A summary of a study of 1500+ dogs with undesirable behaviors in which a significant relationship was found between thyroid dysfunction and such behaviors and/or seizures. Dr. Dodds emphasizes the importance of thyroid testing for dogs with behavior problems and notes that treatment provided marked improvement. Thyroid, Behavior problems

RELATIONSHIP BETWEEN CANINE THYROID DYSFUNCTION AND ABERRANT BEHAVIOR

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Summary

The principal reason for pet euthanasia stems not from disease, but undesirable behavior. While this abnormal behavior can have a variety of medical causes, it also can reflect underlying problems of a psychological nature. An association has recently been established between aberrant behavior and thyroid dysfunction in the dog. Typical clinical signs include unprovoked aggression towards other animals and/or people, sudden onset of a seizure disorder in adulthood, disorientation, moodiness, erratic temperament, periods of hyperactivity, hypoattentiveness, depression, fearfulness and phobias, anxiety, submissiveness, passivity, compulsiveness, and irritability. After the episodes, most of the animals appeared to be coming out of a trance like state, and were unaware of their previous behavior.

Our ongoing study involves over 1500 cases of dogs presented to veterinary clinics for aberrant behavior. The first 499 cases have been analyzed independently by a neural network correlative statistical program. Results showed a significant relationship between thyroid dysfunction and seizure disorder, and thyroid dysfunction and dog-to-human aggression. Treatment outcomes in 95 cases showed a significant behavioral improvement in 61% of the dogs.

Collectively, these findings confirm the importance of including a complete thyroid antibody profile as part of the laboratory and clinical work up of any behavioral case.

Background

A sudden onset of behavioral changes in an otherwise healthy young animal should alert the client and veterinarian to the possibility of an underlying thyroid imbalance. While abnormal behavior can reflect underlying problems of a psychological nature, it also can have a variety of medical causes. Therefore, the medical evaluation should include a complete history, clinical examination and neurological work up, routine laboratory testing of blood counts, blood chemistry and thyroid profiles, urinalysis, fecal exam and x-ray. Additional specific laboratory tests may be indicated based on the specifics involved. If all of these tests prove to be negative, evaluation by a qualified behavioral consultant should be undertaken.

Inheritance has been shown to play an important role in the behavior of both animals and humans. The role of inheritance in behavior was reviewed by Plomin (Science 248:183-188, 1990), who pointed out that the genetic influence on behavioral disorders rarely accounts for more than half of the phenotypic expression of behavioral differences. Each of the multiple genes involved has a small effect on behavior. Development and application of newer techniques in molecular biology offers the promise of identifying the DNA marker sequences responsible for behavioral variation. However, behavior is the most complex phenotype because it reflects not only the functioning of the whole organism but also is dynamic and changes in response to environmental influences.

With respect to animal behavior, applied behavioral genetics was first studied several thousand years ago because animals were bred and selected for their behavior as much as their conformation. The results can be attested to by the dramatic differences in behavior and physique among various dog breeds. Today, these breeds have a great range of genetic and behavioral variability.

An association between behavioral and psychologic changes and thyroid dysfunction has been recognized in humans since the 19th century, and more recently has been noticed in cats with hyperthyroidism. In a recent human study, 66% of patients with attention deficit-hyperactivity disorder were found to be hypothyroid, and supplementing their thyroid levels was largely curative.
The mechanism whereby diminished thyroid function affects behavior is unclear. Hypothyroid patients have reduced cortisol clearance, and the constantly elevated levels or circulating cortisol mimic the condition of an animal in a constant state of stress, as well as suppressed TSH output and production of thyroid hormones. In humans and seemingly in dogs, mental function is impaired and the animal is likely to respond to stress in a stereotypical rather than a reasoned fashion. Chronic stress in humans has been implicated in the pathogenesis of affective disorders such as depression. Major depression has been shown in imaging studies to produce changes in neural activity or volume in areas of the brain which regulate aggressive and other behaviors. Dopamine and serotonin receptors have been clearly demonstrated to be involved in aggressive pathways in the CNS. Hypothyroid rats have increased turnover of serotonin and dopamine receptors, and an increased sensitivity to ambient neurotransmitter levels.

