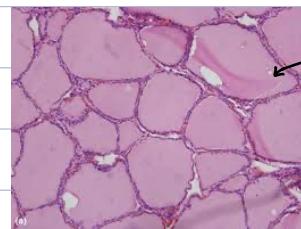
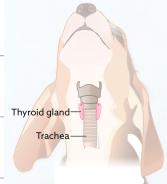


Thyroid Gland!



Contain proteinaceous colloid (thyroglobulin)

and store hormone precursors and iodine

Development of fetal thyroid

Ectoderm derived - descends from floor of mouth forming thyroglossal duct

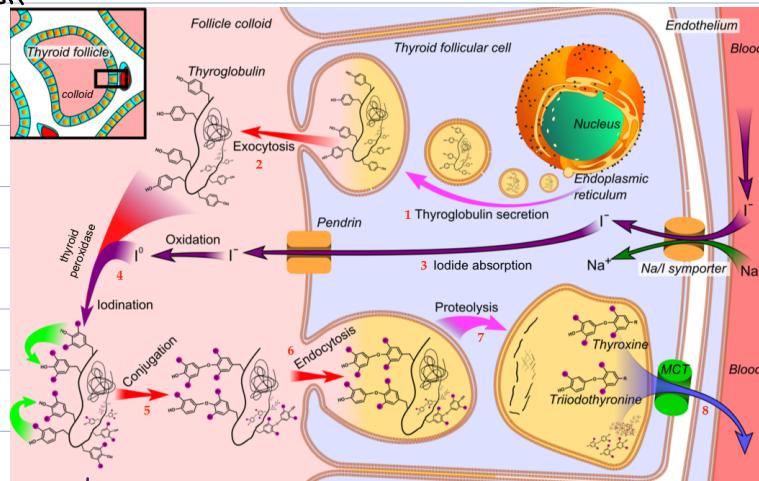
Active thyroid cells can continue to occupy the thyroglossal duct anywhere between the base of the tongue and the base of the heart

↳ that is why ectopic thyroid tissue is often @ tongue base, neck, mediastinum

Iodide trapping - Iodide absorbed in GIT from diet

80% rapidly excreted from the kidneys or selectively removed from circulation by thyroid follicular cells

Rate is dependent on TSH



Thyroglobulin is synthesized in the follicular cell ER and Golgi complex

Tyrosine amino acid is incorporated into the thyroglobulin molecule as it is being formed

Tyrosine-containing thyroglobulin is exported from follicular cell cytoplasm into the colloid via exocytosis

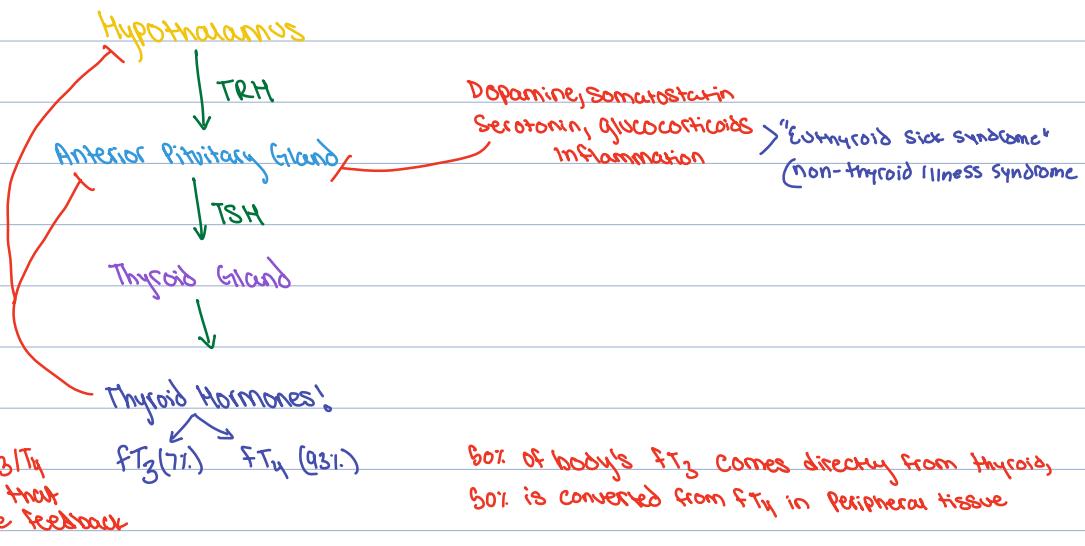
Thyroid cells capture iodide from blood and transfer it into colloid as iodine

