Vcheck

T4 & TSH

Thyroid function tests

BIONOTE Marketing team

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- Thyroid Hormones (T4, T3, TSH)
- The Thyroid Feedback Mechanism

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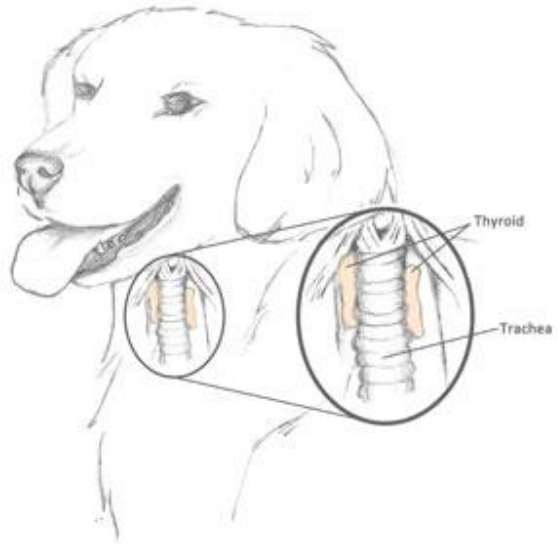
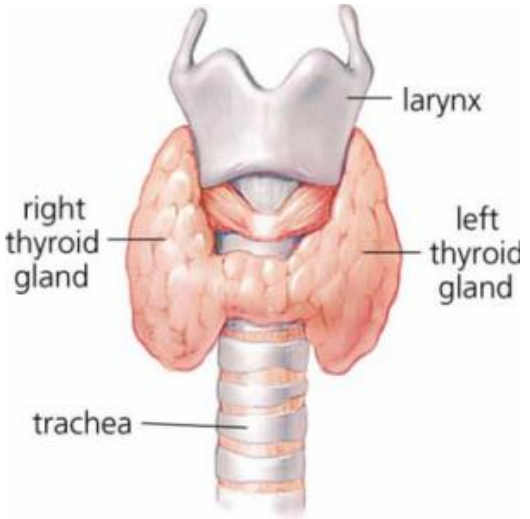
Thyroid gland





- The thyroid glands are paired structures located along the trachea, about halfway down the neck of dogs.
- These glands produce thyroxin, a hormone that regulates the body's metabolism.

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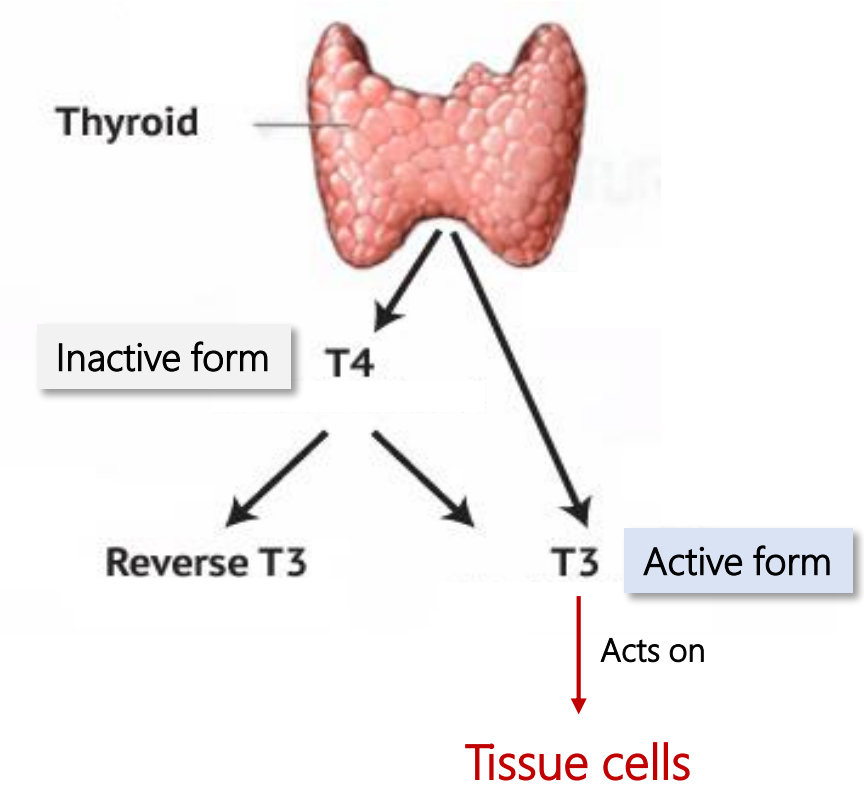
Thyroid Hormones

