

Making Sense of Blood Work in Greyhounds

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ABSTRACT: The purpose of this article is to provide a brief overview of the components of the blood work in dogs, and to illustrate how values in Greyhounds frequently differ from those in dogs of other breeds.

Blood work is a general term referring to diagnostic laboratory tests done on blood samples, and include everything from heartworm tests to thyroid hormone assays. Some of the indications for performing blood work include illness, annual health checks, and pre-anesthesia. The most commonly performed tests when a veterinarian refers to "running blood work" are the complete blood cell count (CBC) and the serum biochemical profile.

The Complete Blood Count (CBC)

A CBC evaluates the various cellular components of a blood sample. Red blood cells (RBCs or erythrocytes), white blood cells (leukocytes), and platelets are all counted and other measurements are performed.

Red blood cells carry oxygen throughout the body and are typically reported as a packed cell volume (PCV), hematocrit (Hct), or RBC count.

The PCV and Hct report the percentage of red blood cells in a blood sample after spinning it down in a centrifuge. **Anemia** is defined as a low number of RBCs (or a low PCV or Hct); dogs with anemia have difficulty transporting oxygen to their tissues, so they are therefore tired (exercise intolerant), pale (light-pink gums), and their heart rates and pulses are usually faster than normal (tachycardia). Figure 1 depicts a Hct tube in a dog with hemolytic anemia (red cell destruction); the dark layer in the bottom of the tube are the red blood cells.

Normal reference values for PCV and Hct in dogs range from 35 to 50%, whereas normal Greyhounds typically have PCVs of 45 to 65%. Therefore, a Greyhound with a PCV or Hct in the low end of the normal range (e.g.: 38%) is likely anemic. Further testing should be performed in these cases, since anemia can be associated with bone marrow disease, immune-mediated disease (immune-mediated hemolytic anemia), blood loss (trauma, parasites, etc.), and some infectious diseases (*Babesia*, *Ehrlichia*, etc.). A condition called primary **polycythemia** or **erythrocytosis** can be a

pathologic cause of an increased PCV or Hct, but this diagnosis is exceedingly rare. Dehydration can also result in a high PCV or Hct.

Most CBCs also include a determination of total plasma protein (TPP) concentration; dehydration, lipemia (fat in the blood, as it commonly occurs after a meal), some infections, and some tumors can result in high TPP. Causes of high and low TPP are discussed under "Serum Biochemical Profile" below.

White blood cells (WBCs) are commonly used to fight infection and are a part of the immune system; the reference range for WBC counts in normal dogs is 4,000 to 15,000/ μl (or 4-15 $\times 10^9/\text{L}$). Greyhounds frequently have lower WBC counts than normal dogs, and commonly have between 2,000 and 6,000/ μl (2-6 $\times 10^9/\text{L}$); therefore, a WBC count of 2,000/ μl (2.0 $\times 10^9/\text{L}$) is normal for the breed and should not be of concern in an otherwise healthy dog. There are several types of circulating WBCs, including neutrophils (banded or segmented neutrophils), lymphocytes, monocytes, basophils and eosinophils.

Neutrophils and *monocytes* are white blood cells that can attack and destroy bacteria and other organisms. Their numbers are commonly increased in association with stress, or in bacterial infections or

inflammation, and can be decreased in patients with overwhelming infections, immune-mediated diseases, drug reactions, or bone marrow disease.

Greyhounds have lower neutrophil counts than the reference range for dogs (3,000-10,000/ μl or 3-10 $\times 10^9/\text{L}$); thus, neutrophil counts as low as 1,800/ μl ($1.8 \times 10^9/\text{L}$) should not be of concern if the dog is healthy.

Lymphocytes are white blood cells that play a key role in recognizing foreign proteins and producing antibodies; there are B- and T-lymphocytes. Circulating lymphocyte numbers are commonly increased in response to foreign proteins in the body (e.g. a normal vaccine response), in some infections (e.g.; ehrlichiosis), in some dogs with adrenal insufficiency (Addison's disease), and in some leukemias (e.g.; lymphoid leukemias). Lymphocytes are commonly decreased in response to stress or disease, and in some immunodeficiency syndromes; most sick dogs have low lymphocyte counts due to stress.

Eosinophils are white blood cells involved in immunity against parasitic infections and allergic reactions. Interestingly, eosinophils in Greyhounds frequently lack the characteristic orange granules of eosinophils in other breeds, and can be misdiagnosed as "toxic neutrophils", cells commonly found in severe overwhelming infections. *Basophils* are white blood cells that also

play a key role in allergic reactions; they can be increased in dogs with parasitic infections or allergic reactions, but that is rare. Decreased numbers of basophils or eosinophils are rarely clinically significant without other indications of disease.

