Feline Hyperthyroidism: The Signs Are Recognizable, but What Happens in the Body?

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In clinical practice, middle-aged to older cats often present with classic signs of hyperthyroidism, characterized by rapid weight loss (to the point of cachexia) despite a ravenous appetite. Affected cats can also present with polyuria/polydipsia, hyperactivity, vomiting, or haircoat changes (patchy alopecia). But what is actually happening in these patients’ bodies?

Hyperthyroidism is the most common endocrine disease seen in older cats.1,2 The age at presentation ranges from 4 to 20 years, with an average of 8 years.1 Hyperthyroidism is a disorder resulting from excessive production of thyroid hormone. It is often due to a mass on one or both thyroid lobes.

Physiology
The thyroid gland, which is composed of two lobes, is located in the neck ventral to the larynx2 (FIGURE 1). The main purpose of the thyroid gland is to control basal metabolism through the release or suppression of thyroid hormones based on cellular metabolic demand. The main thyroid hormones are 3,5,3’-triiodothyronine (T3) and thyroxine (T4). The thyroid produces T3 and T4 in response to thyroid-stimulating hormone (TSH), which is produced by the pituitary. Once TSH is released, the thyroid gland produces T4, and the cells of the body that take in T4 remove an iodine molecule to convert T4 to T3, the active thyroid hormone. Only a small amount of T3 is released from the thyroid gland. T3 determines how hard or fast each cell works to do its job. More than 99% of circulating T4 is bound to plasma proteins. This bound T4 acts as a reserve to maintain a balanced T4 concentration in the plasma, regardless of changing demands. Unbound T4 (free T4 [FT4]) is biologically active and is ready to enter the cells when necessary. T4 and FT4 exert negative feedback inhibition on TSH (i.e., T4 and FT4 negatively affect the release of additional TSH; FIGURE 2).2

The thyroid gland is also involved in regulating calcium, primarily through the production and release of the hormone calcitonin. An increase in the serum calcium level increases secretion of calcitonin. Calcium is also regulated by the parathyroid glands, which produce parathyroid hormone (PTH). PTH raises the calcium level and decreases the phosphate level.2 PTH reacts to the calcium level

*Ms. DeVictoria discloses that she received an honorarium for working on Pfizer’s Techron program on feline heartworm disease.

FIGURE 1
through negative feedback: a low calcium level stimulates PTH secretion; an increase in the calcium level decreases PTH secretion.

**Pathophysiology**

In a hyperthyroid animal, disease of the thyroid gland is most often due to a small, benign thyroid mass (adenoma). Carcinomas and thyroid adenomas that enlarge and distort the lobes are also possible, but less likely. Approximately 90% of hyperthyroid cats have a palpable mass on one or both thyroid lobes. Approximately 20% of affected cats have disease in one thyroid lobe, while 70% have disease in both lobes. The active thyroid mass causes excessive release of T₃ and T₄, in turn causing the metabolic rate to soar. Excessive thyroid hormone production can predispose cats to medical conditions such as hypertrophic cardiomyopathy (HCM) and hypertension. Thyroid hormones increase the heart rate and the force of cardiac contraction, which can cause enlargement or thickening of the left ventricular wall, resulting in HCM. As the thickened wall becomes less flexible, fluid may be forced from the lung vessels into the lung parenchyma and chest cavity, resulting in pulmonary edema or pleural effusion (commonly called congestive heart failure or CHF). HCM also commonly causes a heart murmur.

Hypertension is common in cats with hyperthyroidism. It results from an increased heart rate, increased contractility of the heart, and dilation of vessels, all of which are caused by hyperthyroidism. Hypertension typically produces no clinical signs and often subsides after hyperthyroidism is treated, underlying kidney disease can often be unmasked. Because determining the effect of hyperthyroidism on renal function can be difficult, reversible therapy (i.e., oral antithyroid drugs) should initially be administered to affected cats until the effect of establishing euthyroidism on renal function can be determined.

