

# Diagnostic Testing for Feline Thyroid Disease: Hyperthyroidism

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**Abstract:** In older cats presenting with clinical features of hyperthyroidism, confirming the diagnosis of thyroid disease is usually straightforward. However, the potential for false-negative and false-positive results exists with all thyroid function tests, especially when used for routine screening of large numbers of asymptomatic cats. Therefore, all thyroid function test results must be interpreted in light of the cat's history, clinical signs, and other laboratory findings. If a high serum thyroxine ( $T_4$ ) value is found in a cat that lacks clinical signs of hyperthyroidism, or if hyperthyroidism is suspected in a cat with normal total  $T_4$  concentrations, repeating the total  $T_4$  analysis, determining the free  $T_4$  concentration, or performing thyroid scintigraphy may be needed to confirm the diagnosis.

**For more information, please see the companion article, "Diagnostic Testing for Feline Thyroid Disease: Hypothyroidism."**

The diagnosis of hyperthyroidism in cats is primarily based on a constellation of typical clinical features, including the cat's signalment, history, clinical signs, and physical examination findings (e.g., palpation of a thyroid nodule).<sup>1-3</sup> Because many nonthyroidal diseases can mimic the signs of thyroid disease in cats, a complete database (e.g., complete blood count, serum chemistry profile, urinalysis, blood pressure measurement) must always be evaluated to help exclude other illnesses. After reviewing these data, thyroid function tests should be used to confirm the diagnosis of hyperthyroidism.

Over the past 2 decades, tests that can be used to diagnose feline hyperthyroidism have become more widely available. However, all of the commonly used tests have limitations, especially when evaluating cats with nonthyroidal illness. Therefore, it remains clear that the "perfect" thyroid test capable of both confirming the diagnosis of thyroid disease in all affected cats and completely excluding it in cats that do not have thyroid disease does not exist.

This article reviews the common thyroid function tests currently recommended to diagnose feline hyperthyroidism. Because definitive diagnosis of this common disorder is not always straightforward, protocols used in the management of problem cases are also presented.

## Diagnosing Cats With Hyperthyroidism: Total Thyroxine Concentration

In older cats presenting with clinical features of hyperthyroidism (e.g., weight loss despite a good appetite), confirming the diagnosis

of hyperthyroidism is usually straightforward, as 90% of hyperthyroid cats have a serum total thyroxine ( $T_4$ ) concentration that is clearly high.<sup>1,2,4-6</sup> Measurement of serum total triiodothyronine ( $T_3$ ) is not recommended as the sole screening test for hyperthyroidism because 25% to 30% of hyperthyroid cats have  $T_3$  values within the normal reference interval (i.e., not diagnostic for hyperthyroidism).<sup>5,6</sup>

Practitioners should be aware of the assay techniques being used by their commercial or in-house laboratories. In general, serum  $T_4$  can now be measured by four different assay techniques:

- Radioimmunoassay (RIA) has long been considered the gold standard,<sup>1,5,7,8</sup> but the regulations regarding radioactivity have resulted in a search for alternative methods. In addition, the lack of automation is a limitation of RIA, as this can increase expense. Very few major commercial veterinary laboratories still measure  $T_4$  by RIA. However, RIA is still used as the assay method for  $T_4$  at many of the diagnostic laboratories at university veterinary teaching hospitals (e.g., Michigan State, Auburn, Cornell, Tennessee).
- Chemiluminescent enzyme immunoassays (CEIAs) (e.g., Immulite Total  $T_4$  assay, Siemens Healthcare Diagnostics) use the same type of antibody testing as RIA; however, instead of measuring a radioactive isotope bound to the hormone, CEIA testing uses a chemiluminescent substrate that emits light when it reacts with the bound label. The amount of light emitted, which is proportional to the amount of analyte originally present in the sample, is detected by a photomultiplier tube, allowing results to be calculated for the sample. This method, which has been validated for use with feline serum,<sup>7,9</sup> is preferred by some laboratories because it is more automated and does not use any radioactive reagents.

