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Thoughts on Thyroid **Written by: Linda Aronson, DVM**

Hypothyroidism is the most common endocrine disease in dogs.

Autoimmune thyroiditis is the most common autoimmune disease in dogs, and results in 80% or more cases of hypothyroidism.

Hypothyroidism is very over-diagnosed.

Hypothyroidism is very under-diagnosed.

How can all of these statements be true? Confused? It would seem you are from the contents of my in-box, and quite possibly your vet it too.

Thyroid hormones act throughout the body to regulate metabolism, but they act at the cellular level. While it is true that the hormones are transported in the blood, the levels measured in the blood may not accurately reflect the levels reaching the cells. The body's needs for thyroid hormone vary almost constantly, and the production and release of hormones as well as their uptake as needed is under exquisite control. The levels we measure in the blood represent a snapshot in time, and may not give us accurate data over the long-term.

What thyroid hormone does.

There are two thyroid hormones, levothyroxine (T4) and triiodothyronine (T3) so called because they have respectively 4 and 3 atoms of iodine per molecule. The thyroid gland manufactures both hormones from iodine and the amino acid tyrosine. While the gland manufactures 80% T4 and only 20% T3, and this is reflected in the levels of hormone measured in the blood, only T3 actually performs a physiological role in the cell. Most of the hormones are transported in the blood attached to proteins and only a small amount is unbound or free. To enter cells though the hormone must rid itself of the protein. Once inside the cell any T4 is converted to T3. It is the role of T3 which we will now consider.

One of the most important functions of thyroid hormone is to help convert the basic elements of food stuffs – carbohydrates, fats and protein - into energy and heat. T3 is very active in the mitochondria of all cells increasing



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energy production and increasing the metabolic rate of the cell. It will increase the synthesis of proteins by increasing gene transcription rate. Increased cellular activity results in an increase in oxygen requirements, and so T3 increases heart rate to help meet these needs. Increased metabolism in the cells requires fuel, and so increased levels of T3 result in weight loss, unless the body takes in more calories. Increased work raises body temperature at the cellular level. Food intake and external temperature affect thyroid hormone production. Levels will increase in the cold to help warm the body, they will increase if the animal eats more. In starvation production of thyroid hormones decreases as it does in hot weather. Reducing thyroid hormone levels not only burns fewer calories in starvation but also reduces ketone body production. Ketones are produced when the body starts to use fat rather than carbohydrates for energy and an excess can damage the kidneys.

Thyroid stimulating hormone as well as increasing production and release of thyroid hormones from the thyroid, stimulates brown fat production. This fat is rich in mitochondria, and under the influence of T3 increases body heat without muscle activity. Slow healing injuries and some chronic illnesses lower levels of thyroid hormone, sick euthyroid syndrome, but they will rebound once the injury is healed or the body healthy again.

Thyroid hormones are particularly important during development. T3 binds to special receptors and regulates the expression of genes, increasing production of some proteins and reducing the production of others within the nucleus of the cell. Not all genes are under thyroid control, and the affected genes may be different for different species. For example only in dogs are seizures associated with hypothyroidism, whereas in all species fatigue, apathy, obesity in the face of reduced appetite and heat seeking are. In adults, thyroid hormones will also influence the rate at which dying cells are replaced and the ability of the body to heal itself.

In the brain and peripheral nervous system, T3 affects the production of and sensitivity to neurotransmitters such as serotonin, dopamine, epinephrine and norepinephrine. Reduced levels can seriously impact behavior, as well as causing lethargy, depressed neurological function, slow muscle and nerve response and reduced muscle tone. The gut's motility will be reduced, leading to constipation.



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Thyroid hormone levels are regulated by and interact with other hormones. The hypothalamus reacts to a reduction in circulating thyroid hormone levels by increasing production and release of thyrotrophin releasing factor (TRF). This in turn causes the anterior pituitary gland to increase production and release of thyroid stimulating hormone (TSH) a.k.a. thyrotrophin, which in turn acts on tissue in the thyroid gland to increase production and release of thyroid hormones. Estrogen partially blocks the efficacy of thyroid hormones, and so intact females tend to have reduced levels of thyroid hormones when in season. Thyroid is also needed for normal gonadal function, and infertility can result from hypothyroidism. Thyroid hormone also boosts milk production in lactating mammals. The role of growth hormone is more complex; it partially blocks the efficacy of T3, but also complements its effects on growth, development and metabolism. Young animals have significantly higher metabolic needs, and should have higher levels of thyroid hormones than older animals until they are 18-24 months. (Small breeds have relatively higher metabolic rates, and large and giant ones lower metabolic rates, and again this should be reflected in their normal levels of circulating hormones. Low thyroid levels delay cortisol clearance and this often results in a state of prolonged stress.