In the colloid, iodine is attached to tyrosine by the enzyme thyroid peroxidase

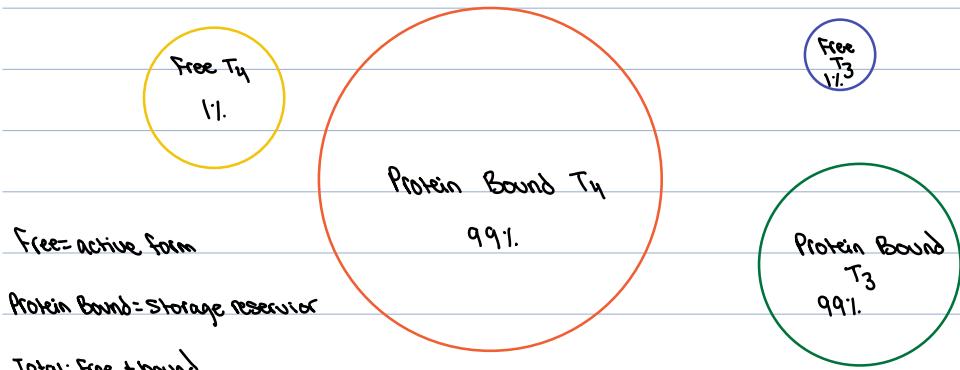
This forms MIT and DIT

The two iodinated tyrosine molecules are coupled to form T₃ and T₄ in the colloid

Hypothalamus - Pituitary - Thyroid gland axis



Circulating Thyroid Hormones



Degradation of Thyroid Hormones

T_4 - Glucuronidated (limited rxn in cats) > occurs in liver

T_3 -Sulfated

Both products excreted into bile

Thyroid Gland Pathology

Thyroid Gland: 3 different endocrine tissues

Thyroid Gland (follicular cells)

(Intracapsular)
Parathyroid gland

(Between follicles)
Interstitial thyroid C-cells

Lobular - columnar follicular cells around a

- discrete circumscribed gland

Interstitial location and secrete calcitonin

wall of colloid, extensive capillary network

- key for calcium homeostasis

Around the follicles

Thyroid Physiology

Plasma Iodide I^- is trapped by thyroid epithelial follicular cells

Transported and oxidized to I in microvilli at luminal border

I bound to Tyrosine w/ thyroglobulin molecules as monoiodotyrosine (MIT) or di-iodotyrosine

$DIT + MIT \rightarrow T_3$ ← active form of the hormone!

$DIT + DIT \rightarrow T_4$ ← majority (90%) of circulating thyroid hormone

Thyroid hormones ↑ basal metabolic rate

Diseases of the Thyroid Gland

Follicular cysts

↳ Degenerative lesions

Hypothyroidism

- Typically a primary lesion of the thyroid gland

- Congenital hypothyroidism has been seen in neonatal/fetal foals and young kittens

Clinical Signs: hyperkeratosis, alopecia, hyperpigmentation, comedones, epidermal atrophy, myxedema

- loss of libido, low sperm count, altered estrus cycles

- Hypercholesterolemia, atherosclerosis, hepatic, renal, corneal and glomerular lipidoses

$T_4 < 0.6 \mu\text{g/dL}$ Free $T_4 < 0.3 \mu\text{g/dL}$ TSH high (0.58 ng/mL)

Hypothyroidism

Labs: CBC - mild normocytic, normochromic, nonregenerative anemia

Chem - hypercholesterolemia, hypertriglyceridemia

UA - +: Proteinuria from hyperlipidemia

Thyroid testing: low T₄/fT₄, elevated TSH

↑ thyroid gland is trying to stimulate thyroid hormone production

Testing: TSH Stim or technetium scan

Treatment: Oral levo-thyroxine bid

Initial dose 0.1-0.2 mg / 10 lbs maintenance: 0.1 mg / 10 lbs

Hyperthyroidism

Labs: CBC - +: Polycythemia

Chem - elevated liver enzymes (reactive hepatopathy)

