

**INTERNATIONAL SYMPOSIUM**  
**ON**  
**CANINE HYPOTHYROIDISM**

**UNIVERSITY OF CALIFORNIA AT DAVIS**

*August 3 & 4, 1996*

Co-sponsored by

**CANINE HEALTH FOUNDATION**  
**American Kennel Club**

WHITE PAPER # 97-1

March 20, 1997

An Open Letter to All AKC Clubs, dog owners, breeders and exhibitors:

In 1995 the AKC Delegates Committee on Canine Health Education and Research identified several health priority areas for dogs. The first concern on their list was canine hypothyroidism. Taking this list as a priority the newly formed AKC Canine Health Foundation contacted Dr. Richard Nelson and Dr. Niels Pedersen, authorities in canine endocrinology and auto-immune disease at the University of California, Davis. Dr. Nelson and Dr. Pedersen and Sharon Anglin, administrator of the Companion Animal Research Center at UC Davis worked very hard to make the program a success and we thank them and all of the participants at the conference for their efforts.

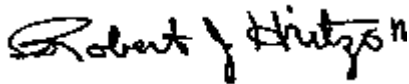
They proposed an International Conference on Canine Hypothyroidism where all of the experts in the field would gather to provide updates on their research and discuss recommendations for testing and future investigations. The symposium would be augmented by a presentation from a dog breeder that had extensive experience dealing with this disease in a breeding population of dogs. Craig Sparkes, a breeder of English Setters since 1974, gave an excellent presentation on the needs of breeders and veterinarians dealing with canine hypothyroidism in a clinical setting.

Also attending the conference were representatives of the AKC Canine Health Foundation, and the AKC Delegates Committee on Canine Health Education and Research. They proposed that the scientists attempt to sort through the available testing alternatives and make a series of recommendations that could guide breeders and veterinarians. This discussion was held in the second day of the conference and led to a series of recommendations that may form the basis for future recommendations in this area.

The proceedings of the conference were published in Canine Practice, Vol. 22 No. 1, January/February 1997. This journal is directed primarily to the veterinary community. The AKC Gazette also published an article summarizing the findings of the conference in their February issue. The AKC Canine Health Foundation decided to provide a summary directed to dog breeders. Elizabeth Bodner, DVM, reviewed all of the material from the conference proceedings and produced this first white paper for the Foundation. It summarizes the proceedings in lay language and captures the primary principles expressed at the conference in a shortened format.

We hope dog owners and breeders will find the information in this paper useful and that it will help them in their ongoing search for the most recent information in canine health.

Sincerely,



Dr. Robert J. Hritz  
President  
AKC Canine Health Foundation

## CANINE HYPOTHYROID SYMPOSIUM SPEAKER LIST

**Mary M. Christopher, DVM, PhD**

Department of Pathology, Microbiology & Immunology  
School of Veterinary Medicine  
University of California, Davis  
Davis, CA 95616  
Phone: 916-752-1385

**Joan Coates, DVM**

Department of Small Animal Medicine  
College of Veterinary medicine  
The University of Georgia  
Athens, GA 30602  
Phone: 706-542-6314  
Fax: 706-542-6400

**Autumn Davidson, DVM**

Encina Veterinary Hospital  
2803 Ygnacio Valley Road  
Walnut Creek, CA  
Phone: 510-937-5000  
Fax: 510-937-8519

**W. Jean Dodds, DVM**

938 Stanford Street  
Santa Monica, CA 90403  
Phone: 310-282-4804  
Fax: 310-828-8251

**Deborah Greco, DVM, PhD**

Department of Clinical Sciences  
College of Veterinary Medicine & Biomedical Sciences  
Colorado State University  
Fort Collins, CO 80523-1678  
Phone: 970-491-1243  
Fax: 970-491-1275

**Duncan C. Ferguson, DVM, PhD**

Department of Physiology & Pharmacology  
College of Veterinary Medicine  
The University of Georgia  
Athens, GA 30602  
Phone: 706-542-5864  
Fax: 706-542-3015

**Russell T. Greene, DVM, PhD**

Southwest Veterinary Diagnostics  
13633 N. Cave Creek Road  
Phoenix, AZ 85022  
Phone: 602-971-4110  
Fax: 602-225-0439

**Cheri A. Johnson, DVM, MS**

College of Veterinary Medicine  
Veterinary Teaching Hospital  
Michigan State University  
East Lansing, MI 48824-1314  
Phone: 517-353-5420  
Fax: 517-432-1799

