Greyhounds: a breed apart

Breed-specific reference intervals at IDEXX Reference Laboratories for greyhounds

Greyhounds have been intensively bred over centuries for performance. As a result of adaptations for racing success, even basic bloodwork parameters have diverged markedly from other breeds of dogs making it difficult to apply general canine reference intervals to this population. Published studies have previously demonstrated that greyhounds require different reference intervals for many common parameters.[1–7] This update provides breed-specific reference intervals for hematology, chemistry, and total T_4 that can be used to help interpret results from IDEXX Reference Laboratories.

Greyhound reference interval study

Reference intervals are most accurate when based on reference interval studies performed using the same analyzer and reagents. IDEXX is committed to providing clients with the most accurate and reliable results possible. IDEXX followed the Clinical and Laboratory Standards Institute (CLSI) guidelines for determining the greyhound-specific reference intervals summarized in tables 1 and 2. Clinically healthy greyhounds (N=220) were enrolled into the study both by participating veterinary hospitals and by on-site blood collection at an annual gathering of greyhounds by greyhound owners and enthusiasts. Greyhounds at the event were pre-enrolled by their owners to take part in the study. Adult (1–10 years of age) greyhounds were characterized as healthy based on history and physical examination. Minimum time retired from the track for all participating greyhounds was 1 year. Animals were on no medications except for routine heartworm and parasite preventives and were negative on the Lab 4Dx® Plus Test for Lyme disease, *Ehrlichia* spp., *Anaplasma* spp. and heartworm disease. All hematology, chemistry, and total T_4 testing were performed at IDEXX Reference Laboratories. As such, these greyhound-specific reference intervals apply only to IDEXX Reference Laboratories testing. However, breed differences should be considered when interpreting bloodwork performed on any methodology, and the general trends shown in the tables may provide directional benefit when interpreting greyhound results from other testing modalities.

Evaluating kidney function in greyhounds

Evaluation of kidney function in greyhounds has traditionally been challenging due to the markedly higher creatinine levels seen in clinically healthy greyhounds compared to other breeds. Glomerular filtration rate (GFR) studies in greyhounds have been variable, but at least one study demonstrated a higher GFR in healthy greyhounds than non-greyhounds, despite higher creatinine levels, suggesting that increased creatinine values do not necessarily reflect decreased renal clearance.[8] The higher creatinine reference intervals observed in greyhounds have been attributed to the increased muscle mass seen in this breed.[9] The IDEXX SDMA® Test is not impacted by muscle mass and should be a more accurate predictor of kidney health than creatinine in greyhounds. However, an independent reference interval study and anecdotal experience suggested that greyhounds may have a higher upper limit (20 µg/dL) than other dog breeds for their SDMA reference interval.[10] The IDEXX greyhound reference interval study confirmed this higher upper limit for SDMA.

Table 1. Comparison of IDEXX Reference Laboratories general canine reference intervals with greyhound-specific reference intervals for common chemistry parameters.

Chemistry	General canine	Greyhound-specific
IDEXX SDMA® Test	0–14 µg/dL	0–20 µg/dL
Creatinine	0.5–1.5 mg/dL	1.2–2.1 mg/dL
BUN	9–31 mg/dL	13–29 mg/dL
Glucose	63–114 mg/dL	72–118 mg/dL
Calcium	8.4–11.8 mg/dL	9.3–10.5 mg/dL
Phosphorus	2.5–6.1 mg/dL	2.3–5.1 mg/dL
Chloride	108–119 mmol/L	107–117 mmol/L
Potassium	4–5.4 mmol/L	3.8–4.7 mmol/L
Sodium	142–152 mmol/L	139–149 mmol/L
Na/K ratio	28–37	31–39
TCO_2 (Bicarbonate)	13–27 mmol/L	18–25 mmol/L
Anion gap	11–26 mmol/L	12–20 mmol/L
Total protein	5.5–7.5 g/dL	5.2–6.8 g/dL
Albumin	2.7–3.9 g/dL	2.7–3.9 g/dL
Globulin	2.4–4 g/dL	2.2–3.5 g/dL
Alb/Glob ratio	0.7–1.5	0.9–1.5
ALT	18–121 U/L	24–97 U/L
AST	16–55 U/L	23–84 U/L
ALP	5–160 U/L	12–79 U/L
GGT	0–13 U/L	0–18 U/L
Total bilirubin	0–0.3 mg/dL	0.2–0.5 mg/dL
Conjugated bilirubin	0–0.1 mg/dL	0–0.1 mg/dL
Unconjugated bilirubin	0–0.2 mg/dL	0.1–0.4 mg/dL
Cholesterol	131–345 mg/dL	110–236 mg/dL
CK	10–200 U/L	59–538 U/L

A second study was performed with greyhound puppies to determine a greyhound puppy SDMA reference interval and to determine whether the higher upper limit of the SDMA reference interval noted in adults could be attributed to subclinical kidney damage sustained during training.[11] These puppies had not yet begun training as racing greyhounds and did not yet have the substantial muscle mass typical in adult greyhounds. The SDMA reference interval in greyhound puppies was found to be the same as in adults (0–20 μg/dL) and was higher than that seen in puppies of other breeds (0–16 μg/dL). Unlike in adult greyhounds, however, creatinine in these puppies was within the general adult canine reference interval (0.5–1.5 mg/dL), supporting the hypothesis of muscle mass as the primary contributor to higher creatinine in adult greyhounds. These findings suggest that the higher SDMA levels seen in adult and puppy greyhounds likely represent breed-specific physiologic differences (e.g., in enzyme pathways, protein metabolism) resulting in increased generation of SDMA.