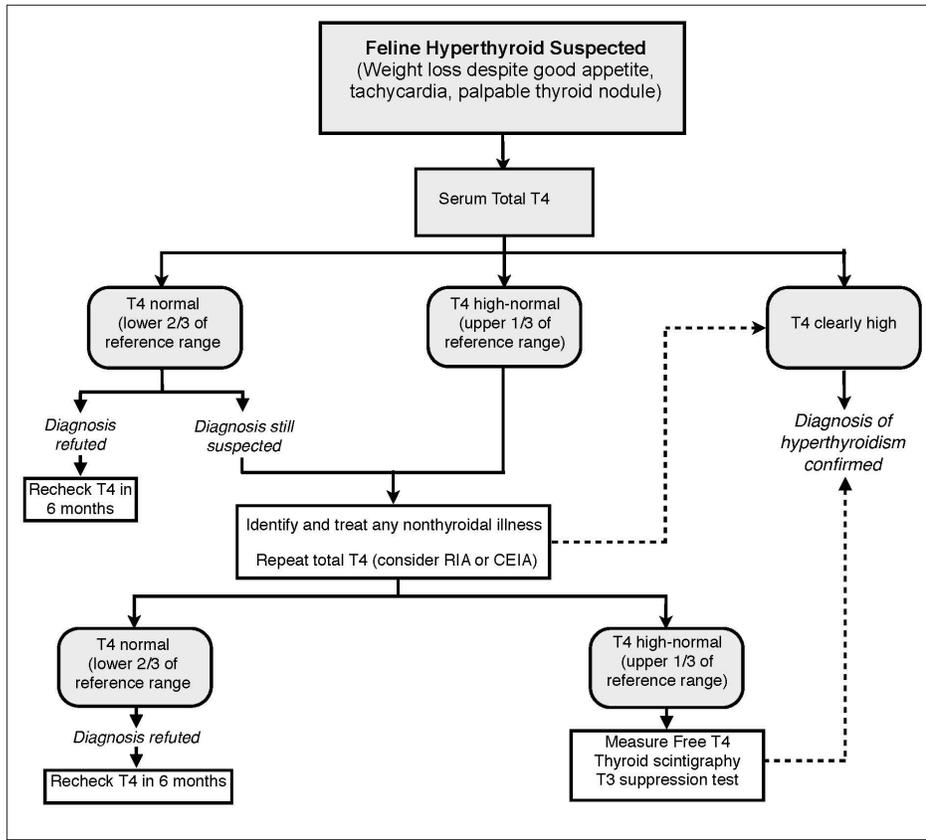


Figure 1. Flow chart for initial diagnosis of hyperthyroidism in cats when disease is suspected.

- A point-of-care ELISA test kit is also commercially available for in-house use (i.e., SNAP T<sub>4</sub> Test, IDEXX Laboratories).<sup>8,10</sup> This method offers a convenient way for veterinarians to measure serum T<sub>4</sub> immediately in their own practice.
- Recently, a number of major commercial veterinary laboratories (e.g., Antech Diagnostics, IDEXX laboratories) have switched to use of a homogenous enzyme immunoassay (EIA) method (e.g., DRI Thyroxine [T<sub>4</sub>] assay, Microgenics Corporation).<sup>11</sup> For commercial laboratories, a major advantage of this method is that it is fully automated and can be adapted to automated photometric analyzers and performed in conjunction with routine clinical chemistry testing, thus reducing manual procedures. Like the CEIA and ELISA techniques, this method does not use radioactive reagents. For veterinarians, the main advantage of the CEIA and ELISA methods is that automation allows for quick turnaround, so test results are available sooner.