**Richard Kienle, DVM**

Mission Valley Veterinary Cardiology  
Gilroy, CA

**Peter Kintzer, DVM**

Tufts University  
School of Veterinary Medicine  
Division of Laboratory Animal Medicine  
200 Westboro Road  
North Grafton, MA 01536  
Phone: 508-839-5302  
Fax: 508-839-7980

**Ray Nachreiner, DVM, PhD**

College of Veterinary Medicine  
Animal Health Diagnostic Laboratory  
P.O. Box 30076  
Lansing, MI 48909-7576  
Phone: 916-752-1363  
Fax: 517-353-5096

**Richard W. Nelson, DVM**

Department of Medicine & Epidemiology  
School of Veterinary Medicine  
University of California, Davis  
Davis, CA 95616  
Phone: 916-752-1363  
Fax: 916-752-0414

**David Panciera, DVM, MS**

Alameda East Veterinary Hospital  
Denver, CO 80231

**Ian Ramsey, Vet MB, MRCVS**

Department of Clinical Veterinary Medicine  
University of Cambridge  
Madingley Road  
Cambridge, UK CB3 7XD  
Phone: 44-1223-337621  
Fax: 44-1223-330848

## Speaker List, Continued

**Kent R. Refsal, DVM PhD**

College of Veterinary Medicine  
Animal Health Diagnostic Laboratory  
P.O. Box 30076  
Lansing, MI 48909-7576  
Phone: 517-353-1683  
Fax: 517-353-5096

**Catharine Scott-Mocrieff, Vet MB, MRCVS**

Department of Veterinary Clinical Sciences  
School of Veterinary Medicine  
1248 Lynn Hall  
Purdue University  
W. Lafayette, IN 47907-1248  
Phone: 317-494-1105  
Fax: 317-496-1166

**Dianne Young, DVM, PhD**

Department of Physiology & Pharmacology  
205 Greene Hall  
College of Veterinary medicine  
Auburn, AL 36849-5520  
Phone: 334-844-4425  
Fax: 334-844-5388

**Rod A.W. Rosychuk, DVM**

Department of Clinical Sciences  
College of Veterinary Medicine & Biomedical Sciences  
Colorado State University  
Fort Collins, CO 80523-1678  
Phone: 970-491-1274  
Fax: 970-491-1275

**Eileen L. Thacker, DVM, PhD**

Iowa State University  
Veterinary Medical Research Institute  
1802 Elwood Drive  
Ames, IA 60011  
Phone: 515-294-5097  
Fax: 515-294-1401

## **Introduction**

Canine hypothyroidism is perceived by dog fanciers to be a very common disorder. In fact, the incidence of hypothyroidism is unknown. It has been estimated that approximately 10 percent of cases with clinical signs compatible with hypothyroidism actually have the disease. To make a definitive diagnosis, veterinarians must relate the patient's history and clinical signs to results from laboratory tests that measure thyroid function.

But for one reason or another, some dogs are not tested prior to treatment. Others are diagnosed after a single test that may fail to tell the whole story. And even those that are tested extensively may receive results that are conflicting or difficult to interpret. Furthermore, the diagnostic value of the various laboratory tests--at least 11 different ones, at last count--has been questioned by some researchers. It's small wonder that a survey by the AKC Delegate Committee on Health Research found that thyroid problems are the top concern among breeders, clubs, dog fanciers and AKC members.

Thus the AKC Canine Health Foundation and the Center for Companion Animal Health at the School of Veterinary Medicine, University of California, Davis, asked Richard Nelson, DVM to organize an international symposium on canine hypothyroidism for the benefit of all those concerned. The symposium was envisioned as an opportunity for endocrinologists, veterinarians and breeders to share ideas, discuss their current understanding of the disease, debate controversial topics and consider future strategies for the prevention, diagnosis and treatment of hypothyroidism.

The symposium became a reality on August 3 and 4, 1996, when approximately 100 people gathered at the University of California at Davis. Presenters included leading researchers in canine endocrinology. Craig Sparkes, an English Setter fancier, spoke about issues of hypothyroidism that affect breeders. Representatives from the AKC and the AKC Canine Health Foundation, which helped sponsor the event, included Dr. Sheldon Adler, chairman of the Delegates Committee on Canine Health Research and Education; Robert Kelly, a Board Member

of the AKC/CHF, Ed Gilbert, an AKC Delegate; and Deborah Lynch, executive director of the AKC/CHF.

