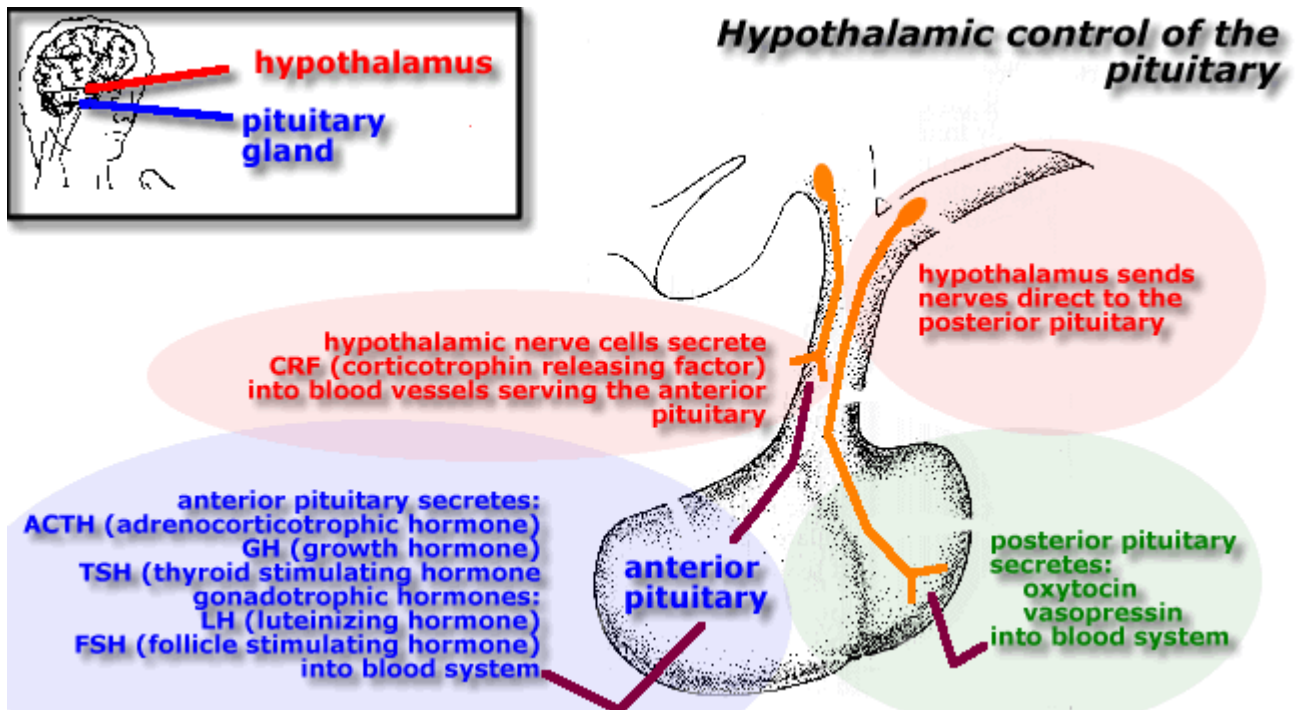


## Endocrine System

- I. What is the endocrine system?
- Hormones, orchestrate metabolic equilibrium between organ systems
  - Hormones act on target cells distant from site of synthesis
  - Increased activity of target tissue often downregulates activity of gland (feedback inhibition)
  - Slower signaling mechanism, allows for gradual adaptation
  - May have impaired synthesis or release, abnormal interactions with target tissue, or abnormal response of target tissues
  - Lesions may be nonfunctional, or result in over- or underproduction of hormones
- II. The Pituitary Gland
- Located at the base of the brain in the sella turcica
  - Plays critical role in regulation of most other endocrine glands



- Development
  - Derived from pharyngeal epithelium (Rathke's pouch)
  - Migrates to meet with posterior pituitary (neural component, derived from hypothalamus)

- Anterior Pituitary
  - Somatotrophs—GH, acidophilic
  - Lactotrophs—prolactin, acidophilic
  - Corticotrophs—ACTH, MSH, basophilic
  - Thyrotrophs—TSH, basophilic
  - Gonadotrophs—FSH, LH, basophilic
- Posterior pituitary
  - Connected to posterior hypothalamus via pituitary stalk
  - Hormones synthesized in hypothalamus, transported via axons to posterior pituitary, dumped out into circulation via vein
  - Secretes oxytocin, vasopressin