**Diagnosis**

A diagnosis of hyperthyroidism is most commonly based on the combination of medical history, physical examination findings, palpation of a thyroid nodule, and an elevated serum T₄ concentration (TABLE 1). It can be difficult to diagnose hyperthyroidism in a cat with a borderline high T₄ level (i.e., >2.5 to <4.0). In these cases, the FT₄ level should be obtained by equilibrium dialysis. A high normal T₄ level and an elevated FT₄ level are consistent with hyperthyroidism. A low normal T₄ level and an elevated FT₄ level are more consistent with euthyroid sick syndrome and not hyperthyroidism. Concurrent disease states such as cancer, infection, or organ failure can suppress the T₄ level in a hyperthyroid cat, resulting in a normal T₄ level. Occasionally, concurrent illness can cause the FT₄ level to test extremely high, even outside of the reportable range. For these reasons, the FT₄ level should always be checked in tandem with the T₄ level, and a normal T₄ level in a patient with the appropriate clinical signs should prompt an evaluation of the FT₄ level.

**Treatment**

Hyperthyroidism is generally treated with oral antithyroid medication, radioactive iodine, or thyroidectomy. Most pet owners choose oral antithyroid medication. Methimazole is relatively inexpensive and effective for controlling, but not curing, hyperthyroidism. Felimazole (methimazole; Dechra Veterinary Products) is the first FDA-approved.
therapy for hyperthyroidism in cats. Methimazole blocks the production of T₃ and T₄. Because the drug does not affect thyroid hormones that are already in the body, it can take 2 to 4 weeks for blood work to show a response to treatment. Methimazole is available as an oral tablet or liquid as well as a transdermal gel that is applied to the inner pinna. Potential adverse effects of methimazole include lethargy, vomiting, and anorexia. In addition, fewer than 10% of cats develop leukopenia, fewer than 5% develop platelet disorders or autoimmune hemolytic anemia, and fewer than 2% develop liver problems. Because of these adverse effects and because therapy can unmask kidney disease, blood work (including a biochemical profile, complete blood count, and T₄ level) and urinalysis should be performed frequently. Blood work should be performed at least 1 month after therapy begins and every 3 to 6 months after hormone regulation is achieved.

Radioactive iodine therapy consists of one SC or IV injection of iodine 131. Iodine 131 becomes concentrated within the thyroid gland, effectively killing tumor cells without harming normal thyroid tissue. Most treated cats become euthyroid within 1 week, >80% are euthyroid within 3 months, and 95% are euthyroid within 6 months. A second treatment is required in 2% to 4% of cats, and hyperthyroidism recurs in 2% of cats within 1 to 6 years. Adverse effects of this therapy include hypothyroidism (2% of cats). Another disadvantage of this therapy is its relatively high cost compared with methimazole therapy. Radioactive iodine therapy should be considered in cats that are diagnosed early and cats with inoperable masses (ectopic thyroid masses) or thyroid carcinoma.

Thyroidectomy is the most invasive treatment and is more expensive than methimazole therapy, but it can completely resolve hyperthyroidism. In some cases, thyroidectomy does not ameliorate hyperthyroidism. Of the three methods of treatment, thyroidectomy has the most potential for adverse effects (BOX 1). The most severe effect is hypocalcemia in cases of bilateral thyroid gland removal. Even in cases in which not all of the parathyroid glands are removed, subsequent hypocalcemia can develop because of altered blood flow to the remaining parathyroid tissue. Because PTH is secreted from the parathyroid glands and calcitonin from the thyroid gland, removal of these glands affects calcium regulation.

**Prognosis**

The prognosis for a hyperthyroid cat depends greatly on (1) when, in the disease course, the cat presents to the hospital, (2) concurrent disease states, and (3) the incidence of adverse effects of therapy. Any of the treatment methods can be successful if no adverse effects are seen.

