The Thyroid

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Peter A. Graham, Kent R. Refsal, and Raymond F. Nachreiner

The causes of canine hypothyroidism are varied, but most cases result from irreversible acquired thyroid pathologic changes and only a small proportion arise from congenital anomalies of the thyroid gland or pituitary. Of primary thyroid failure, at least half is the result of immune-mediated thyroiditis. Recent research has focused on the genetics and immunology of canine thyroid disease, adding to what is known from experimental and human studies. Epidemiologic and diagnostic laboratory studies continue to provide information on contributing factors and raise questions for future research directions. Serum antibodies against thyroid components are common in thyroid pathologic conditions and dysfunction, and understanding their properties and frequency is important in the interpretation of thyroid diagnostic test results.

Etiopathologic Findings of Hyperthyroidism in Cats 633
Mark E. Peterson and Cynthia R. Ward

None of the studies to date have isolated a single dominant factor that could be incriminated in the development of hyperthyroidism in cats. Rather, most of the studies provide further evidence of the widely held view that hyperthyroidism is a multifactorial disease in this species. At this time, the most likely candidates include one or more of the goitrogenic chemicals that have been shown to be present in cat food or the cat’s environment. In addition, mutations of the thyroid stimulating hormone receptor gene or mutations of its associated G proteins seem to play an important role in the pathogenesis of this disease.

Testing for Hypothyroidism in Dogs 647
Duncan C. Ferguson

Hypothyroidism is the most common endocrinopathy in the dog. Rather than being a comprehensive review of all possible thyroid function tests, the focus in this article is on the logical progression of test choice, highlighting total thyroxine, free thyroxine, triiodothyronine, thyrotropin (TSH), and antithyroid antibodies. This article includes extensive discussion of the current status of the canine TSH assay and the potential for improving this assay.
Testing for Hyperthyroidism in Cats
Robert E. Shiel and Carmel T. Mooney

Hyperthyroidism remains a common endocrine disorder of cats. Although relatively easy to diagnose in classically presenting cats, the increased frequency of testing cats with early or mild disease has had significant implications for the diagnostic performance of many of the routine tests currently used. Further advances in the etiopathogenesis and earlier diagnosis are only likely with the advent of a species specific feline thyroid-stimulating hormone assay.

Calcium Homeostasis in Thyroid Disease in Dogs and Cats
Patricia A. Schenck

Hyperthyroidism is the most common endocrine disorder of cats, and hypothyroidism is the most common endocrine disorder of dogs. Little is known regarding the effects of hyperthyroidism, hypothyroidism, or treatment of these disorders on calcium metabolism in the dog or cat, however, especially any potential effects on bone. With better diagnostic tools, better treatments, and increased longevity of pets, the clinical impact of thyroid disorders on calcium metabolism and bone may be uncovered.

Clinical Signs and Concurrent Diseases of Hypothyroidism in Dogs and Cats
J. Catherine Scott-Moncrieff

Canine hypothyroidism may present with a wide range of clinical signs. The most common clinical signs are those of a decreased metabolic rate and dermatologic manifestations; however, many other clinical signs have been associated with hypothyroidism. There is strong evidence for a causal relation between hypothyroidism and a variety of neurologic abnormalities; however, the association between hypothyroidism and other manifestations, such as reproductive dysfunction, clinical heart disease, and behavioral abnormalities, is less compelling. Further studies are necessary to determine the full spectrum of disorders caused by hypothyroidism.

Cardiovascular and Renal Manifestations of Hyperthyroidism
Harriet M. Syme

In the simplest terms, hyperthyroidism is the clinical syndrome that results from an excess of thyroid hormones. This review considers the effects of hyperthyroidism on the cardiovascular and renal systems by reviewing the available literature on the clinical manifestations of this syndrome in the cat and also considering experimental studies and experience in other species, including human beings.
**Feline Thyroid Storm**
Cynthia R. Ward

Thyroid storm is a syndrome described in human medicine to define a multisystemic disorder resulting from organ exposure to excessive levels of thyroid hormone. This form of acute thyrotoxicosis, although uncommon, can be life threatening and is a significant cause of mortality in human emergency rooms. Although thyroid storm is a well-recognized clinical entity in human medicine, it has not been described in veterinary medicine. This article discusses the human syndrome and defines a similar syndrome in hyperthyroid veterinary patients. The clinical signs of and treatment modalities for feline thyroid storm are also presented.

**Thyroid Tumors in Dogs and Cats**
Lisa G. Barber

The clinical presentation and biologic behavior of thyroid tumors vary widely among dogs, cats, and human beings. Although thyroid tumors in dogs are rare, they are most likely to be malignant. Clinical signs are usually the result of impingement on surrounding structures, and clinical hyperthyroidism is rare. In contrast, hyperthyroidism resulting from benign thyroid proliferation is relatively common among older cats. Malignant tumors are extremely uncommon but have high metastatic potential. Irrespective of the tumor’s ability to produce functional thyroid hormone, scintigraphy is often helpful in the diagnosis and staging of thyroid tumors in all three species. Treatment with surgery is a reasonable treatment option for noninvasive tumors. Iodine 131 is a well-established treatment for thyroid nodules in cats, but its effectiveness in dogs is controversial. In dogs, external beam radiation therapy has produced more consistent results in affording local tumor control when surgery is not possible.

**Pharmacologic Management of Feline Hyperthyroidism**
Lauren A. Trepanier

Radioiodine is considered the treatment of choice for hyperthyroidism, but in some situations, methimazole therapy is preferred, such as in cats with preexisting renal insufficiency. Unfavorable outcomes from methimazole are usually attributable to side effects, such as gastrointestinal upset, facial excoriation, thrombocytopenia, neutropenia, or liver enzyme elevations. Because restoration of euthyroidism can lead to a drop in glomerular filtration rate, all cats treated with methimazole should be monitored with blood urea nitrogen and creatinine levels in addition to serum thyroxine (T4) and a complete blood cell count. Transdermal methimazole is associated with fewer gastrointestinal side effects and can be used in cats with simple vomiting or inappetence from oral methimazole. Hypertension may not resolve immediately when serum T4 is normalized, and moderate to severe hypertension
should be treated concurrently with atenolol, amlodipine, or an angiotensin-converting enzyme inhibitor.

**Thyroid Surgery in Dogs and Cats** 789

MaryAnn G. Radlinsky

Thyroid surgery is indicated for malignant and benign neoplasms or hyperplasia of the thyroid glands. A ventral midline cervical approach allows for bilateral thyroid exploration. Care should be taken to avoid the surrounding neurovascular structures and esophagus. Evaluation of both thyroids should be done before proceeding with partial or complete thyroidectomy. Complications of thyroid surgery include intraoperative hemorrhage and clinical signs associated with damage to the recurrent laryngeal nerves, parathyroid blood supply, or parathyroidectomy.

**Nuclear Imaging and Radiation Therapy in Canine and Feline Thyroid Disease** 799

Daniel A. Feeney and Kari L. Anderson

The indications, techniques, and expectations for radionuclide diagnostic studies on canine and feline thyroid glands are presented. In addition, the considerations surrounding radioiodine or external beam radiotherapy for benign and malignant thyroid disease are reviewed. The intent of this article is to familiarize primary care veterinarians with the utility of and outcome of the ionizing radiation-based diagnostic and therapeutic techniques for assessing and treating canine and feline thyroid disease.

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