### **Landmark Consensus**

The most significant outcome was the establishment of a practical approach to diagnosing and monitoring hypothyroidism.

For all dogs, the protocol begins with a complete blood count, blood chemistry panel, urinalysis, case history and physical examination. After this initial database is developed, testing depends on whether the patient is a pet, performance or breeding dog.

**Breeding Dogs.** The work-up for a breeding dog continues with the following laboratory tests: total T<sub>4</sub> (TT<sub>4</sub>), free T<sub>4</sub> measured by equilibrium dialysis (fT<sub>4</sub>ed), thyroglobulin autoantibodies (TgAA) and canine thyroid stimulating hormone (cTSH). In an apparently healthy dog, normal results indicate no current thyroid disease, and breeding may proceed. If there is a family history of hypothyroidism, the tests may be repeated annually.

On the other hand, a dog that has normal results but shows clinical signs of hypothyroidism should be withheld from breeding, and the tests should be repeated in two to six months. Other causes for the clinical signs should also be pursued.

If the results of the apparently healthy dog's tests are abnormal, there is some potential risk in breeding. The experts again recommend waiting and retesting the dog in two to six months. Abnormal results in conjunction with clinical signs of hypothyroidism warrant treatment and, of course, a stay on breeding.

**Performance Dogs.** After its initial database has been established, the performance dog should also have a TT<sub>4</sub> test, fT<sub>4</sub>ed test, TgAA test and cTSH test. If the results are normal and no clinical signs are present, but a family history of hypothyroidism exists, the tests should be repeated annually. The tests should be repeated in 2 to 6 months if the dog has normal test results and symptoms of hypothyroidism. Again, other causes for the clinical signs should also be pursued.

The apparently healthy performance dog that tests positive for low thyroid activity should be followed closely, and a cautious approach to breeding is recommended. Abnormal test results in combination with clinical signs warrant treatment.

**Pet Dogs.** The diagnostic protocol for pet dogs calls for a TT<sub>4</sub> test after creation of the initial database. A normal result, in the absence of clinical signs, means there is no current hypothyroid disease. A normal result in conjunction with clinical signs, however, should lead to a cTSH and fT<sub>4</sub>ed test. At this point, if the results of those additional tests are normal, the investigation ends, there is no treatment, and another cause for the clinical signs should be pursued. If the cTSH and fT<sub>4</sub>ed test yield abnormal results, the dog is treated with thyroid supplementation. The pet dog that has clinical signs of hypothyroidism and an abnormal result on its initial TT<sub>4</sub> test should also be treated.

Symposium participants also discussed the preferred method of monitoring thyroid status. Response to therapy should be critically evaluated 6 to 8 weeks after initiating treatment, and should include assessment of clinical response and thyroid hormone testing. Most recommended a TT<sub>4</sub> or fT<sub>4</sub>ed test, measured four to six hours after thyroid supplementation. The test result, known as a "peak value," should fall within the high-normal to slightly high range. A few participants advocated pre-pill testing (just prior to thyroid supplementation), especially if the supplement is only given once a day. This test result, or "trough value," should fall within the normal range. Testing should be repeated annually, unless the history and clinical signs warrant earlier action. Also, dogs should be treated with a name-brand, synthetic levothyroxine sodium product approved for veterinary use.

### **Symposium Highlights**

A presentation by one California veterinarian in private practice demonstrates why the preceding information should help relieve some of the confusion surrounding hypothyroidism.

Autumn Davidson observed that many of the dogs referred to her internal medicine/reproduction practice arrive on thyroid supplementation. Some have historical,

laboratory and clinical data to support the diagnosis of hypothyroidism, but many do not. Suspecting hypothyroidism without the benefit of veterinary advice, some owners obtain and administer the inexpensive medication without a prescription, apparently unaware of the potential risks. Most owners are reluctant to wean their dog off thyroid supplementation to repeat meaningful testing; others prefer not to finance testing if they perceive clinical improvement. Dr. Davidson's experience illustrated how insufficient information, misinformation and misunderstandings about canine hypothyroidism are typical.