### III. Pituitary Disease

#### A. Vascular

- Sheehans Syndrome (aka postpartum pituitary necrosis)—Pituitary normally doubles in size during pregnancy. Ischemic necrosis of gland occurs, usually associated with hemorrhage and shock of childbirth. Clinically, manifests first due to loss of gonadotropins, then loss of TSH and ACTH→anterior pituitary hypofunction
- Pituitary apoplexy—may occur suddenly if adenoma hemorrhages, causing sudden expansion and dysfunction. Most patients have headache, visual dysfunction. May result in panhypopituitarism or dysfunction of one area.

#### B. Neoplasms

- Frank carcinomas very rare
- Adenomas *most common cause* of pituitary hyperfunction, may be functioning or nonfunctioning, up to 20% of individuals have nodules on MRI. Mass effect of both functioning and nonfunctioning results in headaches, increased ICP, visual field defects (esp bitemporal hemianopsia). While one hormone may be overproduced, others are depressed.
  - \*Nonfunctional—because these do not cause endocrine derangements, may grow to a much larger size without notice. Cause more pronounced mass effect, and may lead to pituitary apoplexy if hemorrhage occurs.
  - \*Prolactinoma—most common, usually chromophobic. In women, results in secretion of prolactin→amenorrhea, galactorrhea, loss of libido, infertility. May also be caused by hypothalamic lesions or medications that interfere with negative feedback of dopamine on prolactin secretion.
  - \*Growth Hormone secretion (aka acromegaly)—Second most common. If onset before epiphyseal closure, results in gigantism (children). In adults, acromegaly and enlargement of jaw, hands, feet, and soft tissues; general enlargement of viscera. Cardiomegaly results in HTN. Causes secondary hyperproduction of somatomedins (esp

somatomedin C) by liver. Somatomedin C is known as insulin-like growth factor (IGF), and these patients will also have hyperglycemia. Symptoms due to both excess GH and somatomedins.

\*Corticotrophic Adenoma and ACTH hypersecretion—Results in increased production of adrenal hormones.

Cushing disease—classically refers to hypercorticism due to pituitary adenoma

Cushing syndrome—refers to hypercorticism of any cause (adrenals, pituitary, ectopic production, etc).

Will be covered further in adrenals lecture

If pituitary in origin, will see hyperpigmentation because ACTH shares amino acid sequence with MSH.

C. Posterior pituitary

- Trauma—*Classic Case of Diabetes Insipidus*—Head trauma patient with polyuria, insatiable thirst, dehydration. ADH deficiency causes inability to concentrate urine, polyuria, dehydration.
- SIADH—Oversecretion of ADH, causes edema, fluid retention, dilutional hyponatremia, reduced serum osmolality, inability to dilute the urine. Most commonly caused by ectopic production by tumors.

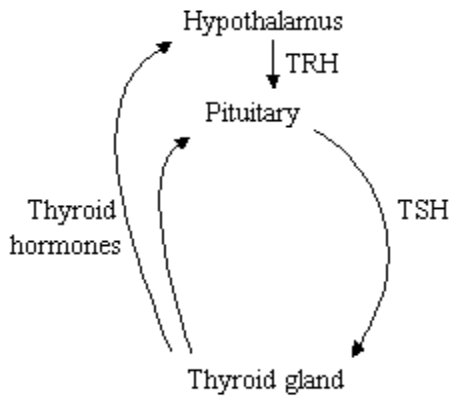
Hyperfunction of Pituitary:

Hormone	Lesion	Staining of Cells	Manifestations
Prolactin	Prolactinoma	Chromophobic	Amenorrhea, galactorrhea in women; impotence +/- galactorrhea in men
Somatotropin (GH)	Somatotrophic Adenoma	Acidophilic	Gigantism or acromegaly
Corticotropin (ACTH)	Corticotrophic Adenoma	Basophilic	Pituitary Cushing Syndrome
Antidiuretic Hormone (ADH)	Nonpituitary lesions with ectopic production of ADH		Water retention, dilutional hyponatremia

