mammals.

Bile acids are a good test of liver function in psittacine birds. Samples are taken either following a short fast (< 12 hours) or randomly. Most species have normal values less than 100 umol/L and values greater than 150-200 umol/L indicate liver dysfunction. This assay is affected by artifacts like lipids (fats) in the blood and damaged red blood cells (from sample handling).

LDH or lactate dehydrogenase is a non-specific enzyme in birds, similar to mammals. Liver disease, skeletal muscle damage, and cardiac disease most commonly contribute to elevations. Sampling error resulting in damaged blood cells can also elevate LDH as the blood cells release this enzyme.

References and Recommended Reading

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