As a veterinary internist and employee of a major diagnostic laboratory, Russell Greene presented some of the most common questions he encounters about hypothyroidism. "The right answer seems to depend on who is quoted and, sometimes, when it was stated," he remarked. Many questions were met with more questions. For example, when queried about which TSH response test protocol is acceptable, Dr. Greene noted that researchers appear to disagree on the dosage of TSH, the post-TSH blood collection time and the interpretation of results. Regarding methodology, he described published reports that send mixed messages about the use of free T<sub>4</sub> assays performed by the dialysis method versus radioimmunoassay (RIA), and also said that information concerning the accuracy of endogenous TSH assays is lacking. Furthermore, Dr. Greene argued that no "ultimate" test can be routinely used to assess thyroid gland function, since the result from one test may prove equivocal or contradictory in light of results from other "ultimate" tests.

### **Etiopathogenesis**

Most cases of primary thyroid disease stem from idiopathic thyroid atrophy and lymphocytic thyroiditis, said Eileen Thacker.

Idiopathic thyroid atrophy is characterized by loss of thyroid tissue, which is replaced by fat and connective tissue. This differs from lymphocytic thyroiditis, in which inflammatory cells invade and eliminate the thyroid tissue. Clinical signs of hypothyroidism become apparent as the thyroid gland is progressively destroyed.



Lymphocytic thyroiditis affects male and female dogs equally. A familial tendency has been demonstrated in Great Danes, Beagles and Borzois. An increased prevalence of thyroid autoantibodies noted in Doberman Pinschers, Old English Sheepdogs and Irish Setters suggests that thyroiditis is inherited in these breeds. The pattern of heritability appears to be polygenic.

"Recognition that the major initiating cause of the autoimmune response is generated within the thyroid and that the thyroid has the capacity to induce this destructive response, makes the thyroid not only the target of the autoimmune response, but also the source," commented Dr. Thacker. Although the initiating factor is unknown, environmental and genetic influences are suspected.

Diane Young continued by saying that autoantibodies (AA) are important for their potential role in the development of autoimmune lymphocytic thyroiditis (ALT), and for their capacity to exacerbate the hypothyroid condition by binding thyroid hormone. Thyroglobulin AA (TgAA) are much more prevalent than thyroid hormone AA (THAA), and may have a direct role in inducing ALT. However, detection of TgAA has limited use as a diagnostic tool. Thyroid hormone autoantibodies can also interfere with assays for T<sub>4</sub> and T<sub>3</sub>, making a diagnosis more difficult to obtain.

Dr. Young proposed long-term monitoring of hypothyroid-prone dogs for the sequence of appearance and changes in titer of anti-thyroid AA relative to the progression of thyroid damage; this could help identify the role of anti-thyroid AA in the development of ALT. Similarly, studies to determine the anti-thyroid AA profile in dogs with documented ALT and idiopathic thyroid atrophy could prove valuable.

Thyroid AA are more prevalent in dogs assessed as hypothyroid, noted Kent Refsal and Ray Nachreiner. However, they have also been detected in the serum of normal dogs, including dogs related to hypothyroid dogs, and in dogs with other illnesses.

For more than 7 years, Drs. Refsal and Nachreiner have screened laboratory dogs for T<sub>3</sub>AA and T<sub>4</sub>AA as part of a canine thyroid profile. Surveys of their database support the association of positive thyroid hormone AA and hypothyroidism in the dog. Autoantibodies

were more prevalent in sera with other laboratory results consistent with hypothyroidism, i.e. elevation of TSH and low thyroid hormone concentrations. The AA are more prevalent in young to middle-aged dogs, the age group associated with a higher occurrence of clinical hypothyroidism. They are also more prevalent in breeds that are considered predisposed to hypothyroidism. The significance of positive AA in young, healthy dogs remains to be fully defined, but researchers feel that there should be concern for an increased risk of clinical hypothyroidism.

W. Jean Dodds added that the prevalence of autoimmune diseases in animals has increased rapidly in recent years. This has been attributed to genetic and sex predisposition, nutritional influences, exposure to toxins and drugs, recent viral infections or use of polyvalent vaccines and pituitary-thyroid axis imbalances. Individuals that are genetically susceptible to autoimmune thyroid disease may also become more susceptible to immune-mediated diseases affecting other target tissues and organs. Dr. Dodds observed behavioral problems in some dogs affected with thyroid or polyglandular autoimmune disease.

### **Discussion Section I**

A discussion session took place after the segment on etiopathogenesis, where participants raised the following issues:

\* **Evaluating the impact of different stages of the estrus cycle on thyroid gland tests.** Estrogen, a factor in autoimmunity in humans, may also play a role in dogs.

