HYPOTHYROIDISM IN THE DOG

Dog Owners and Breeders Symposium
University of Florida
College of Veterinary Medicine
July 29, 2000

Michael Schaer, DVM
Diplomate ACVIM, ACVECC
University of Florida, College of Veterinary Medicine
Gainesville, Florida 32610

Hypothyroidism is one of the most commonly diagnosed hormone disorders in the dog. Some cases are clinically very obvious while others are more difficult to diagnose.

Types

The causes of hypothyroidism are listed in Table 1 (pg. 4). Primary acquired hypothyroidism is the most common type of hypothyroidism in the dog. It is usually the result of lymphocytic (autoimmune) thyroiditis or thyroid atrophy. Congenital hypothyroidism is rare in occurrence. Central hypothyroidism results from damage or dysfunction to the anterior pituitary gland. The secondary form of hypothyroidism is rare.

Incidence

Estimates of the incidence of canine hypothyroidism ranges from 1:156 to 1:500. Middle-aged dogs (4 to 10 years of age) of mid-to large-sized breeds are at increased risk. Commonly affected breeds include Golden Retriever, Doberman Pinscher, Irish Setter, Miniature Schnauzer, Dachshund, Cocker Spaniel, Airedale Terrier, Great Dane and Old English Sheepdog. German Shepherd Dogs and mixed-breeds are at low risk.

Physiologic Effects of Thyroid Hormones

Most of the varied effects of thyroid hormones result from the stimulation of oxygen utilization (calorigenic action) by almost all metabolically active tissues. Tissues which do not depend on T_3 and T_4 for oxygen consumption include the adult brain, testes, uterus, lymph nodes, spleen, and anterior pituitary. As a consequence to the increased metabolic rate induced by T_3 or T_4, nitrogen excretion is increased, internal protein and fat stores are broken down, and body weight is decreased. In young hypothyroid animals, small doses of thyroid hormones induce a positive nitrogen balance because they stimulate growth, but excessive doses will cause protein utilization.

Large doses of thyroid hormones cause excessive body heat production and a slight rise in body temperature. This, in turn, activates heat-dissipating mechanics. Excessive levels of thyroid hormone in conjunction with epinephrine secretion lead to an increased cardiac output. In

addition to these effects, thyroid hormones influence other physiologic processes as listed in Table 2 (pg. 4).

ADVERSE SYSTEMIC EFFECTS OF HYPOTHYROIDISM

Hypothyroidism is defined as a clinical condition characterized by inadequate quantities of circulating thyroid hormone. Table 3 lists the various causes of hypothyroidism in the dog. With the addition of iodized salt to commercial pet foods, hypothyroidism is usually associated with the nongoitrous (without cystic enlargement) form.

The clinical signs of hypothyroidism that are related to decreased metabolic rate and calorigenesis include lethargy, cold intolerance, decreased cerebral function, and a mild increase in body weight. Dermatologic changes are characterized by hair loss, skin thickening, and increased pigmentation.

Cardiovascular changes associated with a decreased cardiac output include a weak apex beat and a weak peripheral pulse. The electrocardiogram can show low amplitude R waves with or without a slow heart rate. Impaired peripheral circulation is suspected when the extremities seem cool to the touch.

Other clinical signs associated with hypothyroidism are decreased libido, gonad underdevelopment, anestrus, diarrhea, constipation, anemia, muscle weakness, muscle and nerve dysfunction (including cranial nerves VII, VIII and X dysfunction), and mammary milk production.

Myxedema is the extreme form of hypothyroidism. The signs in the dog are characterized by severe mental depression terminating in coma and hypothermia. Signs of hypothyroidism are usually present, but hypoventilation, hypotension, slow heart rate, and profound hypothermia are usually present as well. Often acute decompensation is triggered by an anesthetic episode. For these reasons, great care should be taken when anesthetizing a hypothyroid dog.

Endocrinologic Diagnosis

The serum T_4 determination is still the most commonly run test for initial thyroid evaluation. A normal value (1.5-4.3 μ/dl, 20-55 nmol/L) essentially rules out hypothyroidism. A very low T_4 level in conjunction with appropriate clinical signs and the absence of confounding factors is usually sufficient for making the diagnosis of hypothyroidism.

The serum T_3 determination (normal 0.7-2.3 nmol/L, 45-150 ng/dl) is commonly run but it is not as diagnostic as T_4 measurement. It is not uncommon to find normal T_3 concentrations in dogs with hypothyroidism.

