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# Hypothyroidism

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The University of Tennessee  
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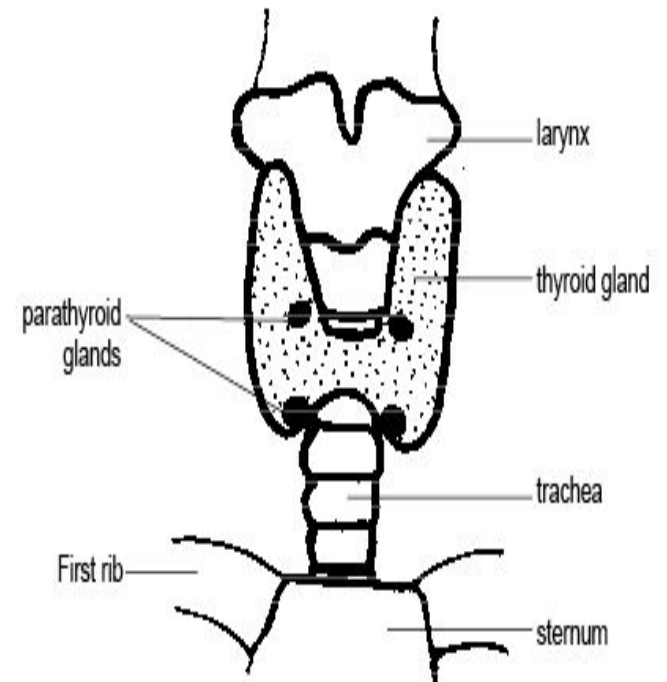
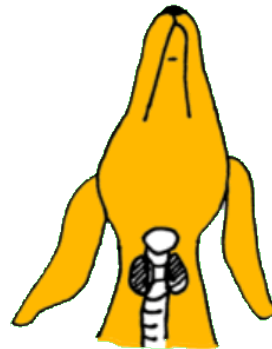


# HYPOTHYROIDISM

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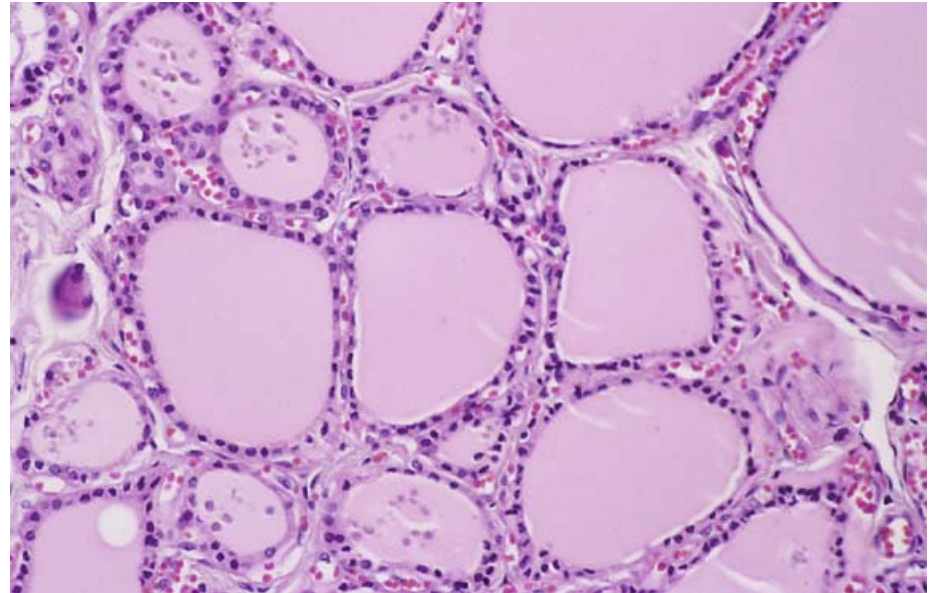
# ANATOMY

- 2 lobes
- Cranial artery (*common carotid branch*)
- Caudal vein (*int. jugular branch*)
- Sympathetic innervation



# THYROID GLAND

- Follicular cells  $T_3, T_4$
- Parafollicular (“C”) cells *Calcitonin*
- Thyroglobulin (colloid)
- Interstitial connective tissue



# FUNCTION

## *Thyroid hormones:*

1.  $T_3$  (triiodothyronine)
2.  $T_4$  (thyroxine)