\* **The relationship between the presence of anti-T<sub>3</sub> antibodies and hypothyroidism.** Some dogs are positive for these antibodies but have no clinical signs and have normal concentrations of serum TSH and free T<sub>4</sub> measured by equilibrium dialysis. Others have hypothyroidism but serum anti-T<sub>3</sub> antibodies have not been identified on blood testing. Dr. Thacker commented that there is a very small data base upon which to formulate the belief that anti-thyroid hormone antibodies are associated with lymphocytic thyroiditis. At this point, she would not state absolutely that a dog with T<sub>3</sub> autoantibodies is going to become clinically hypothyroid sometime in its life.

\* **Recommendations to breeders on reducing hypothyroidism.** Until the mode of inheritance of hypothyroidism is determined, participants advised breeders to expand their gene pool, avoid inbreeding and line breeding as much as possible, and keep records of thyroid status, including parents, siblings and offspring.

\* **Thyroid biopsies.** Histologic evaluation of a thyroid biopsy can confirm a diagnosis of hypothyroidism, but it is not without controversy. Dr. Thacker commented that the potential gains would have to be weighed against the invasiveness of the technique. Dr. Davidson believed that a biopsy may be warranted in the case of a valuable breeding dog that is likely to have a significant impact on the breed. Dr. Greene added that the sample may not be representative of the entire gland, and that normal histologic findings do not ensure normal results in the future. Dr. Nelson recalled biopsies from the 1980s in which "the results were just as confusing as the other diagnostic tests."

\* **Genetic testing.** Breeders need access to good information about hypothyroidism; professionals need to agree on what constitutes true hypothyroidism and what tests, when abnormal, raise concern for possible transmission of the disease to offspring. Duncan Ferguson believes a genetic test will ultimately predict which dogs are predisposed to developing hypothyroidism. However, multiple factors are probably involved, and even if genetic markers are identified, a prediction may be uncertain.

### **Clinical Manifestations**

Thyroid hormone secretion is essential for normal postnatal development of the nervous and skeletal systems, commented Deborah Greco during her presentation.

Although congenital hypothyroidism is relatively uncommon in dogs, it results in characteristic findings such as gait abnormalities, disproportionate dwarfism, facial anomalies, delayed dental eruption, abdominal distention, retained puppy coat and mental dullness. The first signs of abnormal growth occur as early as three weeks after birth and abnormal body proportions are evident by two months. There are also clinicopathologic abnormalities, such as

hypercholesterolemia, hypercalcemia and mild anemia. A diagnosis may be confirmed by thyroid function testing (normal ranges for puppies may differ from those for adults). Dr. Greco suggested that puppies of breeds at high risk for congenital hypothyroidism be screened at 6 to 8 weeks.

Skin abnormalities are the most common clinical signs associated with hypothyroidism, said Rod Rosychuk. These signs appear to vary with breed, severity and chronicity of the disease.

The earliest change is usually excessive scaling. Shedding is altered, and hairs may become coarse, brittle, fine, matted or lighter than normal. Hair loss is common, and hair may not regrow after clipping. Some of the other changes include darkening of the skin, facial puffiness, thickening over pressure points and poor wound healing. The skin is not itchy, unless secondary infection or other problems are involved.

Skin biopsies are helpful, but the cutaneous histologic changes associated with hypothyroidism are not considered diagnostic of the disease. Dr. Rosychuk says there is a need to correlate breed specific histology of normal skin with breed specific histologic changes from hypothyroid dogs to better assess the value of biopsies.

Hypothyroidism is an underlying cause of some neurologic diseases, said Joan Coates, and it may also be diagnosed in association with neurologic disorders. The most clearly defined neurologic disease associated with canine hypothyroidism is hypothyroid polyneuropathy, which causes generalized weakness. Electromyography can help define the neurologic disease, but diagnostic confirmation depends on the resolution of the clinical signs with therapy.

Studies to determine the effects of hypothyroidism on reproduction have yielded conflicting results. The disease may or may not be associated with clinical signs of reproductive dysfunction. Drs. Johnson, Nachreiner, Mullaney and Olivier compared the reproductive function of two groups of male laboratory Beagles, one normal and the other with experimentally induced hypothyroidism. Although the latter group developed progressively worsening signs of hypothyroidism such as skin and coat changes, obesity and lethargy, the researchers found no

difference in their daily sperm production, sperm motility or morphology. They concluded that hypothyroidism induced by radioactive iodine does not affect reproductive function in male dogs.