Despite the evidence that greyhounds require breed-specific reference intervals for renal biomarkers, the possibility of true decline in renal function should never be excluded without full diagnostic exam. Greyhounds have been shown to have the potential for increased risk for kidney disease due to the high prevalence of proteinuric disease and systemic hypertension.[12] Additionally, there is the possibility of sustained damage to the kidneys occurring during training (either due to renal ischemia or nonsteroidal anti-inflammatory usage). The availability of breed-specific reference intervals for SDMA and creatinine will help to determine the need for additional diagnostics such as systemic blood pressure measurement, complete urinalysis and urine protein:creatinine ratio. With a greyhound's higher risk for protein-losing kidney disease, it is recommended to include a complete urinalysis with urine protein:creatinine ratio if indicated as part of all routine preventive care bloodwork, as well as whenever the SDMA is either increased or trending upwards within the upper end of the greyhound-specific SDMA reference interval.

Interpreting CBCs in greyhounds

In both this and prior studies, greyhounds have been shown to have higher hematocrit, red blood cell counts, mean cell volume (MCV), and hemoglobin concentrations.[1–2,4–5] These findings have also been found in young greyhounds who have not started training for racing,[6] indicating that it is a breed related physiologic difference rather than a change developing secondary to increased oxygen needs during training. These breed differences have traditionally been attributed to the impact of selective breeding for greater oxygen-carrying capacity associated with superior racing performance. Platelets in greyhounds are typically mildly decreased in relation to the general canine reference interval without clinical impact. The cause of this is unknown but may represent shifting of bone marrow production towards the red blood cell line, splenic or pulmonary sequestration, or increased tendency towards platelet clumping. Greyhounds have also been noted to have a lower total white blood cell count and mild decreases of each cell within the 5-part differential (neutrophils, lymphocytes, monocytes, eosinophils, and basophils).

Because greyhounds' hematocrits are normally at the upper end or above general canine reference interval, a relative anemia in these dogs can be easily missed. Conversely, low platelets or white blood cells could be overinterpreted without an understanding of these breed differences. Use of breed specific reference intervals can be invaluable in identifying meaningful changes in hematologic parameters.

Table 2. Comparison of IDEXX Reference Laboratories general canine reference intervals with greyhound-specific reference intervals for common CBC parameters and total T_4.

Hematology	General canine	Greyhound-specific
RBC	5.39–8.7 M/μL	7.04–9.73 M/μL
HCT	38.3%–56.5%	52%–68.4%
Hgb	13.4–20.7 g/dL	16.9–23.1 g/dL
MCV	59–76 fL	67–80 fL
MCH	21.9–26.1 pg	23.1–25.7 pg
MCHC	32.6–39.2 g/dL	30.4–35.8 g/dL
Platelets	143–448 K/μL	97–232 K/μL
WBC	4.9–17.6 K/μL	3.6–8.6 K/μL
Neutrophils	2.94–12.67 K/μL	2.14–6.52 K/μL
Lymphocytes	1.06–4.95 K/μL	0.59–2.1 K/μL
Monocytes	0.13–1.15 K/μL	0.04–0.34 K/μL
Eosinophils	0.07–1.49 K/μL	0.02–1.19 K/μL
Basophil	0–0.1 K/μL	0–0.1 K/μL
Endocrinology		
Total T_4	1.0–4.0 μg/dL	0.5–1.7 μg/dL

Diagnosis and monitoring of hypothyroidism in greyhounds

Diagnosis of hypothyroidism in dogs is commonly based on the presence of a low total T_4 in association with classic clinical signs of low thyroid hormone. If clinical signs are not obvious or if there are concurrent diseases, further confirmation based on low free T_4, and in some cases, elevated canine TSH levels, may be helpful. The situation is more complex in greyhounds. Studies have shown that total T_4 levels in healthy greyhounds commonly fall below the general dog total T_4 reference interval.[13] To avoid overdiagnosis of hypothyroidism, it is important that total T_4 levels in greyhounds be interpreted using breed-specific and methodology-specific reference intervals.

When there is concurrent disease which may lower total T_4 levels or when only vague or absent clinical signs of hypothyroidism are reported, confirming hypothyroidism in greyhounds can be difficult. A normal free T_4 can confirm the euthyroid state in a greyhound. Greyhound-specific free T_4 reference intervals are markedly lower than that in other breeds, with at least one study showing a lower limit of 0 pmol/L in adult healthy greyhounds.[13] As a result, a low free T_4 alone cannot be used to confirm hypothyroidism. In these dogs, canine TSH levels may provide additional information in the diagnosis of hypothyroidism.

Similarly, when monitoring greyhounds on thyroid hormone supplementation, breed-specific reference intervals are needed. Total T_4 levels may not be as high in greyhounds being treated for hypothyroidism as in other dog breeds. A low canine TSH in combination with a normal total T_4 and resolution of clinical signs generally reflects adequate supplementation in greyhounds.

Summary

Greyhounds are a unique breed with many physiologic adaptations resulting from centuries of purpose-driven breeding. These adaptations result in notable differences in CBC, chemistry, and thyroid values in clinically healthy greyhounds as compared to other breeds. Interpretation of bloodwork in these dogs, requires the use of breed-specific reference intervals. In addition, establishing patient-specific baseline values through preventive care bloodwork may be especially helpful in recognizing clinically meaningful changes in these special dogs.

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