VSG - decreased

Testing: Elevated total T₄

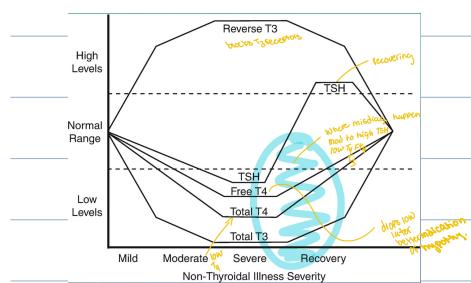
Treatment: Oral methimazole (Inhibits thyroid peroxidase) ← Starting dose = 2.5 mg / cat

Ultra-low iodine diet

I-131

Thyroidectomy

Euthyroid Sick Syndrome "ESS" - Non-thyroidal illness syndrome (NTIS)



Sickness that can mimic thyroid disease

Thyroid Gland Labwork Abnormality Comparison

Hypothyroidism	Euthyroid Sick syndrome	Hyperthyroidism
T ₄	↓	↓
FreeT ₄	↓	Normal low w/ mod-severe illness
TSH	↑	Normal mild high upon recovery
TGAA	+ or -	-

Interpreting total T₄

Normal rules out hypothyroidism, does NOT rule out hyperthyroidism (especially if high normal) → fT₄, TSH

Low hypothyroidism may be present (sensitive) → fT₄, TSH, TGAA *could also be euthyroid sick syndrome

High hyperthyroidism probably present if the clinical picture fits

Primary hypothyroidism - Pathology in thyroid gland

Secondary hypothyroidism - Pathology in the pituitary gland (\downarrow TSH production)

Tertiary hypothyroidism - Pathology in the hypothalamus (\downarrow TSH production)

Lymphocytic Thyroiditis (Hashimoto's Disease)

- Thyroid tissue is infiltrated by multiple medium-sized aggregates of lymphocytes, plasma cells, and macrophages
- Immune-mediated pathogenesis is suspected

Idiopathic Follicular Atrophy

- Progressive loss of follicular epithelium \rightarrow replacement w/ adipose tissue
- Minimal inflammatory response
- Smaller thyroid glands that are lighter in color
- * May be the ultimate result of lymphocytic thyroiditis

Nonfunctional Thyroid Tumors (total/subtotal destruction of thyroid gland)

- Occurs in dogs + horses but is rare
- Clinical effects occur with $>75\%$ follicular loss

Follicular goiter

↑ Non-neoplastic TSH-driven hyperplastic enlargement of the thyroid gland that is associated with hypofunction.

Causes: Dalm's diet deficient in iodine

Iodineogenic compounds that interfere with thyroxinogenesis

Dietary iodine excess $\xrightarrow{\text{Seaweed supplementation}}$ interference w/ steps in thyroxinogenesis and $\downarrow T_3, T_4$

Genetic defects in enzymes involved in the biosynthesis of thyroid hormones

$\downarrow T_3, T_4$ \uparrow TRH, TSH \rightarrow hypertrophy + hyperplasia of epithelial follicular cells

Congenital Thyroid Gland Hypofunction in kittens and foals

- Low/undetectable Serum T₄, elevated TSH (treated w/ levothyroxine)
- Delayed tooth eruption and delayed onset of secondary centers of ossification
- Similar to congenital hypothyroidism and dysmaturity syndrome
- Hypoplasia of the thyroid gland

Feline Hyperthyroidism

- most common endocrinopathy in cats

Dogs don't really get hyperthyroidism unless they have a thyroid neoplasia carcinoma adenoma

- Hyperactive, (3 double expressos), weight loss, ↑ appetite

- Adenomatous hyperplasia → thyroid Slip

- Excessive production of T₃T₄ w/ positive feedback inhibition to suppress TRH and TSH secretion

- Mild to moderate ↑ AST, ALT, ALP ^{w/ most predictably elevated}

~77% of hyperthyroid cats have ↓ ionized Ca²⁺, hyperphosphatemia, and diffuse parathyroid hyperplasia

- Cardiac Changes- cardiomegaly w/ tachycardia, hypertension, LV hypertrophy and decompensating congestive heart failure

Azotemia may also be present

Horses

Thyroid adenomas are the second most common endocrine tumor identified in older horses

Usually functionally inactive