- Stimulate oxygen utilization and heat production  
(*↑ CHO utilization, protein breakdown and fat oxidation*)
- **NIS** gene expression in thyroid is regulated by TSH

# FUNCTION

- Stimulate oxygen utilization and heat production
- Thyroid involved in nervous, musculoskeletal and other organ development and function  
*( $T_4$  acts with somatomedin, that liver releases after GH release. The result is skeletal growth)*
- Thermogenesis:  $T_4$  ↓ monoaminoxidase & catecholamine levels, which ↑ break down of brown fat *(neonates!)*



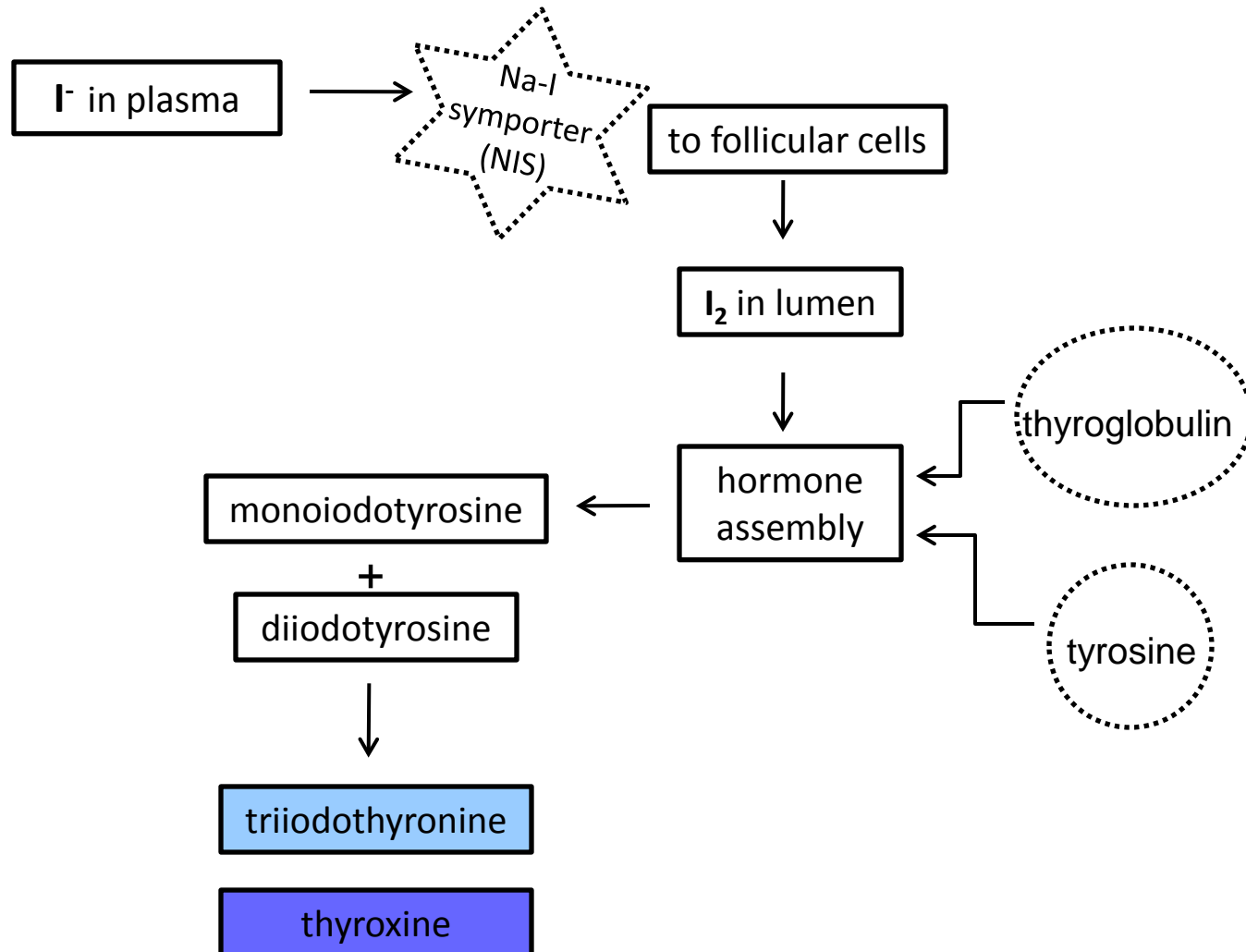
# FUNCTION

## *Influenced by:*

- Diet: selenoproteins play role (*deiodinase converts  $T_4$  to  $T_3$* ). Then, in  $\downarrow$  Se,  $T_4$  can accumulate and  $\downarrow$   $T_3$
- Drugs: phenylbutazone, dexamethasone and  $\uparrow$  energy, protein, Zn and Cu diets influence synthesis
- $\uparrow$  exercise
- Prematurity:  $\downarrow$  concentration of total and free thyroid hormones
- Neonates: higher concentration of  $T_3$  and  $T_4$  at 4 days