* Thyroid Hormones
  - T3: Triiodothyronine
  - T4: Thyroxine



- Most of the thyroid hormone consists of T4 and only small quantities of T3 and rT3.
- Conversion: T4 (Inactive form) ⇒ T3 (Active form)

- Once released into circulation, only small amounts of T4 and T3 are unbound (Free T4, T3)
- In dogs, the amount of free hormones in plasma is low (less than 1% for T4, slightly more than 1% for T3)
  - ✓ Total T4: Measures the bound and free hormone
  - ✓ Free T4: Measures free hormone (what is not bound)

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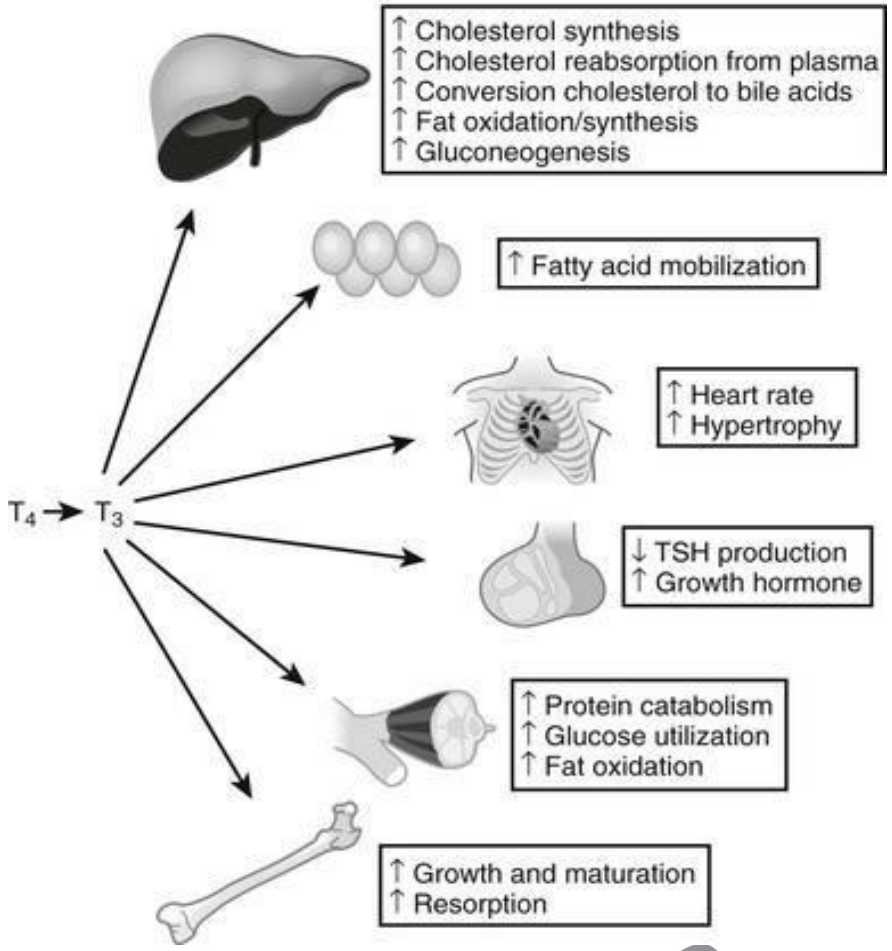
Effects of thyroid hormone

- ✓ Thyroid hormones are the primary factors for the control of basal metabolism.
- ✓ Thyroid hormone is important for the normal regulation of metabolic rate and activity in many tissues.

- Canine hypothyroidism is the common disease related to thyroid function in dogs.
- Feline hyperthyroidism is the most common endocrine disease affecting old cats.