Although the correlation of serum T<sub>4</sub> concentrations between all of these assay methods is generally good, any of these assays can provide serum T<sub>4</sub> values that are falsely high or falsely low; no assay has 100% sensitivity and specificity. CEIA has been shown to provide very similar results to RIA, whereas the ELISA test kit sometimes underestimates the T<sub>4</sub> value. Although most T<sub>4</sub> results correlate well with the cat's thyroid state, in my experience, the EIA method shows the highest rate of false-positive and false-negative

results (i.e., falsely high or low T<sub>4</sub> values) in euthyroid cats.<sup>6</sup>

Because the potential for false-negative and false-positive results exists with any diagnostic method, all serum T<sub>4</sub> results must always be interpreted in light of the cat's history, clinical signs, and other laboratory findings. If a high serum T<sub>4</sub> value is found in a cat that lacks clinical signs of hyperthyroidism, especially if no thyroid nodule is palpated, clinicians should never hesitate to repeat the serum T<sub>4</sub> test using a different technique, with RIA or CEIA being preferred in such cases.

### Problems in the Diagnosis of Feline Hyperthyroidism

There are three common clinical scenarios in which difficulties can arise in the routine diagnosis of hyperthyroidism in cats:

1. A cat is hyperthyroid, but the serum T<sub>4</sub> concentration falls within the normal reference interval
2. A cat has a palpably enlarged thyroid nodule(s) but does not have other clinical or biochemical evidence of hyperthyroidism
3. A euthyroid cat is screened and is misdiagnosed as hyperthyroid based on a falsely

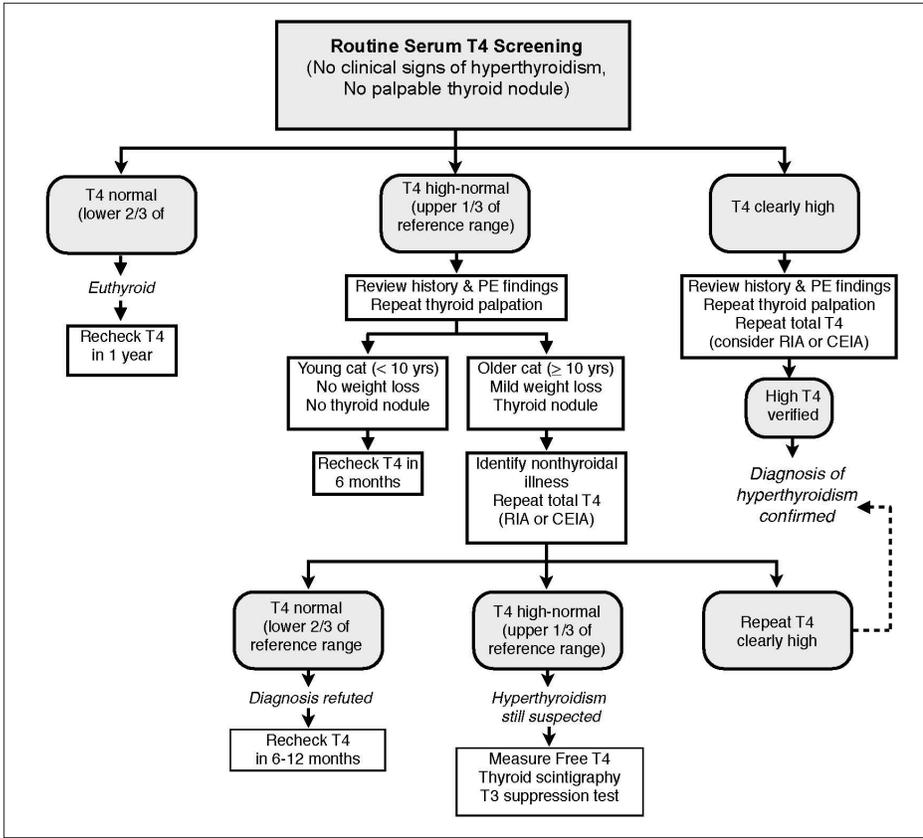
high serum T<sub>4</sub> (or free T<sub>4</sub>) concentration