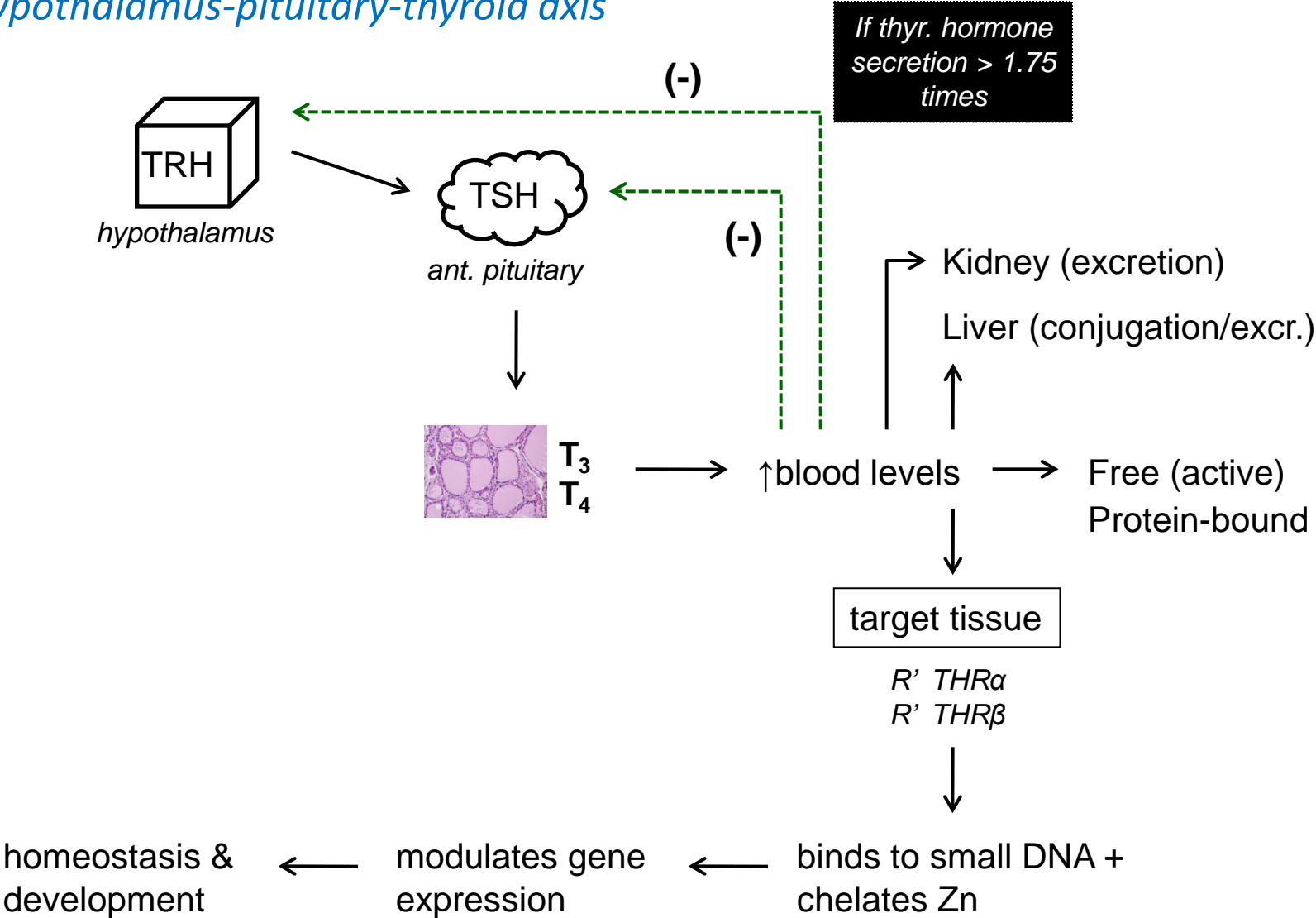
# HORMONE SYNTHESIS





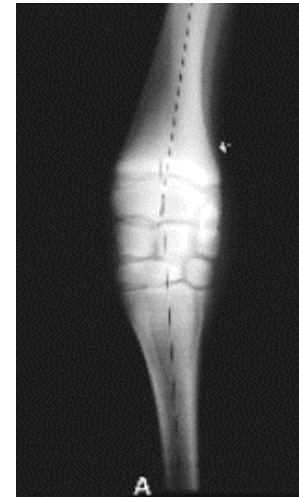
# THYROID SECRETION

## Hypothalamus-pituitary-thyroid axis



# HYPOTHYROIDISM

- Reported in llamas
- Usually < 1 year of age
- Failure to grow
- Chronically underweight
- Angular limb deformities
- Depression
- Other (anemia, poor haircoat)



# HYPOTHYROIDISM

- With goiter *most common by ↓iodine*
- Without goiter

**Goiter** is just a term for abnormal thyroid enlargement (thyroid hyperplasia)



# HYPOTHYROIDISM

- **PRIMARY**

Unlikely in llamas. In adult dogs. Chronic lymphocytic thyroiditis (autoimmune) or idiopathic non-inflammatory hypothyroidism

- **SECONDARY**

Congenital or acquired. Less common. ↓ TSH secretion

- **TERTIARY**

Congenital or acquired. ↓ TRH. Perhaps due to biochemical error in metabolism



# HYPOTHYROIDISM

## CAUSES:

- Iodine deficiency
- Goitrogenic substances: *sulfonamides, Brassica plants, thiouracil, unprocessed soybeans, etc.*
- Congenital: sheep, goats, cattle, humans (prevalence of 1:2000 in newborns). Dam was deficient in iodine.



# HYPOTHYROIDISM

## DIAGNOSIS:

- ↓ T<sub>3</sub> and T<sub>4</sub> resting levels + ↓ response to TSH stimulation test + history and clinical signs
- TSH: 3 IU of TSH/ 45 kg IV

### *Thyroid hormones and TSH stimulation in llamas*

	ng/mL	[ ] peak
Resting T <sub>3</sub>	0.45-4.18	-