The thyroid stimulating hormone (TSH) response test is used to identify hypothyroidism when the T_4 results are questionable. A reduced or no response to TSH is expected in hypothyroidism. It is important to consider that although the test will distinguish many borderline situations, the results are not always clear in dogs with nonthyroid illness or those treated with certain drugs.

However, post TSH T_4 levels greater than 45 nmol/L rule out hypothyroidism while levels less than 15 nmol/L indicate a need for replacement therapy. On the negative side, the commercial availability of TSH is unreliable and it is relatively expensive.

The free T_4 level represents the fraction of total hormone available for target cell entry. It comprises less than 1% of total T_4. The equilibrium dialysis technique is the preferred method with normal values ranging from 12-33 pmol/L (Nachreiner, MSU).

Many laboratories are now offering the TSH assay. It is essential that the appropriate standards are run with this test. Normal TSH levels range from 7-40 mU/L (Nachreiner, MSU), while the hypothyroid dog typically has elevated serum levels.

Antithyroid globulin antibody and antithyroid hormone antibody titers can be increased with lymphocytic or autoimmune thyroiditis. These dogs can be either euthyroid or hypothyroid in the presence of an elevated antibody titer. Some dogs with elevated antithyroid hormone antibody titers can also have increased measured serum thyroid hormone levels while still being clinically euthyroid. Therefore, elevated antithyroid globulin and antithyroid hormone antibodies are not reliable tests for diagnosing canine hypothyroidism.

Treatment

Primary hypothyroidism is initially treated with thyroxine (levothyroxine) at a dosage of 22 μg/kg (0.1 mg/10lb) every 12 hours. This same dose can be decreased to once daily treatment after the first month. Periodic blood level monitoring should be done 4-7 hours post-thyroxine administration, and the treatment should be adjusted accordingly.

Improved mentation and activity levels should become apparent over the first 2-7 day period. Skin and neurological improvement should occur after 1-3 months of treatment. Reproductive abnormalities might hopefully improve over a 3-10 month period.

Sodium liothyronine (synthetic T_3 Cytomel) is not the initial thyroid hormone supplement of choice. While liothyronine will raise the T_3 level, it will also lower the T_4 level through negative feedback inhibition. Synthetic T_3 therapy is indicated when levothyroxine treatment fails to achieve a desired clinical response in a confirmed hypothyroid dog. This can arise if there is impaired thyroxine absorption from the bowel.

Prognosis

The prognosis is generally good for primary hypothyroidism so long as there are no complications associated with the hyperlipidemia (coronary artery disease, acute pancreatitis) or the neuropathy.

Table 1. Causes of Hypothyroidism in the Dog

I. Primary hypothyroidism
congenital
acquired – atrophy of unknown etiology
autoimmune – lymphocytic thyroiditis
neoplastic – bilateral thyroid carcinoma

II. Pituitary hypothyroidism (Secondary hypothyroidism)
pituitary neoplasms, e.g. chromophobe adenoma
congenital hypopituitarism
defective TSH molecule
Iatrogenic
drugs (glucocorticoids)
radiation
hypophysectomy

III. Tertiary hypothyroidism
congenital hypothalamic malformation
acquired destruction of the hypothalamus

IV. Hypothyroidism associated with goiter
iodine deficiency
dyshormonogenesis (congenital)
ingestin of various goitrogens, i.e., thiocyanates

Table 2. Physiologic Effects of Thyroid Hormones

Effects of Excessive Levels of Thyroid Hormones	Effects of Inadequate Levels of Thyroid Hormones
■ rapid mentation, irritability, and restlessness ■ increased CNS sensitivity to circulating catecholamines ■ shortened stretch reflex time ■ increased rate of carbohydrate absorption from the intestinal tract ■ increased lipid metabolism ■ increased requirements of water soluble vitamins and fat soluble vitamins	■ anemia resulting from decreased erythropoiesis ■ depressed lactation ■ infertility ■ decreased mentation ■ increased stretch reflex time ■ depressed cholesterol and lipid metabolism ■ impaired growth and skeletal maturation in young animals

Table 3. Common Clinicopathologic Findings in the Hypothyroid Dog

Test	Abnormalities
Hemogram	Normocytic normochromic anemia
Serum chemistries	Increased cholesterol Increased triglycerides Increased creatine kinase