#### Problem 1: Hyperthyroidism is suspected but the serum T4 concentration is normal

Although serum total T<sub>4</sub> is preferable as a screening test for hyperthyroidism, approximately 10% of hyperthyroid cats (and 40% of cats with early or mild hyperthyroidism) have serum T<sub>4</sub> within the reference interval (FIGURE 1).<sup>1,2,4-6</sup> Such "normal" T<sub>4</sub> values are usually within the upper third of the reference interval (e.g., >3.0 µg/dL); thus, finding a single "normal" T<sub>4</sub> value does not preclude the diagnosis of hyperthyroidism.

In general, there are three possible reasons why a hyperthyroid cat could have a normal T<sub>4</sub> value and still show clinical signs of the disease.

- The hyperthyroid state could still be in an early or subclinical stage. These cats likely show either no or only very mild clinical signs. The thyroid nodule(s) in these cats should be small and may be difficult to palpate. In cats with early or mild hyperthyroidism and no concurrent illnesses, serum total T<sub>4</sub> concentrations eventually increase into the diagnostic thyrotoxic range as the thyroid nodule grows and secretes more T<sub>4</sub> into the circulation.
- In cats with mild hyperthyroidism, serum total T<sub>4</sub> concentrations can fluctuate in and out of the reference range.<sup>12</sup> Such



**Figure 2.** Algorithm for recommended workup of cats in which a high serum T<sub>4</sub> or free T<sub>4</sub> level is found with routine screening.

fluctuation of thyroid hormones occurs in all hyperthyroid cats, but the degree of fluctuation is of little diagnostic significance in cats with severe hyperthyroidism and markedly elevated T<sub>4</sub> concentrations.

- Severe nonthyroidal illness is also capable of suppressing serum total T<sub>4</sub> concentrations to below the reference interval in euthyroid cats.<sup>13-15</sup> Similarly, marginally elevated serum total T<sub>4</sub> concentrations may be suppressed to the mid- to high-end of the reference interval in cats with mild hyperthyroidism and concurrent moderate to severe nonthyroidal disease. Once the concurrent disease resolves, the serum total T<sub>4</sub> concentrations increase into the diagnostic thyrotoxic range.

If hyperthyroidism is suspected based on history, clinical signs (weight loss despite a good appetite), and examination findings (tachycardia, palpable thyroid nodule) but the serum T<sub>4</sub> remains within the upper third of the reference interval (e.g., >3.0 µg/dL), hyperthyroidism is still possible. There is no definitive approach to diagnosing hyperthyroidism in this scenario, but there are several options for further workup, as outlined below (**FIGURE 1**).

### Repeat Total T<sub>4</sub> Concentration

In cats in which overt, manageable underlying disease is identified, such concurrent disease should be managed before proceeding

with further thyroid testing (**FIGURE 1**). Once concurrent disease is resolved, most hyperthyroid cats develop a clearly high T<sub>4</sub> level, confirming the diagnosis.<sup>1,2,4,5</sup>

On the other hand, in cats without overt underlying disease, simply repeating the serum T<sub>4</sub> concentration 2 weeks later may be diagnostic if the T<sub>4</sub> is fluctuating in and out of the reference interval.<sup>11</sup> In some cats with preclinical disease, it may take a number of weeks or even months for the serum total T<sub>4</sub> concentrations to increase into the “high” range diagnostic for hyperthyroidism. Again, clinicians should never hesitate to repeat the serum T<sub>4</sub> test using a different technique, with RIA or CEIA being preferred in such cats (**FIGURE 1**).