Resting T <sub>4</sub>	70-220	-
T <sub>3</sub> post TSH	1.75-3 times	8 h
T <sub>4</sub> post TSH	3-5.5 times	4 h

# HYPOTHYROIDISM

$T_3$  and  $T_4$  resting levels may be influenced by:

- Lack of appetite
- Illness
- Drugs
- Serum protein carrier molecules: *humans have thyroxine-binding globulin (to albumin)*



# HYPOTHYROIDISM

After TSH administration:

- $T_3$  should  $\uparrow$  in 2 h and peak at 4 h.  
2.5 times more, compared to resting levels.
- $T_4$  should  $\uparrow$  in 2 h and peak at 8 h  
2 times more than resting levels.



Collect blood at these times, depending the hormone.



# HYPOTHYROIDISM

## TREATMENT:

In one study, it was seen that when L-Levotyroxine supplementation on sick llamas was suspended, contributed to the reoccurrence of some of the clinical signs

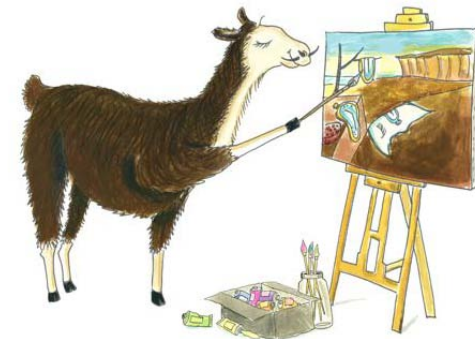
- *Wrong dose*
- *Absorption*
- *Failure to treat*



# FUNCTION

## REMEMBER...

- Thyroid function regulates metabolic rate of the body
- Neonates have a higher  $T_3$  and  $T_4$  concentrations (4 days of age)
- Diagnosis of hypothyroidism based on resting levels + clinical signs + TSH stimulation test
- TRH and TSH are stimulated by sympathetic nerve system and cold weather (*hypothalamic centers*)
- Hypothyroidism is rare in camelids





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**Thank you!**