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The Thyroid Feedback Mechanism

- **Negative feedback**
  - ✓ As thyroid hormone(T3, T4) production drops,
    (due to destruction of the thyroid gland)

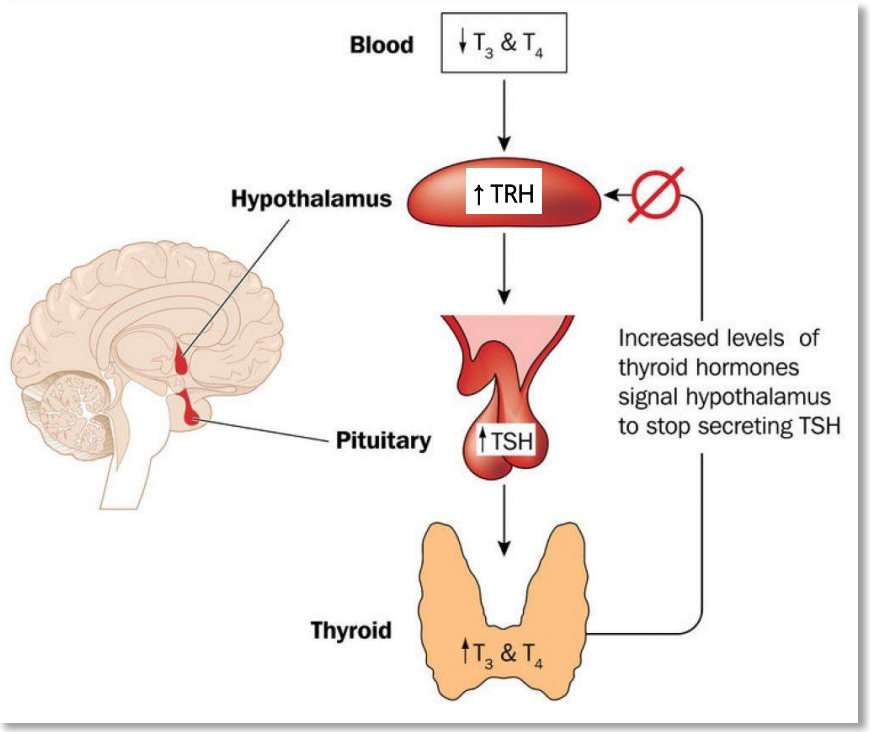
    ⇒ The negative feedback decreases

    ⇒ TSH level increases in response

- **In hypothyroid dogs,** (low T4 & high TSH)
  - ✓ TSH increases in dogs due to a lack of thyroid hormone by negative feedback.
  - ✓ TSH provides additional evidence for or against the diagnosis of hypothyroidism.

- **In hyperthyroid cats,** (high T4 & low TSH)
  - ✓ Hyperthyroid cats will generally have low levels of TSH by negative feedback.

The hypothalamic-pituitary-thyroid axis
[Negative feedback mechanism]



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Canine hypothyroidism

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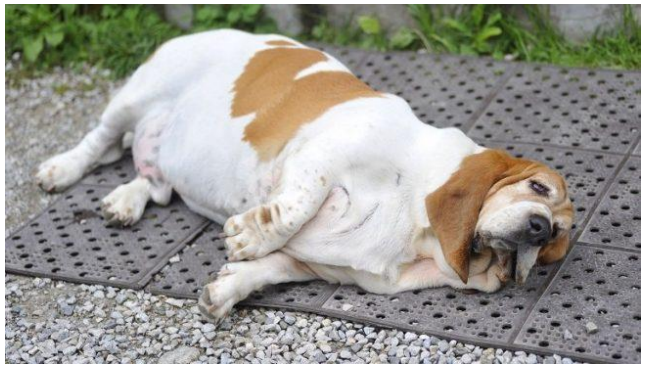
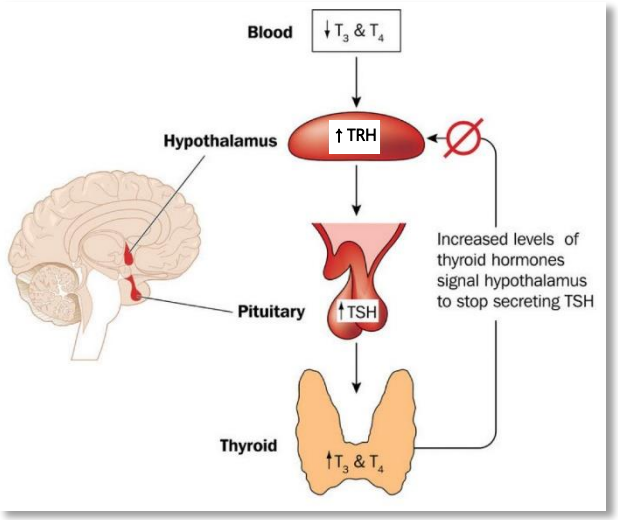
Canine Hypothyroidism

(Picture Credit: Getty Images)



Hypothyroidism in dogs is a disorder where the thyroid gland in the neck doesn't secrete enough thyroxine, a hormone that controls metabolism.