Platelets are cells which are used by the body to help form blood clots and repair injuries to blood vessels. Platelets are commonly decreased in association with bone marrow disease, immune-mediated diseases (immune-mediated thrombocytopenia), and with some infectious organisms (*Ehrlichia*, *Babesia*). Some breeds, including Greyhounds and Cavalier King Charles spaniels have lower numbers of circulating platelets than the reference range for dogs, yet they do not experience any bleeding problems. Most non-Greyhound dogs have platelet counts of over 150,000/ μl ($150 \times 10^9/\text{L}$), whereas Greyhounds frequently have platelet counts as low as 80,000-120,000/ μl ($80\text{-}120 \times 10^9/\text{L}$).

If your Greyhound has a mildly decreased platelet count, but is otherwise healthy, close observation and repeating the platelet count in 1-3 weeks is the best approach. If he/she develops evidence of bleeding (pinpoint bloody spots - petechiae, or bruising), additional evaluation is warranted. In those cases, tests for tick-borne diseases such as *Ehrlichia*

spp and *Babesia spp* are indicated. High platelet counts are rarely clinically relevant.

CBC-Summary

- In conclusion, *Greyhounds* usually have higher PCV/Hct, lower WBC and neutrophil counts, and/or lower platelet counts than non-*Greyhound* dogs.

The Serum Biochemical Profile

A serum biochemical profile is the "second half" of the traditional blood work; it evaluates kidney function, liver enzymes, electrolytes, muscle enzymes, cholesterol, and other important values. Kidney function is determined primarily by two analytes, the creatinine and the blood urea nitrogen (BUN) concentrations; these are protein byproducts normally eliminated by the kidneys. The term **azotemia** refers to an increase in both values, and is typically associated with kidney disease, urinary obstruction (more common in cats than in dogs), or severe dehydration. *Greyhounds* have higher creatinine concentrations than dogs of other breeds (probably due to their large muscle mass); therefore mild increases in creatinine concentration without increases in the BUN concentration in a healthy *Greyhound* are likely normal for the breed. The BUN concentration can also

increase as a consequence of high dietary protein intake, gastrointestinal bleeding, or dehydration. A urinalysis should always be performed in dogs with azotemia to determine if it is due to kidney disease or extrarenal causes. A low creatinine concentration can be associated with decreased muscle mass, whereas low BUN concentration can be associated with liver failure, malnutrition, or increased water intake.

The liver enzymes alanine transaminase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) are all used to evaluate the health of the liver and can be increased in association with various liver diseases. ALT is an enzyme found inside hepatocytes (liver cells) and in muscle fibers; damage to hepatocytes or muscle by toxins, trauma, or inflammation causes increases in ALT activity (values) in serum. As a general rule, high ALT activity is suggestive of ongoing liver damage (of which there are many causes, such as hepatitis and ingestion of toxins or drugs); however, trauma (e.g. a dog hit by a car) or extensive muscle damage (e.g. rhabdomyolysis) can cause increases in ALT activities. AST is less liver-specific than ALT; high AST activity usually occurs in cases of severe muscle or liver damage, in addition to liver disease. In most dogs with extensive muscle disease, another enzyme (CK or creatinine kinase) is also markedly

increased in serum. Greyhounds have slightly higher ALT, AST, and CK activities than non-Greyhound dogs.

ALP is less liver-specific than ALT. When increases in ALP are due to liver disease, the bile pigment (bilirubin) concentration also increases, and the dog may be jaundiced (yellow). ALP activity can also be mildly increased in young growing dogs, and markedly increased in association with reactions to certain drugs (corticosteroids, barbiturates) or adrenal gland disease (hyperadrenocorticism or Cushing's disease).

Additional information on the liver can be gained by evaluating the cholesterol, albumin, BUN, and bilirubin concentrations. Decreased concentrations of cholesterol, BUN, and/or albumin (see below), and increased concentration of bilirubin can be seen in dogs with some types of chronic liver disease. Changes in some or several of these values may be an indication for your veterinarian to assess liver function or morphology. A bile acid blood test before and after feeding is one of the tests used to evaluate liver function, and is normally not included in a standard biochemical profile; abdominal radiographs and ultrasonography are noninvasive techniques used to image the liver.