### Thyroid Scintigraphy

Thyroid scintigraphy is a nuclear medicine procedure that produces a visual display of functional thyroid tissue based on the selective uptake of radionuclides by thyroid tissue.<sup>1,2,16-18</sup> In normal cats, the thyroid gland appears on thyroid scans as two well-defined, focal (ovoid) areas of radionuclide accumulation in the cranial to middle cervical region. The two thyroid lobes are symmetrical in size and shape and are

located side by side. On the scintiscan, the thyroid and salivary glands are expected to be equally bright (a 1:1 brightness ratio). In addition to visual inspection, the scintiscan allows calculation of either the percent thyroidal uptake of the radioactive tracer or the thyroid:salivary ratio. Both of these calculations strongly correlate with circulating thyroid hormone concentrations and provide an extremely sensitive means of diagnosing hyperthyroidism.<sup>16,17</sup>

In cats with suspected hyperthyroidism in which the serum T<sub>4</sub> is normal or borderline (**FIGURE 1**), use of thyroid scintigraphy provides an extremely sensitive diagnostic test. Likewise, thyroid imaging can be helpful for confirming or excluding a diagnosis of hyperthyroidism in cats with high-normal to high T<sub>4</sub> or free T<sub>4</sub> concentrations on routine screening, especially if a thyroid nodule cannot be palpated (**FIGURE 2**).

Because thyroid scintigraphy directly visualizes functional thyroid tissue and the “uptake” of the radioisotope can be estimated by determining the thyroid:salivary ratio, thyroid imaging can diagnose hyperthyroidism before laboratory tests are consistently abnormal. Thyroid scintigraphy can also exclude the diagnosis of hyperthyroidism in euthyroid cats that have false-positive elevations in their serum T<sub>4</sub> or free T<sub>4</sub> values. Treatment for hyperthyroidism is contraindicated and may be harmful in euthyroid cats.

Unfortunately, because of the expense and the special licensing required to perform nuclear imaging, few veterinarians have access

to the equipment needed to obtain thyroid images or perform thyroid uptake determinations. If access to thyroid scintigraphy is available, however, this is definitely the “gold standard” for confirming (or excluding) a diagnosis of mild or occult hyperthyroidism in cats (**FIGURE 1**).

## Free T<sub>4</sub> Concentration

In cats with mild hyperthyroidism and normal T<sub>4</sub> values, free T<sub>4</sub> concentrations can aid in diagnosis. In one study,<sup>5</sup> serum free T<sub>4</sub> concentrations measured by equilibrium dialysis were more consistently elevated in hyperthyroid cats (>98%).<sup>5</sup> Although the free T<sub>4</sub> was more sensitive than the total T<sub>4</sub> for diagnosing hyperthyroidism, the test specificity for free T<sub>4</sub> is poor, with up to 20% of sick (and some clinically normal) euthyroid cats having false-positive free T<sub>4</sub> results. Thus, this is not a screening test. It should be used as an aid in the confirmation of suspected cases.<sup>5,6,15,19</sup> Sick cats with high free T<sub>4</sub> concentrations generally have corresponding total T<sub>4</sub> values in the lower half or below the reference interval.

Caution is therefore advised in using serum measurements of free T<sub>4</sub> by equilibrium dialysis as the sole diagnostic test for hyperthyroidism. As a thyroid function test, free T<sub>4</sub> should always be interpreted with a corresponding total T<sub>4</sub> measurement. A T<sub>4</sub> value within the upper third of the reference range (>3.0 µg/dL) combined with a high free T<sub>4</sub> concentration is consistent with mild hyperthyroidism, whereas a low or low-normal T<sub>4</sub> with a high free T<sub>4</sub> is usually associated with nonthyroidal illness. However, these thyroid test results must be combined with the cat's clinical features and the presence of a palpable thyroid nodule to make the correct diagnosis.