Many investigators in recent years, have noted the sudden onset of behavioral changes in dogs around the time of puberty or as young adults. Most of the dogs have been purebreds or crossbreeds with an apparent predilection for certain breeds. For a significant proportion of these animals, neutering does not alter the symptoms and in some cases the behaviors intensify. The seasonal effects of allergies to inhalants and ectoparasites such as fleas, followed by the onset of skin and coat disorders including; pyoderma, allergic dermatitis, alopecia, and intense itching, have also been linked to changes in behavior. Many of these dogs belong to a certain group of breeds or dog families susceptible to a variety of immune problems and allergies (e.g. Golden Retriever, Akita, Rottweiler, Doberman Pinscher, English Springer Spaniel, Shetland Sheepdog, and German Shepherd Dog). The clinical signs in these animals, before they show the sudden onset of behavioral aggression, can include minor problems such as inattentiveness, fearfulness, seasonal allergies, skin and coat disorders, and intense itching. These may be early subtle signs of thyroid dysfunction, with no other typical signs of thyroid disease being manifested.

The typical history starts out with a quite, well-mannered and sweet-natured puppy or young adult dog. The animal was outgoing, attended training classes for obedience, working, or dog show events, and came from a reputable breeder whose kennel has had no prior history of producing animals with behavioral problems. At the onset of puberty or thereafter, however, sudden changes in personality are observed. Typical signs can be incessant whining, nervousness, schizoid behavior, fear in the presence of strangers, hyperventilating and undue sweating, disorientation, and failure to be attentive. These changes can progress to sudden unprovoked aggressiveness in unfamiliar situations with other animals, people and especially with children.

In adult dogs, moodiness, erratic temperament, periods of hyperactivity, lack of concentration, depression, fearfulness and phobias, anxiety, submissiveness, passivity, compulsiveness, and irritability may be observed. After the episodes, most of the animals behave as though they were coming out of a trance like state, and are unaware of their previous behavior.

Another group of dogs show seizure or seizure-like disorders of sudden onset that can occur at any time from puberty to mid-life. These dogs appear perfectly healthy outwardly, have normal hair coats and energy, but suddenly seize for no apparent reason. The seizures are often spaced several weeks to months apart, may coincide with the full moon, and can appear in brief clusters. In some cases the animals become aggressive and attack those around them shortly before or after having one of the seizures. The numbers of animals showing these various types of aberrant behavior appear to be increasing in frequency over the last decade.

In dogs with aberrant aggression, a large collaborative study between our group and Dr. Dodman and colleagues at Tufts University School of Veterinary Medicine has shown a favorable response to thyroid replacement therapy within the first week of treatment, whereas it took about three weeks to correct their metabolic deficit. Dramatic reversal of behavior with resumption of previous problems has occurred in some cases if only a single dose is missed. A similar pattern of aggression responsive to thyroid replacement has been reported in a horse.

Whenever an animal is presented for exhibiting abnormal behavior, the clinical veterinarian needs to apply a systematic diagnostic approach in search of medical causes that could explain the problem. Our
studies, summarized below, indicated that a complete thyroid profile should be included in the clinical and behavioral work up of these cases.

**Results**

**Complete Thyroid Profile**

Most veterinary diagnostic laboratories now offer comprehensive diagnostic tests for thyroid disease. The basic panel includes total T4, total T3, free T4, free T3, T3 autoantibody (T3AA) and T4 autoantibody (T4AA), which can be augmented with cTSH and thyroglobulin autoantibody (TgAA). For purposes of our study, abnormal thyroid function is defined as a dog having 3 or more complete thyroid profile analytes falling outside the predetermined normal reference ranges.

**Behavioral Score**

The predefined 6-point subjective behavioral scale developed by Dr. Dodman at Tufts University is used. Tables 1-2 summarize results of complete thyroid diagnostic profiling on 634 canine cases of aberrant behavior, compiled by this author in collaboration with Drs. Nicholas Dodman, Linda Aronson, and Jean DeNapoli of Tufts University School of Veterinary Medicine, North Grafton, MA. Ninety percent (568 dogs) were purebreds and 10% were mixed breeds. There was no sex predilection found in this case cohort, whether or not the animals were intact or neutered. Sixty-three percent of the dogs had thyroid dysfunction as judged by finding 3 or more abnormal results on the comprehensive thyroid profile. The major categories of aberrant behavior were aggression (40% of cases), seizures (30%), fearfulness (9%), and hyperactivity (7%); some dogs exhibited more than one of these behaviors (Table 2). Within these 4 categories, thyroid dysfunction was found in 62% of the aggressive dogs, 77% of seizuring dogs, 47% of fearful dogs, and 31% of hyperactive dogs.

Outcomes of treatment intervention with standard twice daily doses of thyroid replacement were evaluated in 95 cases. Of these, 58 dogs had greater than 50% improvement in their behavior as judged by a predefined 6-point subjective scale (34 were improved > 75%), and another 23 dogs had >25 but <50% improvement. Only 10 dogs experienced no appreciable change, and 2 dogs had a worsening of their behavior. When compared to 20 cases of dominance aggression treated with conventional behavior or other habit modification over the same time period, only 11 dogs improved more than 25%, and of the remaining 9 cases, 3 failed to improve and 3 were euthanized or placed in another home. These initial results are so promising that complete thyroid diagnostic profiling and treatment with thyroid supplement, where indicated, is warranted for all cases presenting with aberrant behavior.