Hemostasis, or the ability to control bleeding, appears to be minimally affected by hypothyroidism in dogs. Recent studies have failed to confirm a causal relationship between hypothyroidism and von Willebrand's disease, commented David Panciera, who added that any association probably stems from the high prevalence of both diseases in certain breeds. Further research is necessary to evaluate the effect of levothyroxine treatment on dogs deficient in von Willebrand factor.

As for the cardiovascular system, hypothyroidism can cause slowing of the heartbeat and cardiac arrhythmias. Abnormalities are observed on echocardiography and ECG, many of which reverse with thyroid hormone supplementation. The relationship between hypothyroidism and dilated cardiomyopathy has not been documented convincingly, and no relationship has yet been drawn between hypothyroidism and overt congestive heart failure.

## **Discussion Section II**

Participants reconvened for a question-and-answer session at the completion of the section on clinical manifestations. The dialogue included:

\* **The relationship between hypothyroidism and megaesophagus or laryngeal paralysis.** The group heard about one case of megaesophagus that improved after supplementation and another that did not. One dog with laryngeal paralysis improved with treatment, but this may have been due to weight loss and reduced pharyngeal swelling. Also, no association was made with periocular disease.

\* **Are studies of induced hypothyroidism adequate?** They provide good models for the study of the metabolic effects, participants said, but they are less than ideal for studying immunological effects. Studies on reproductive function need to be performed in dogs with spontaneously-occurring disease. Dr. Dodds commented on the need to work with breeders and

design prospective studies using breeds predisposed to developing hypothyroidism, or families within a breed that have hypothyroidism in their line.

\* **Additional discussion on hypothyroidism and fertility.** Dr. Johnson defended the results of her study, but remarked that the relationship between hypothyroidism and reproductive problems in females remains to be critically evaluated. Most of the bitches she has evaluated are not hypothyroid and if they are, she believes their fertility problem is related to something else. In her experience, Dr. Henderson commented, many males that have received thyroid medication to improve their fertility remain sterile.

\* **Thyroid supplementation and cardiac disease.** Dr. Kienle discussed treatment protocols in cases of pre-existing and concurrent cardiac disease. He also said that cardiac manifestations are minimal to nonexistent in hypothyroid dogs receiving standard therapy, with normal to mildly increased serum T<sub>4</sub> concentrations and no signs of hyperthyroidism.

### **Laboratory Test Results**

The third segment of the symposium began with remarks by Mary Christopher on abnormal laboratory test results that are associated with hypothyroidism. Dr. Christopher reflected that these abnormalities are not specific for hypothyroidism, but when viewed in context they can help indicate or support the diagnosis, reflect the severity of metabolic derangement and predict complications such as atherosclerosis. The most common biochemical abnormality in hypothyroid dogs is hyperlipidemia, or high serum lipid levels. High cholesterol is observed in 66%-80% of hypothyroid dogs. Evaluating thyroid gland function is an important component of diagnosing hypothyroidism, and Dr. Nelson made recommendations concerning the use of baseline thyroid hormone concentrations. Measurement of baseline serum T<sub>4</sub> and/or serum free T<sub>4</sub> concentration as determined by modified equilibrium dialysis is recommended for initial evaluation of thyroid gland function, he said. Measurements of serum T<sub>3</sub> and serum free T<sub>4</sub> determined by RIA are not recommended. In humans, a diagnosis of hypothyroidism is supported by interpreting basal thyroid hormone concentrations with an

endogenous thyrotropin (TSH) concentration. J. Catharine Scott-Moncrieff described studies of a new assay for measuring canine TSH (cTSH). The assay had good specificity in diagnosing hypothyroidism, especially when interpreted with TT<sub>4</sub>. Some euthyroid dogs with severe concurrent illness may have increased cTSH concentration. All but one of the euthyroid dogs with increased cTSH concentrations in Dr. Scott-Moncrieff's study had a normal TT<sub>4</sub>. Thus a dog with consistent clinical signs, a low TT<sub>4</sub> and a high cTSH is highly likely to be hypothyroid.

Another study, described by Ian Ramsey and Michael Herrtage, compared the value of total thyroxine (TT<sub>4</sub>) and thyrotropin (cTSH) measurements in the diagnosis of hypothyroidism.