The electrolytes evaluated on a standard serum biochemical profile include sodium, potassium, calcium, chloride, and phosphorous. These minerals can increase or decrease in association with a variety of causes ranging from dehydration to hypoadrenocorticism (Addison's disease). Dehydrated dogs usually have high sodium, chloride, and calcium concentrations; dogs with hypoadrenocorticism usually have high potassium and low sodium concentrations. High concentrations of calcium (hypercalcemia) can be associated with cancer (lymphoma, anal sac carcinoma, myeloma), vitamin D toxicity, kidney disease, and parathyroid gland problems. If a high calcium concentration persists, your veterinarian should perform additional diagnostic tests (e.g. ionized calcium, hormones). Electrolyte changes are also common in association with kidney disease and other endocrine disorders.

Another useful value on a biochemical profile is the glucose (sugar) concentration. Glucose is the primary source of energy for living organisms; blood glucose concentration can be high in dogs with diabetes mellitus, pancreatitis, or with some drug reactions. Decreased glucose concentration can be associated with malnutrition, liver failure, cancer (insulinoma), septicemia, and insulin overdose.

Albumin and globulins together make up the total protein, a value measured in the biochemical profile. Albumin and most globulins are synthesized (manufactured) by the liver; some globulins (antibodies) are made by immune cells. Serum albumin is vital to keep fluid inside the blood vessels (oncotic pressure); low albumin concentrations frequently result in fluid accumulation under the skin (edema) or in body cavities (effusion). Low serum albumin concentration can occur in patients with chronic liver disease, a specific kind of kidney disease referred to as "protein-losing nephropathy", small intestinal disease (protein-losing enteropathy), or blood loss. High albumin concentration can only occur in association with dehydration.

Globulins play an important role in the immune system and transport various substances in the blood. Globulin concentrations are commonly increased in association with dehydration, inflammation, some forms of cancer (myeloma, chronic lymphoid leukemia), and various infectious diseases, such as ehrlichiosis and other tick-borne diseases. Decreased globulin concentrations can be associated with blood loss, protein loss in the gastrointestinal tract, or severe immunodeficiency; low globulin concentrations are a normal finding in young dogs.

Greyhounds have significantly lower concentrations of protein and globulin than non-Greyhound dogs, but their albumin concentration is similar to that of other dogs. Serum protein and globulin concentrations in Greyhounds are frequently below the reference range for dogs. Therefore, an otherwise normal Greyhound with low protein or globulin concentrations in the profile should not be extensively evaluated for disease.

A final blood work component worth mentioning that is not included in a standard biochemical profile is a thyroid hormone concentration (level). Thyroid hormones play a large role in metabolism. In contrast with cats, where hyperthyroidism is relatively common, thyroid hormone concentrations are rarely high in dogs. Low thyroid hormone concentration can be associated with hypothyroidism, or any systemic illness. Most normal Greyhounds have mildly to markedly decreased thyroid hormone concentrations, and their values are commonly below the reference range for dogs; therefore, people frequently treat their Greyhounds with thyroid hormone replacement (supplementation), although their thyroid function is normal for the breed. In other words, thyroid hormone supplementation should not be used in a healthy Greyhound on account of a "low thyroid level" (see below).

Common signs of hypothyroidism in dogs include lethargy, weight gain, alopecia (loss of hair), dry skin and haircoat, cold intolerance, and neurologic signs such as incoordination. One of the difficulties in assessing the clinical signs of hypothyroidism in Greyhounds is that Greyhounds normally have many of those signs. Most Greyhounds are couch potatoes (apart from a good run in the backyard) and are normally fairly inactive dogs.

Furthermore, most Greyhounds are normally intolerant of the cold and many show signs of alopecia in their thighs (thigh alopecia is very rarely related to hypothyroidism). Therefore, a full thyroid panel should be done on any dog (especially any Greyhound) prior to starting therapy as treatment is lifelong and unnecessary supplementation may harm your pet. A full thyroid panel includes the following tests: total T4, free T4 by equilibrium dialysis (ED), total T3, free T3, thyroid stimulating hormone (TSH), T4 autoantibody, T3 autoantibody, and thyroglobulin autoantibody. All of these tests give a complete view of the thyroid gland and aid in interpretation of the results.

The Animal Health Diagnostic Laboratory at Michigan State University performs a complete panel and will give interpretation by the endocrinologists who have extensive knowledge of a Greyhound's normal thyroid concentrations.

Serum Biochemical Profile-Summary

. In summary, Greyhounds typically have higher creatinine concentrations and muscle and liver enzyme activities, and lower protein and globulin concentrations than non-Greyhound dogs. Their thyroid hormone concentrations are also lower.

Contact Information for Thyroid Panel

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