To complicate the free T<sub>4</sub> assay situation further, the current free T<sub>4</sub> by equilibrium dialysis method, which is used by veterinary commercial laboratories all around the world, is likely not the exact same assay that was used in all of the published studies that evaluated free T<sub>4</sub> in cats with thyroid disease.<sup>5,15</sup> Nichols Diagnostics, the company that produced the original assay, sold the distribution rights for the assay to VCA a few years ago, and results of a recent study in cats<sup>20</sup> indicates a much higher prevalence of false-positive test results than reported more than a decade ago.<sup>5,15</sup> The current assay used to measure free T<sub>4</sub> by dialysis needs to be reevaluated in a large number of normal, hyperthyroid, and sick cats to verify its accuracy as a diagnostic test for this disorder.

Finally, many commercial diagnostic labs are now using other free T<sub>4</sub> assays, most of which do not use RIA or have the equilibrium dialysis step that was once believed so important.<sup>20,21</sup> Only one of these assays, a free T<sub>4</sub> CEIA, has been critically evaluated in hyperthyroid cats.<sup>20</sup> In that study (presented in 2011), this free T<sub>4</sub> assay showed excellent test performance in euthyroid and hyperthyroid cats, having comparable or even better accuracy when compared with the free T<sub>4</sub> by dialysis method. The major flaw in that report, however, was that a group of cats with moderate to severe nonthyroidal illness was not included in the study, so the prevalence of false-positive test results with this method in sick cats that do not have hyperthyroidism is still unknown. This is a critical issue that still needs to be determined; if it turns out that the prevalence of

false-positive free T<sub>4</sub> results is lower with this CEIA, that would represent a major advantage over the free T<sub>4</sub> by dialysis method. On the other hand, it may be that the rate of false-positive free T<sub>4</sub> results is as high or even higher with the CEIA than that reported with the dialysis method.

Overall, it is still unclear how much additional useful information is truly gained by present dialysis or free T<sub>4</sub> CEIA assays over the use of total T<sub>4</sub> estimations alone. Many veterinarians mistakenly believe that the finding of a high free T<sub>4</sub> in a cat is completely diagnostic for hyperthyroidism. However, since up to 25% of these cats turn out to be euthyroid, it is clear that the free T<sub>4</sub> test can never be considered a gold standard diagnostic test. Use of free T<sub>4</sub> testing can lead to more confusion than clarity in some cats and can certainly lead to misdiagnosis and inappropriate treatment of hyperthyroidism in euthyroid cats.

## Thyroid Stimulating Hormone

In human patients, measurement of circulating thyroid stimulating hormone (TSH) concentration is commonly used as a first-line discriminatory test of thyroid function.<sup>22</sup> A feline-specific TSH assay has not yet been developed for commercial use; however, assays for measuring canine TSH (cTSH) are widely available, and it has been suggested that these assays may provide some diagnostic information in cats with suspected hyperthyroidism.<sup>19,23–25</sup>

Theoretically, as in people, it could be expected that serum TSH levels should be low in early stages of hyperthyroidism, even before T<sub>4</sub> is elevated.<sup>22</sup> In cats, a recent prospective study provided evidence that an undetectable TSH concentration (<0.03 ng/mL) in euthyroid cats is associated with an increased risk for the subsequent diagnosis of hyperthyroidism.<sup>24</sup> However, it is important to point out that almost one-third of all cats had undetectable TSH values at baseline, but only half of those cats developed hyperthyroidism. Therefore, in my opinion, TSH measurements are not a great tool for predicting which cats will develop hyperthyroidism.