- One of the most common canine endocrine diseases
- Low concentrations of thyroid hormones (T4, T3) in the blood
- Results from impaired production and secretion of thyroid hormone



- Primary (Thyroidal) hypothyroidism (95%)
  - ✓ Due to destruction of the thyroid gland itself
  - ✓ Idiopathic atrophy of the thyroid, lymphocytic thyroiditis
- Secondary (Pituitary) hypothyroidism (<5%)
  - ✓ Impaired ability of the pituitary gland to secrete TSH
  - ✓ Anterior pituitary dysfunction, destruction from neoplasia

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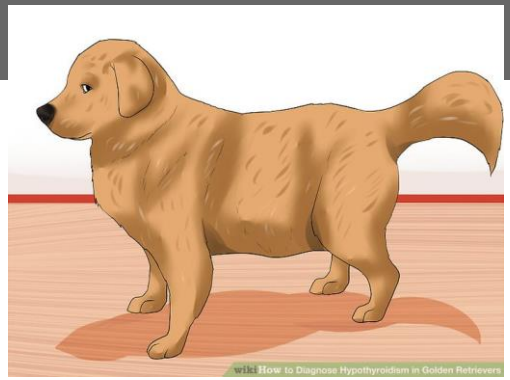
Canine Hypothyroidism

✓ Signalment

- Age
  - Middle-aged
  - Mean age 7 years, with a range of 4-10 years
- Breed
  - Large breed dogs (Golden Retrievers, Doberman Pinchers)
  - Rare in miniature and toy breeds
- Sex
  - Either sex at about the same rate
  - Neutraled males and females have higher risk than intact ones.



▲ Hypothyroidism in Golden Retrievers

Several breeds are genetically predisposed to the disorder, including …

Airedale Terriers	Golden Retrievers
Boxers	Greyhounds
Cocker Spaniels	Irish Setters
Dachshunds	Labrador Retrievers
Doberman Pinschers	Miniature Schnauzers

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Canine Hypothyroidism

✓ Clinical signs

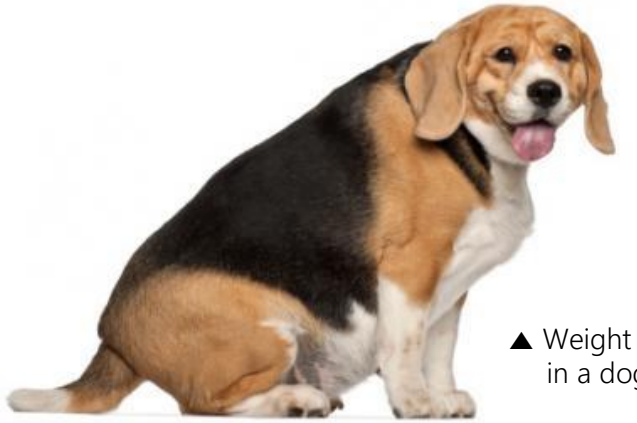
An underactive thyroid affects so many bodily functions that rely on thyroxine.

⇒ Symptoms of the disorder vary widely

Hallmark sign

- Lack of energy
- Frequent napping
- Exercise intolerance
- Loss of interest in running and playing
- Weight gain without increase in appetite or calorie intake
- Low tolerance for the cold
- Dull, dry, brittle, thin or greasy coat
- Hair loss or failure to regrow clipped hair

▲ Hair loss in a dog with hypothyroidism



▲ Weight gain without increase in appetite in a dog with hypothyroidism

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Canine Hypothyroidism

Never base a diagnosis on a single test result!

✓ Diagnosis ①

Based on a combination of clinical signs, physical examination, CBC, biochemistry, test of thyroid gland function.