Assessing cTSH concentrations alone lacks both sensitivity and specificity in diagnosing the disease, they concluded. In addition, prior treatment with drugs can greatly reduce the concentrations of cTSH, negating the diagnostic value of the test. Diagnostic specificity is improved if basal cTSH concentrations are interpreted with basal T<sub>4</sub> concentrations and the response of TT<sub>4</sub> to thyrotropin releasing hormone (TRH) stimulation. Unfortunately, conflicting results are common.

Diagnosing hypothyroidism based upon clinical signs and an assay for TT<sub>4</sub> alone is not a good practice, said Drs. Nachreiner and Refsal. Hypothyroidism is not a clinically unique syndrome and many factors can decrease TT<sub>4</sub> concentrations in euthyroid dogs.

The TSH response test improves the accuracy of TT<sub>4</sub> assays, but injectable TSH is difficult to obtain. However, other assays paired with TT<sub>4</sub> will help improve the diagnostic accuracy of a baseline sample. For instance, pairing the new assay for cTSH with either TT<sub>4</sub> or free T<sub>4</sub> (FT<sub>4</sub>) enhances the accuracy of finding true primary hypothyroid dogs and eliminating dogs with sick euthyroid condition. By using FT<sub>4</sub> (especially free T<sub>4</sub> by dialysis) instead of TT<sub>4</sub>, the accuracy of diagnosis can also be improved. The results of the TT<sub>3</sub> assay, regarded by many clinicians as confusing to interpret, are more meaningful when one considers how TT<sub>3</sub> is affected by other illnesses such as hyperadrenocorticism.

They added that new assays for thyroglobulin autoantibody (TGAA) will help recognize autoimmune thyroiditis. In summary, a thyroid profile of multiple hormone assays offers a better chance of making a diagnostic decision than a single baseline sample.

A TSH stimulation test can help determine thyroid function, said Peter Kintzer. The most commonly recommended protocol involves the measurement of serum T<sub>4</sub> levels prior to and 6 hours after the IV administration of 0.1 U/kg of TSH. Dr. Kintzer described the typical responses shown by dogs with various stages of thyroid function, as well as nonthyroidal illness. The disadvantages of the test are the unavailability of TSH, its high cost and the necessity of hospitalizing the dog for the day.

"With the advent of the canine TSH and free thyroxine by dialysis assays," commented Dr. Kintzer, "there will be less indication for use of the TSH stimulation test in clinical practice." However, it may continue to be useful in certain cases.

Dr. Kintzer advises against using the thyrotropin releasing hormone (TRH) stimulation test as a primary diagnostic test for hypothyroidism. However, evaluating the serum TSH response to TRH may yield some valuable information.

Duncan Ferguson discussed some of the factors that alter thyroid function test results. Certain breeds, most notably the sighthounds, have considerably lower ranges of normal thyroid hormone concentrations. Age is another factor; studies with Beagles have shown an age-dependent decline in TT<sub>4</sub> concentrations and/or free T<sub>4</sub> concentrations. Nonthyroidal illnesses may also greatly lower TT<sub>4</sub> and TT<sub>3</sub>. Low serum TT<sub>4</sub> concentrations have been reported in hyperadrenocorticism, diabetes mellitus, hypoadrenocorticism, chronic renal failure, hepatic disease and a variety of other critical medical illnesses requiring intensive care.

Numerous drugs can also depress thyroid hormone concentrations. These include most forms of general anesthesia, glucocorticoids, Tribissen, iodine containing agents, radiocontrast dyes, phenobarbital, furosemide and nonsteroidal pain relievers such as aspirin and phenylbutazone.



To distinguish the influence of illness and drugs from hypothyroidism, practitioners should first use common sense, based upon a careful history, physical examination and laboratory screening tests. Then they should examine the results from (1) measurement of FT<sub>4</sub> in undiluted serum using an equilibrium dialysis technique; (2) measurement of basal cTSH; and (3) measurement of TRH-stimulated TSH.