Can a serum TSH measurement be used as a diagnostic test for hyperthyroid cats? It has been reported that hyperthyroid cats almost always have a low TSH value at or below the limit of detection of the assay (0.03 ng/mL).<sup>6,19,23,24</sup> However, in one study that included 40 euthyroid cats (20 healthy cats and 20 cats with chronic kidney disease), five (12.5%) of these 40 cats also had undetectable levels of TSH, indistinguishable from the values in the hyperthyroid cats.<sup>19</sup>

Therefore, the problem with the current cTSH assay lies in its inability to reliably differentiate hyperthyroid cats from euthyroid cats. This is related to suboptimal sensitivity when used to measure feline TSH. In other words, the current cTSH assay cannot accurately measure low feline TSH values (i.e., it cannot distinguish a low-normal TSH concentration from an undetectable value).<sup>19,23,24</sup>

Obviously, a better TSH assay for feline hyperthyroidism is needed—particularly, a feline-specific TSH assay that has adequate sensitivity to reliably distinguish a normal value from a low one. Until better TSH assays for cats are available, caution is advised in overinterpreting values in cats. Therefore, at this time, I cannot

recommend using routine serum cTSH determinations as an aid for diagnosing hyperthyroidism in cats. Perhaps the only use for the cTSH assay in cats would be to help exclude hyperthyroidism (i.e., by finding a mid- to high-normal value rather than a suppressed value).

### Dynamic Thyroid Function Testing

In most hyperthyroid cats with a normal total  $T_4$  concentration, identification of a thyroid nodule or concurrent disease, repeat total  $T_4$  analysis (by RIA or CEIA), or simultaneous measurement of free  $T_4$  allows confirmation of the diagnosis (FIGURE 1). Further diagnostic tests are rarely required.

Dynamic thyroid function tests ( $T_3$  suppression and thyrotropin-releasing hormone stimulation tests) have been recommended in the past as helpful in confirming a diagnosis of hyperthyroidism (TABLE 1).<sup>1,2,4,26,27</sup> Nowadays, use of these tests is only considered when a repeated total  $T_4$  concentration remains within the reference interval, when the free  $T_4$  concentration is equivocal, when the thyroid nodule cannot be palpated, or when thyroid scintigraphy is unavailable (FIGURE 1).

### Problem 2: Thyroid gland is palpated in a patient with clinical signs suggestive of hyperthyroidism, but tests do not confirm hyperthyroidism

Nonfunctional enlargement of thyroid gland (goiter) has been recognized since the 1960s but took on new significance when functional hyperthyroidism arose as an entity in the late 1970s. Nonfunctional goiter was “re-recognized” about a decade ago.<sup>28,29</sup>

Many believe that clinical hyperthyroidism has a prodromal period (also called *subclinical hyperthyroidism* or *pre-hyperthyroidism*).<sup>19,24</sup> However, it is not clear whether all goiters are indicative that a cat will develop hyperthyroidism, as some cats will remain healthy and euthyroid for years.

Surgical removal of nonfunctional goiters has been proposed as a preventive measure, but there is no evidence to support this approach because almost all of these tumors are benign. In general, careful observation and monitoring of serum  $T_4$  and thyroid nodule (goiter) size is the recommended, with appropriate treatment instituted if and when needed.

### Problem 3: Misdiagnosis of hyperthyroidism based on falsely high serum total $T_4$ (or free $T_4$ ) concentration

A high circulating total  $T_4$  concentration is the biochemical hallmark of hyperthyroidism and is extremely specific for its diagnosis.<sup>1,2,4,6</sup> False-positive results (i.e., high  $T_4$  in a cat without hyperthyroidism) are rare but are being seen with increasing frequency (especially with automated ELAs).<sup>6</sup> About 25% of cats presenting with a borderline high total  $T_4$  value, together with a high free  $T_4$  concentration, turn out to be euthyroid based on results of thyroid scintigraphy.