- Haematology
  - Mild normocytic, normochromic, non-regenerative anemia (~4-50%)
- Serum Biochemistry
  - Hypercholesterolemia (75%)
  - Mild elevations in liver enzymes (ALP, ALT)

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Canine Hypothyroidism

Never base a diagnosis on a single test result!

✓ Diagnosis ②

Based on a combination of clinical signs, physical examination, CBC, biochemistry, test of thyroid gland function.

Thyroid Function Tests

- **Serum Total T4** (TT4)
  - A good screening test (high sensitivity)
  - Low specificity especially in the presence of concurrent disease

    ⇒ Increases markedly if used in conjunction with endogenous TSH analysis

- **Serum TSH** (Thyroid Stimulating Hormone)
  - **Primary hypothyroidism**: Low T4 & High TSH
  - Poor sensitivity

    ⇒ Approaches 100% in combination with a low fT4 or TT4

- **Serum Free T4** (fT4)
  - Measures unbound fraction of T4
  - Influenced less by euthyroid sick syndrome

[Mechanism]

As thyroid hormone production drops,

⇒ Negative feedback

⇒ TSH levels secreted will be increased in response.

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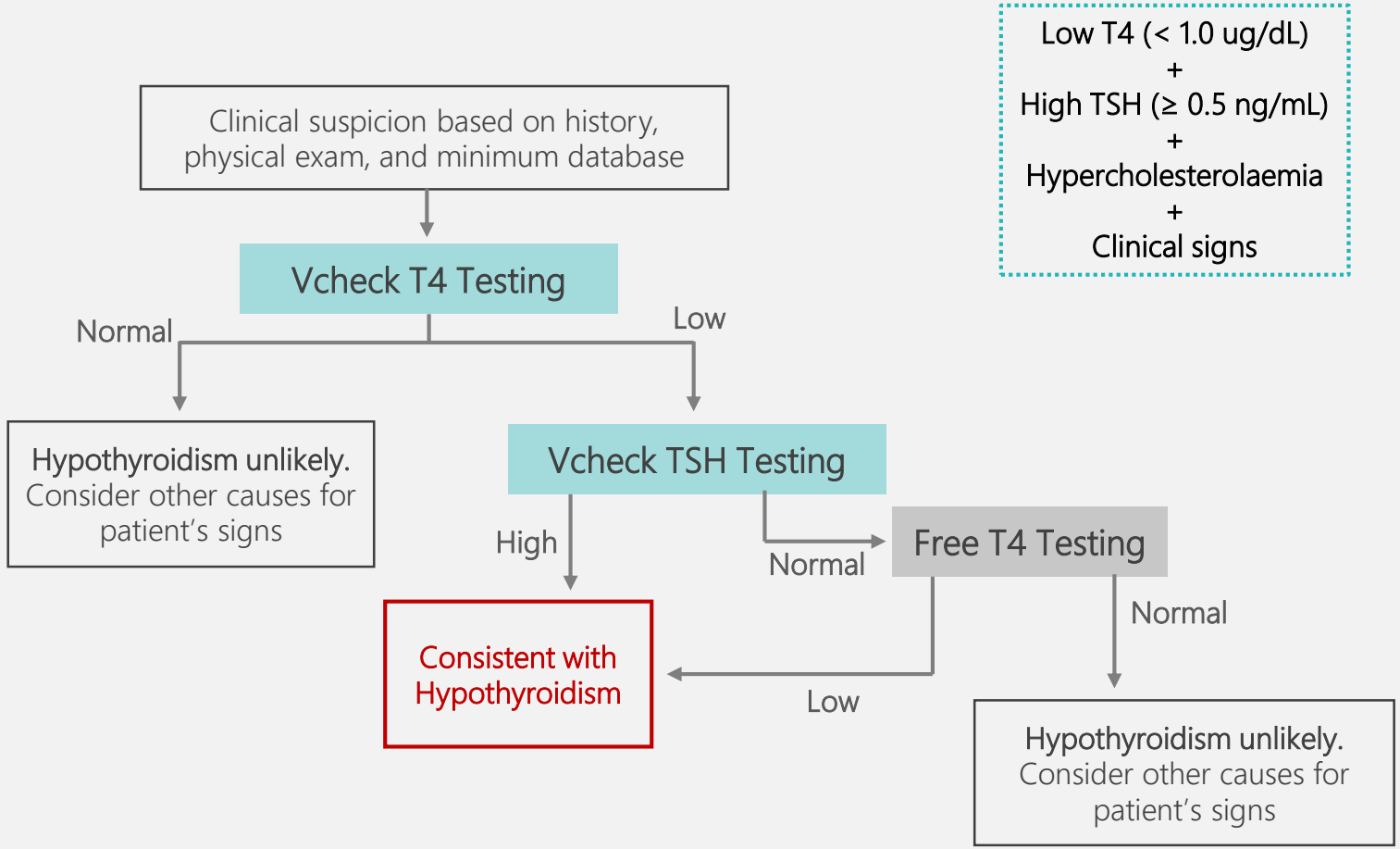
Canine Hypothyroidism