Our collaborative database now exceeds 1500 cases. The first 499 cases have been statistically analyzed independently by Dr. Robert Keller, Chairman, Computer Sciences Department, Harvey Mudd College, Pomona, CA. Dr. Keller used sophisticated neural network and other correlative programs for this analysis.

Results showed that a statistically significant relationship existed in dogs between:

- Thyroid dysfunction and seizure disorder
- Thyroid dysfunction and dog-to-human aggression

(dog-to-dog aggression showed a trend which was not statistically significant)

Two recent cases involved young dogs referred for sudden onset seizure disorder shortly after puberty. Both dogs were found to have early onset autoimmune thyroiditis, which was clinically responsive to thyroid supplementation to the extent that anticonvulsant medications could be gradually withdrawn.

Collectively, these preliminary findings confirm the importance of including a complete thyroid antibody profile as part of the laboratory and clinical work up of any behavioral case.

**References**


Denicoff KD, Joffe RT, Lakschmanan MC, Robbins J, Rubinow DR. Neuropsychiatric manifestations of


Dodds, WJ. Thyroid can alter behavior. Dog World 1992, 77(10); 40-42.


Table 1. Canine Aberrant Behavior *

<table>
<thead>
<tr>
<th>Total No. Cases</th>
<th>Purebreds</th>
<th>Mixed Breeds</th>
<th>Thyroid Dysfunction</th>
<th>Euthyroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>634</td>
<td>568</td>
<td>66</td>
<td>401</td>
<td>233</td>
</tr>
</tbody>
</table>

Mean Age, 3.7 years (Range 0.5 - 12 years). Median Age, 2.5 years.

*Some dogs had more than 1 abnormal behavior. Numerator = Thyroid dysfunction; Denominator = Aberrant behavior; † Total 634 cases; 72 dog breeds represented.

Table 2. Most Commonly Represented Breeds with Thyroid Dysfunction & Aberrant Behavior *

<table>
<thead>
<tr>
<th>Breed†</th>
<th>Thyroid Dysfunction</th>
<th>Aggression</th>
<th>Seizures</th>
<th>Fearful</th>
<th>Hyperactive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>401/634 (63%)</td>
<td>251/634 (40%)</td>
<td>189/634 (30%)</td>
<td>55/634 (9%)</td>
<td>42/634 (7%)</td>
</tr>
<tr>
<td>Golden Retriever</td>
<td>50/73</td>
<td>12/16</td>
<td>22/30</td>
<td>4/6</td>
<td>1/6</td>
</tr>
<tr>
<td>German Shepherd</td>
<td>34/53</td>
<td>10/22</td>
<td>14/16</td>
<td>3/7</td>
<td>2/2</td>
</tr>
<tr>
<td>Akita</td>
<td>27/38</td>
<td>24/33</td>
<td>0/1</td>
<td>0</td>
<td>0/2</td>
</tr>
<tr>
<td>Labrador Retriever</td>
<td>8/30</td>
<td>6/11</td>
<td>12/16</td>
<td>2/15</td>
<td>0/3</td>
</tr>
<tr>
<td>Shetland Sheepdog</td>
<td>14/25</td>
<td>3/6</td>
<td>2/3</td>
<td>2/4</td>
<td>3/3</td>
</tr>
<tr>
<td>Collie</td>
<td>8/9</td>
<td>0</td>
<td>7/7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>English Setter</td>
<td>4/6</td>
<td>1/1</td>
<td>0</td>
<td>1/3</td>
<td>1/2</td>
</tr>
<tr>
<td>Other Purebreds</td>
<td>217/334</td>
<td>89/135</td>
<td>72/93</td>
<td>10/15</td>
<td>5/16</td>
</tr>
<tr>
<td>Mixed Breed</td>
<td>39/66</td>
<td>11/27</td>
<td>16/23</td>
<td>4/5</td>
<td>1/8</td>
</tr>
<tr>
<td>Totals</td>
<td>401/634 (63%)</td>
<td>156/251 (62%)</td>
<td>145/189 (77%)</td>
<td>26/55 (47%)</td>
<td>13/42 (31%)</td>
</tr>
</tbody>
</table>

*Some dogs had more than 1 abnormal behavior. Numerator = Thyroid dysfunction; Denominator = Aberrant behavior; † Total 634 cases; 72 dog breeds represented.