The reason for this higher prevalence of false-positive results may be related to the increasing use of screening  $T_4$  as part of the cat’s annual “wellness” program. When serum  $T_4$  is determined in large numbers of healthy, asymptomatic cats to screen for hyperthyroidism, a percentage of those euthyroid cats can be expected

**Table 1. Commonly Used Protocols for Dynamic Thyroid Function Tests to Diagnose Cats With Mild Hyperthyroidism**

	$T_3$ Suppression Test	TRH Stimulation Test
<b>Drug</b>	Liothyronine	Thyrotropin-releasing hormone (TRH)
<b>Dose</b>	20 $\mu$ g q8h for 7 doses	0.1 mg/kg
<b>Route</b>	Oral	Intravenous
<b>Sampling time</b>	0 and 2–4 hours after last dose	0 and 4 hours
<b>Assay</b>	Total $T_4$ and $T_3$	Total $T_4$
<b>Interpretation<sup>a</sup></b>		
<b>Euthyroidism</b>	$T_4 < 1.5 \mu\text{g/dL}$ with $>50\%$ suppression	$>60\%$ increase
<b>Hyperthyroidism</b>	$T_4 > 1.5 \mu\text{g/dL}$ + $<35\%$ suppression	$<50\%$ increase

<sup>a</sup>Values quoted for interpretation are guidelines only. Each laboratory should furnish its own reference interval.

to have high “outlying”  $T_4$  values that could be mistakenly interpreted as hyperthyroid.

When a patient has a positive result on a particular test (in this case, a high  $T_4$  or free  $T_4$  concentration), the next question is, “what is the chance (probability) of disease given the positive result?” What most veterinarians fail to realize is that in clinical practice, the usefulness of a test result for an individual patient depends primarily on the prevalence of the disease in the population being tested. The diagnostic value of a test is much improved if use of the test is limited to patients that are likely to have the disease in question based on their history and clinical assessment. A positive or a negative result is then more likely to be meaningful than when the test is indiscriminately applied to all patients. A diagnostic test should be used to supplement, rather than substitute for, good clinical judgment. In other words, diagnosis should not rely on a cat’s thyroid results and other blood work but on a good history and careful examination of the cat.

So what is the next step when finding a high serum  $T_4$  in an asymptomatic cat with no palpable goiter? If a high total  $T_4$  concentration is measured in a cat without the characteristic signs of hyperthyroidism, the first steps should always be to repeat cervical palpation for a thyroid nodule and to verify the high  $T_4$  concentration (FIGURE 2) using a different technique, with RIA or CEIA being preferred. If there is any doubt about the diagnosis, thyroid scintigraphy should be considered.

In many asymptomatic cats in which the diagnosis is unclear, the best approach is to use close observation rather than starting treatment. This cautious approach, should include rechecking the cat at 2- to 3-month intervals, at each visit monitoring the cat’s body weight, carefully palpating for a thyroid nodule, and repeating the serum  $T_4$  (with or without free  $T_4$ ) concentration. If the cat is truly hyperthyroid, the thyroid nodule will continue to

grow, the serum  $T_4$  will eventually rise into the hyperthyroid range, and the cat will lose weight. There is minimal risk to the patient to wait for the condition to manifest itself biochemically.

It is extremely important to remember that hyperthyroidism is a clinical diagnosis and should never be based solely on a serum  $T_4$ , free  $T_4$ , or TSH concentration. These laboratory results must be combined with the cat's signalment, clinical features, and the presence of a thyroid nodule to make the diagnosis.

### Conclusion

Although hyperthyroidism is relatively easy to diagnose in classically presenting cats, the increased frequency of testing cats with early, mild disease, as well as the routine screening of large numbers of asymptomatic cats, has had significant implications for the diagnostic performance of many of the routine tests currently used. Therefore, all thyroid function test results must be interpreted in light of the cat's history, clinical signs, and other laboratory findings. If a high serum  $T_4$  value is found in a cat that lacks clinical signs of hyperthyroidism, especially if no thyroid nodule is palpated, the serum  $T_4$  test should be repeated or other testing performed to verify the diagnosis.

None of the treatments used for hyperthyroidism are benign, whereas waiting for conclusive diagnosis is not harmful. Therefore, it is of paramount importance to avoid misdiagnosis of hyperthyroidism in a euthyroid cat to prevent unnecessary and potentially adverse treatment effects.

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