✓ Diagnosis ②

Thyroid Function Tests

- T4 + TSH combination test is mandatory for diagnosis of canine Hypothyroidism.

* A stepwise approach is helpful in accurately diagnosing canine hypothyroidism



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Canine Hypothyroidism

✓ Diagnosis ②

Thyroid Function Tests

- T4 + TSH combination test is mandatory for diagnosis of canine Hypothyroidism.
- Combination of elevated serum TSH and decreased T4 or fT4 has a specificity of 98% for diagnosis of hypothyroidism

Thyroid Tests	T4 Normal	T4 Decreased
cTSH Normal	• Euthyroid * End thyroid investigation	• Non-thyroidal illness (NTI) • Drugs • 20% of hypothyroid dogs
cTSH Increased	• Sulfonamide treatment • Recovery from NTI * Withdraw drug Tx and retest * Wait until recovery complete and retest	• Hypothyroid * Treat with T4 therapy

→ Perform further tests (Ex. free T4) for accurate diagnosis!

→ Diagnosis of hypothyroidism in dogs

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Canine Hypothyroidism

✓ Diagnosis ②

Thyroid Function Tests

Additional test (Ex. Free T4) is warranted in the following scenarios:

- If serum T4 is <1.0 ug/dL, but hypercholesterolaemia and clinical signs are absent.
- If severe systemic illness is present and the potential for ESS is high.
- If drugs known to decrease serum T4 concentration are being administered (prednisolone, phenobarbitone, etc).

What Is Euthyroid Sick Syndrome (ESS) ?

✓ Thyroid gland is secondarily affected by disease in some other organ system

- Other endocrine diseases (Hyperadrenocorticism. Diabetes mellitus)
- Liver, cardiac, renal, pancreatic, lung etc. (Cardiomyopathy, demodicosis, hepatitis, infections, renal failure)

✓ So, the diagnosis of hypothyroidism should never be based on a hormone assay alone, but depends on a large range of findings

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Canine Hypothyroidism

Considerations

- Greyhounds, Scottish deerhounds: have low T4 levels naturally
  ⇒ Diagnose based on clinical signs as well as test results; treat if clinically evident.

- Remember sick animals and animals on certain medications (anti-epileptics) may have depressed T4 levels. (Euthyroid sick syndrome) ⇒ Wait and re-test after treatment of underlying cause if clinical signs persist.

- Several medications have been demonstrated to lower the serum T4 concentration of dogs.

Drugs That Alter Canine Thyroid Hormone Function or Test Results

- ✓ Prednisone (high dose)
- ✓ Phenobarbital
- ✓ Trimethoprim–sulfamethoxazole
- ✓ Aspirin (high dose)
- ✓ Clomipramine
- ✓ Thyroxine supplementation

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Canine Hypothyroidism

Treatment

(Thyroid hormone replacement)

- Needs to be administered lifelong
- Thyroid supplement: **Synthetic sodium levothyroxine**
  - ✓ A starting dose of 20 μg/kg, Maximum dose is 800 μg (usually BID)
  - ✓ Daily administration (usually BID)
- Improvement of Clinical signs
  - ✓ General sense of well being will improve within a few weeks, but improvement in dermatological signs, myocardial function and weight loss may take 2–3 months.

T4 Monitoring During Treatment

- T4 levels can be measured 6–8 weeks after initiating treatment.
  - ✓ 4–6 hours after administration (peak): within high normal range (3.0~4.0 ug/dL)
  - ✓ Just before tablet administration (trough): within low normal range (1.0~2.0 ug/dL)
- Regular rechecks are recommended including bloodwork.

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