### **Discussion Section III**

At this point, symposium participants addressed the following topics on diagnostic testing:

\* **Continuing evaluation of the new chemiluminescence assay for measuring free T<sub>4</sub>.**

\* **The value of TSH response testing in identifying early stages of thyroid dysfunction.** Dr. Nelson commented that the TSH stimulation test is of limited to no value as a screening test to predict future development of clinical hypothyroidism. He advocated tests which suggest current thyroid destruction in dogs that can secrete adequate amounts of T<sub>4</sub> to prevent clinical signs, such as the thyroglobulin or thyroid hormone autoantibody tests. The thyroglobulin autoantibody test is commercially available and holds promise as a screening test for breeding dogs, said Dr. Nachreiner. Participants also discussed the relationship between TSH response testing and hypothyroidism due to pituitary disease.

\* **Do dogs with positive autoantibody tests develop clinical hypothyroidism?** Having followed Golden Retrievers and Old English Sheepdogs that test positive for thyroid hormone autoantibodies, Dr. Dodds found that signs usually start to develop within 1 to 1.5 years. Drs. Peterson and Feldman commented about their experience with dogs that have been positive for thyroid hormone autoantibodies yet remain asymptomatic. Dr. Ferguson discussed a reduction in the prevalence of hypothyroidism from generation to generation when dogs positive for thyroglobulin autoantibody and symptomatic for hypothyroidism were removed from the

breeding colony. Dr. Scott-Moncrieff added that there may be several different variations of thyroiditis in dogs.

\* **How prevalent is hypothyroidism?** Evaluating a random population of 98 healthy dogs, Dr. Nachreiner discovered some evidence of autoimmune thyroid disease in 3% of the group. Dr. Nelson considered three factors that cloud the issue of significance: (1) Clinical signs are vague and extremely variable. (2) T<sub>4</sub> concentration appears routinely in many biochemistry panels, even when hypothyroidism is not part of the veterinarian's differential diagnosis, leading to the misdiagnosis of many euthyroid dogs. (3) Thyroid hormone supplementation does not cause obvious, serious adverse effects when given to a euthyroid dog.

## **Treatment**

Synthetic levothyroxine, initially given twice daily, is the preferred treatment for virtually all cases of hypothyroidism, said Dr. Panciera. A veterinary levothyroxine preparation (not generic) is recommended. The initial dose should be reduced in dogs with some concurrent diseases, as well as in old dogs, and then increased gradually until the appropriate dose is reached. It may need to be increased in pregnant bitches, dogs concurrently treated with certain drugs, and dogs with small intestinal malabsorption disorders. Careful monitoring is needed, and adjustments in dosage should be made accordingly. Response to treatment is usually noted within one week, as evidenced by increased activity and improved attitude. Lack of response after 6 to 8 weeks should lead to further investigation. Complications of treatment generally result from an inadequate or excessive dosage.

Monitoring the effect of supplementation is an important part of case management, said Drs. Refsal and Nachreiner. Assessing clinical response is critical, and measuring the therapeutic concentrations of thyroid hormones provides quantitative data to assist in decisions to maintain or alter the course of treatment. Therapeutic concentrations of thyroid hormone vary among individuals, undoubtedly reflecting differences in efficiency of absorption and elimination of T<sub>4</sub>. The potential influences of aging, other illnesses, diet or drugs merit

investigation, said the researchers. Also, the usefulness of assays such as TSH or free T<sub>4</sub> by equilibrium dialysis in therapeutic monitoring remains to be determined.

#### **Discussion Section IV**

Regarding treatment, participants examined these issues:

\* **Do subtherapeutic dosages of levothyroxine harm euthyroid dogs?** Thyroid supplementation is not indicated in a euthyroid dog, said Dr. Panciera, but as long as high doses that induce hyperthyroidism are avoided, he doubts that it is harmful. A dog may become temporarily hypothyroid when treatment is withdrawn.

\* **Can therapy be adjusted based on post-treatment TSH concentrations?** Although this has not been critically evaluated, Dr. Refsal believes that TSH concentrations decrease once post-pill T<sub>4</sub> concentrations are normal to high (the TSH assay does not identify low TSH values, however). Dr. Scott-Moncrieff studied TSH concentrations over a 12-hour period after administering sodium levothyroxine and found no significant change. Dr. Ferguson commented that TSH concentration was within the normal range in a group of dogs treated with standard, twice daily therapy.

## BIBLIOGRAPHY

For more information about canine hypothyroidism, refer to the relevant chapters in the following veterinary textbooks:

**Canine and Feline Endocrinology and Reproduction**, by Ed Feldman and Richard Nelson. W.B. Saunders Co., publisher.

**Textbook of Veterinary Internal Medicine**, by Stephen J. Ettinger. W.B.Saunders Co., publisher.