### Glossary

- **Alopecia**—lack of hair due to failure to grow or loss after growth
- **Autoimmune hemolytic anemia**—autoantibodies against red blood cells are produced
- **Cachexia**—ill health, malnutrition, and muscle wasting
- **Euthyroidism**—normal thyroid function
- **Glomerular filtration rate**—rate at which the renal glomeruli (tubules; small masses of capillaries) filter
- **Horner’s syndrome**—interruption of the innervations to the eye, characterized by anisocoria and drooping of the eyelid and ear, all on the affected side
- **Hypertrophic cardiomyopathy**—thickening of the left ventricle wall that can lead to congestive heart failure
- **Leukopenia**—a reduced number of white blood cells
- **Tetany**—continuous muscle spasm without noticeable twitching
- **Thyroidectomy**—surgical removal of the thyroid gland

### Complications of Thyroidectomy in Cats With Hyperthyroidism

- Transient or permanent hypoparathyroidism causing hypocalcemia
- Restlessness
- Irritability
- Abnormal behavior
- Muscle cramping and pain
- Muscle tremors, especially in the ears and face
- Tetany
- Convulsions
- Laryngeal paralysis
- Horner’s syndrome
- Hypothyroidism
- Exacerbation of concurrent renal insufficiency

### BOX 1

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The Veterinary Technician’s Role

Client education and compliance are important to the success of treating feline hyperthyroidism. Veterinary technicians can play an important role in recognizing this disease and in caring for affected patients. A thorough history can be invaluable in characterizing the patient’s level of disease and predicting complications. Educating pet owners after diagnosis and explaining laboratory results, the disease process, and treatment options are important skills for technicians to have.

References

1. The main purpose of the thyroid gland is to
   a. regulate blood glucose.
   b. control basal metabolism.
   c. synthesize glucocorticoids and mineralocorticoids.
   d. none of the above

2. Clinical signs of hyperthyroidism include
   a. coughing, sneezing, and exercise intolerance.
   b. weight loss, a ravenous appetite, and hyperactivity.
   c. polyuria, polydipsia, and weight gain.
   d. weight gain, lethargy, and vomiting.

3. Hyperthyroidism is most often associated with a mass on
   a. the adrenal glands.
   b. the right thyroid lobe.
   c. one or both thyroid lobes.
   d. the pituitary.

4. The thyroid hormones are
   a. insulin, T₃, and T₄.
   b. glucagon, T₄, and TSH.
   c. T₃ and T₄.
   d. T₄, glycogen, and insulin.

5. Which of the following is the active thyroid hormone?
   a. TSH
   b. T₃
   c. T₄
   d. none of the above

6. Which of the following is not an adverse effect of hyperthyroidism?
   a. diabetes mellitus
   b. HCM
   c. hypertension
   d. masking of renal insufficiency

7. Which of the following is not a common finding in a cat with hyperthyroidism?
   a. a palpable thyroid nodule
   b. an elevated serum T₄ concentration
   c. a low normal T₄ level and an elevated FT₄ level
   d. a high normal T₄ level and an elevated FT₄ level

8. Why is it not advisable to immediately treat a hyperthyroid cat with radioactive iodine therapy or thyroidectomy?
   a. It is best to first evaluate the effect of hyperthyroidism on renal function by using a reversible therapy.
   b. Radioactive iodine therapy or thyroidectomy is too expensive.
   c. Cats can be permanently cured of hyperthyroidism after beginning oral antihyperthyroid therapy.
   d. Radioactive iodine therapy or thyroidectomy can cause hypercalcemia.

9. Which of the following is not a reaction to methimazole therapy?
   a. lethargy
   b. polyphagia
   c. vomiting
   d. leukopenia

10. Which of the following can be an important task(s) of veterinary technicians in managing cases of feline hyperthyroidism?
    a. take a thorough history
    b. educate clients about treatment options and disease states
    c. help explain laboratory results to clients
    d. all of the above