Signs of Hypothyroidism

Hypothyroidism comes on gradually. In older animals it is often mistaken for aging, and owners expect their dogs to become calmer and less active with age. In normal bearded collies this is really not that apparent, and I would always test the thyroid in any bearded collie that seemed to be aging especially if it was younger than 10 or 12 and had no painful condition that might be expected to limit its activity levels.

Because thyroid hormone affects every cell in the body the signs can be extremely varied. In the early stages behavioral problems are usually the first indication of a problem, and these can occur when levels of thyroid hormones in the blood are in the low normal, suboptimal or borderline range – remembering that young dogs should have higher levels. In young dogs, hypothyroidism can present as attention deficit/hyperactivity disorder – the pup or young dog has trouble sitting still and is slow to learn, failing to retain information. These dogs may also be antisocial, asked to leave training classes, and appear to bounce off the walls. Often, despite the characteristic idea we have of a hypothyroid dog, they are skinny and not obese. They may however show one of more of the non specific signs of



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hypothyroidism listed below. These may also show up in older dogs and may be the major presenting sign until you dig deeper and establish a pattern suggestive of poor thyroid function.

- Excessive shedding, patchy hair loss or "rat tail"
- Dry skin or dull, dry hair coat
- Recurrent infections (especially ear, skin and foot infections)
- Tendency to gain weight
- Heat seeking behavior (acts cold)
- Increased sleep time
- Hyperactivity
- Slow learning
- Seizures
- Worried look, tragic facial expression or looking "old"
- Reduced hearing, sight and scenting ability
- Chronic gastrointestinal symptoms
- Loss of muscle or bladder tone
- Head tilt
- Change in character of bark
- Exercise intolerance
- Infertility, false pregnancy or weak, dying or stillborn puppies
- Recurring eye infections
- Premature graying

Because of the constant state of stress in which hypothyroid dogs live as well as the changes in the central neurotransmitter levels which affect behavior, I see many hypothyroid dogs present as behavioral cases. The actual problem behaviors tend to be more of a reflection of how a dog has learned to handle stress and can fall into any of the three main behavioral problem categories. Aggression can be owner directed, fear, interdog or guarding. It is rarely territorial and this is usually treated separately if there is comorbidity. Fears and phobias of all types can be seen including fear of thunderstorms and other loud noises, which seem to be common in beardies. Obsessive compulsive and repetitive behaviors are also frequently seen. In beardies a favorite seems to be seeing ghosts or staring at blank walls. In other breeds you'll more often see tail chasing, light fixations and obsessive ball play.



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Diagnosis

And here comes the rub. Thyroiditis is progressive, the body can maintain normal serum thyroid levels or near normal ones if there is no increase in hormonal needs with only 60% of the gland functioning. Elevated levels of circulating autoantibodies to T3 or T4 or to thyroglobulin - the parent protein to which T3, T4 and their precursors are bound in the thyroid gland – is always indicative of thyroiditis. Because the blood is monitored as a snapshot in time though, they are not constantly elevated and may well be missed. The pituitary gland may increase production of TSH (and the hypothalamus of TRF), but ultimately it becomes depleted and so cTSH may not always be elevated in hypothyroid dogs. The body tries to protect T3 levels and these tend to be less affected by sickness than T4. Elevated serum levels of cholesterol in the dog usually indicate hypothyroidism, although disease of the liver and other causes do exist for this. It's not a perfect science though, and in diagnosing hypothyroidism you cannot rely solely on the numbers from a particular test. Only dogs showing signs of thyroid related illness should be treated except in the case of elevated autoantibody levels. In other dogs, underlying disease or injury should be sought out.

Replacing the body's hormones with synthetic ones at the recommended dosage (0.1mg/12-15 lbs body weight twice a day, usually 0.3 mg (bitch) or 0.4 mg (dog) twice a day in beardies) will not induce hyperthyroidism. Dogs absorb thyroid hormones very poorly (which is why they should be given 20 minutes before meals), and except in sighthounds this level is perfectly safe. The synthetic hormone will cause the dog's own thyroid to reduce hormone production – although if thyroid tissue still remains in should be able to respond to the dog's subtly changing needs for the hormone. This will not harm the remaining thyroid tissue, and will not speed up deterioration, although it probably won't stop this continuing either. If there is absolutely no change in the dog's (apparently) thyroid related issues (I usually trial for at least 2 months depending upon the problem), the dog can be gradually weaned off thyroid hormones over 2 or 3 weeks allowing its own gland to increase production of thyroid hormones (if it is capable of doing so).

It can be easy to overlook the signs of hypothyroidism as they creep in insidiously, but in terms of quality of life, addressing thyroid issues can be immensely rewarding for both the dog and the quality of the bond it has with its family. Yes, it can be over-diagnosed if a dog is sick for other reasons and



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under-diagnosed especially in the early stages if we aren't looking for subtle changes. For a small gland though it surely has a mighty impact on our dogs' lives and on our own