## The Thyroid

### I. Background

- Arises from base of tongue, close to thymus and parathyroids
- Migrates to neck, may leave behind thyroglossal duct cysts
  - Remnant of thyroglossal duct
  - Most common thyroid anomaly
  - No alteration in thyroid function
- Ectopic sites of parathyroids, thymus may be found in thyroid tissue



- Hormones include T3 (triiodothyronine), T4 (thyroxine)
  - Bound to thyroid-binding globulin (TBG) in bloodstream
  - Synthesis depends on adequate quantity of iodine
  - Rate of production depends on rate of T4, T3 synthesis and release from storage (as thyroglobulin), as well as pituitary TSH

### II. Disease

#### 1. Goiter

- Endemic—iodine deficiency. Pituitary causes thyroid hypertrophy due to lack of T3/T4

2. Immunologic—Thyroid commonly affected by immunologic processes. Initial hyperthyroidism in some conditions eventually leads to hypothyroidism as thyroid “burns out.” Three main types

	<b>Hashimoto</b>	<b>DeQuervain (subacute, granulomatous)</b>	<b>Reidel’s Struma</b>
Clinical	Early, transient hyperthyroid phase, followed by gradual decline in thyroid function to hypothyroidism. Modestly enlarged, tender gland.	Several weeks’ duration of a flu-like illness, associated with pain and tenderness of gland. May have transient hyperthyroidism. Self-	Thyroid replacement with fibrous tissue

		limited	
Histology	Massive lymphocytic infiltrate, Hurthle cells (eosinophilic, atrophic epithelial cells)	Granulomatous inflammation, multinucleated giant cells.	Extensive fibrosis of thyroid
Etiology	Associated with various autoantibodies.	Viral illness causes autoimmune attack on thyroid	Unknown
Epidemiology	Female>>male, most common cause of hypothyroidism	Female>>male	
Other	May be associated with other autoimmune diseases		May clinically mimic carcinoma

Graves Disease—Like Hashimoto, but causes *hyperthyroidism*. Antibodies bind to TSH receptor and activate it, causing excess production of T3/T4. Results in diffuse hypertrophy of thyroid. \*Exophthalmos\* , pretibial myxedema. LATS antibody. Females>>males.

### III. Neoplasms

	<b>Adenomas</b>	<b>Medullary Carcinoma</b>	<b>Follicular Carcinoma</b>	<b>Papillary Carcinoma</b>
Basics	Functional or nonfunctional	Originates from C-cells of thyroid, produces calcitonin (decreased Ca), VIP, serotonin		<i>Most common thyroid cancer</i>
Diagnosis	Iodine tracer, most “cold” or nonfunctional; “hot” are functional			FNA to distinguish from cysts
Histology		Sheets of tumor cells in amyloid stroma	Uniform follicles	Papillary projections into gland-like spaces, orphan-Annie nuclei, <b>P</b> sammoma bodies (calcified spheres) often present
Prognosis		Poor if associated with MEN-2	Poor	Best
Other		Accociated with MEN-2		

#### IV. Hyper- versus Hypothyroidism

	<b>Hyperthyroidism</b>	<b>Hypothyroidism</b>
Labs	Elevated T3, T4	Depressed T3, T4
Metabolism	Hypermetabolic→weight loss, heat intolerance, insomnia	Hypometabolic→weight gain, cold intolerance, fatigue
Cardiac	Tachycardia, palpitations, arrhythmias	Decreased CO
Neuromuscular	Tremors, anxiety, lid lag, muscle atrophy	Decreased DTRs
Other	Exophthalmos <i>only</i> seen in Graves, menstrual abnormalities, fine hair	Edema, tongue enlargement, voice changes, coarse brittle hair
If severe,	Thyrotoxicosis	Myxedema

Labs:

	Primary (Thyroid dysfunction)	Secondary (Pituitary)
Hyperthyroidism	↓ TSH, ↑ FT4	↑ TSH, ↑ FT4
Hypothyroidism	↑ TSH, ↓ FT4	↓ TSH, ↓ FT4

- TSH best screening tool for hypo- and hyperthyroidism
- Total T3, T4 less useful because protein-bound, therefore protein levels may offset true levels (T4 most affected, 99.96% bound)
- Free T3, T4 more useful but tough to measure
- Other labs—anti-thyroid antibodies and anti-thyroid peroxidase for thyroiditis
- Thyroglobulin used to monitor presence of residual thyroid function after ablation or removal.