**Ch 8: Endocrine Physiology**

**Objectives**
1. Review endocrine glands of body.
2. Understand how hypothalamus controls endocrine system & sympathetic epinephrine response.
3. Learn anterior pituitary hormones & their effects on glands of body.
4. Understand some endocrine disorders.

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**1. Endocrine Glands of the Body**

Endocrine System = system involving regulation of body functions through use secretory glands & chemical messengers (hormones)

Endocrine glands of body:
- Pituitary = master endocrine gland
- Pineal gland = located in diencephalon
- Adrenal glands = located above kidneys
- Thyroid = located on anterior trachea
- Parathyroid glands = located on posterior trachea
- Gonads = ovaries & testes
- Pancreas
- GI tract

**Most of these glands controlled by hypothalamus!**

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**2. Hypothalamus controls endocrine system!**

Hypothalamus part of both nervous & endocrine systems

**Controls endocrine system 3 ways:**
1. Hypothalamic nuclei secrete neuro-hormones through posterior pituitary.
   - Supraoptic nucleus secretes **ADH** (vasopressin)
   - Paraventricular nucleus secretes **Oxytocin**
2. Hypothalamus secretes **releasing hormones** or **inhibiting hormones** which control anterior pituitary
3. Hypothalamus controls autonomic sympathetic secretion of **epinephrine** from **adrenal medulla.**

**Hypothalamus Directs Anterior Pituitary Secretions**

Know hypothalamic hormone (acronym) and what it causes anterior pituitary to secrete!

**Hypothalamus secretes:**
1. **GnRH**
2. **GHRH**
3. **TRH**
4. **CRH**
5. **GHIH**
6. **PITH**

**Anterior Pituitary Secretions**

Anterior Pituitary Response:
1. **LH** and **FSH** (target = gonads)
2. **GH** (target = muscle tissue)
3. **TSH** (target = thyroid)
4. **ACTH** (target = adrenal cortex)
5. **GHIH** inhibits **GH** secretion
6. **PITH** inhibits Prolactin secretion

NOT IN BOOK!
How hypothalamus & neg. feedback regulates anterior pituitary secretions:

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Stimulated by</th>
<th>Inhibited by</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>CRH, GnRH</td>
<td>TRH, GHRH</td>
</tr>
<tr>
<td>TSH</td>
<td>CRH, GnRH</td>
<td>TRH, GHRH</td>
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</tr>
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<td>LH</td>
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Anterior Pituitary secretions & their effects on target organs or glands:

- ACTH: Stimulates mammary glands to make milk (lactation)
- TSH: Produces T3 & T4 to regulate metabolism
- GH: Stimulates body tissues to grow!
- FSH: Produces estrogen & sperm
- LH: Produces sex steroids - Cortisol
- PRL: Stimulates mammary glands to make milk (lactation)

Practice Endocrine Flow Chart!

Review

- Hypothalamic controls endocrine system
  - Nuclei secrete ADH & oxytocin
  - 4 Releasing hormones (CRH, GnRH, TRH, GHRH)
  - 2 Inhibiting hormones (PH, GHINH)
  - Controls adrenal medulla secretion of epinephrine

- Anterior pituitary secretions & their target organs
  - ACTH, TSH, GH, FSH, LH, PRL

- Endocrine glands of body
  - Pituitary, adrenals, thyroid, parathyroids, gonads, pineal gland, pancreas, GI tract

Growth Hormone (GH) Disorders: Clinical App Pg 203 & ONLINE

1. Insufficient GH = insufficient body growth
   - Pituitary dwarfism
   - Pituitary dwarfism

2. Excessive GH – excessive body growth
   - Gigantism – when onset in childhood
   - Acromegaly – when onset in adulthood
ACTH stim. Adrenal Cortex to make:
1. Sex steroids (stim. ACTH)
   Ex. - estrogen, testosterone, progesterone
2. Mineralcorticoids (stim. = aldosterone)
   Ex. - aldosterone
   - retain salt, urine output, retain water, blood volume
3. Glucocorticoids (stim. ACTH)
   Ex. - cortisol

Under sympathetic response - hypothalamus stim. Adrenal Medulla to make
- Epinephrine

Adrenal Cortex Disorders:
A. Cushing’s Disease (“hypercortisolism”) – Excess Cortisol
   Clinical View Pg 206 & ONLINE
   Causes:
   - Excess hypothalamic CRH or pituitary ACTH
   - Adrenal gland tumor
   Clinical Presentation:
   - Hyperglycemia = hi blood glucose
   - Hyperlipidemia = hi blood lipids
   - Hypervolemia = hi blood volume (“moon face”)
   - Hypertension =

B. Addison’s Disease – Insufficient Aldosterone
   Clinical View Pg 206 & ONLINE
   Causes:
   - ↓ hypothalamic CRH or pituitary ACTH.
   - Adrenal cortex tumor or autoimmune disorder.
   Clinical Presentation:
   - Hypoatremia = low blood sodium
   - Hyposthenia = high blood K+
   - Hypovolemia = low blood volume
   - Hypotension =
   - Anorexia = weight loss
   - Skin bronzing (overstimulation of melanocytes)

Adrenal Medulla Disorders:
Pheochromocytoma = excessive norepinephrine/epinephrine
   Clinical App ONLINE
   Causes:
   - adrenal medulla tumor
   Clinical Presentation: “fight or flight” symptoms
   - Tachycardia =
   - Hypertension =
   - Hyperventilation =
   - Hyperglycemia = high blood glucose
   - Hyperlipidemia =
   - Nervousness, sweating

Thyroid Gland
Produces:
1. T3 (tri-iodothyronine)
2. T4 (thyroxine)
3. Calcitonin - ↓ blood Ca+2

Parathyroid Glands
Produce:
Parathyroid hormone - ↑ blood Ca+2

Thyroid gland disorders – Clinical App ONLINE
A. Hyperthyroidism = excessive thyroid hormones
   Causes:
   - thyroid tumor
   - Graves disease = autoimmune attack, over-stimulates thyroid receptors.
   Clinical presentation:
   - High metabolism & anxiety
   - Intolerance to heat (sweating)
   - Tachycardia
   - Hypertension
   - ↑ fluid behind eyes (“exophthalmos”)

B. Hypothyroidism = insufficient thyroid hormones
   Causes: thyroid tumor, goiter, insufficient dietary iodine.
   Clinical presentation:
   - Low metabolism, depression
   - Intolerance to cold, dry skin
   - Enlarged thyroid gland
   - When in children called “cretanism”
“Goiter” = thyroid can’t make thyroid hormones, it over-grows (swells)

Sex Steroid Disorders:
A. Kallmann Syndrome (Hyponogadism) = insufficient hypothalamic GnRH production. Results in less pituitary LH & FSH. Causes ↓testes growth and ↓testosterone and estrogen production.

In male child – can interfere with development of penis, testes, sperm production, and other masculine traits.

B. Androgen Insensitivity Syndrome (AIS) = in male fetus, failure of tissues to respond to testosterone. Causes feminization.

Partial AIS - Micropenis or enlarged clitoris, partial or no closure of scrotum.

Complete AIS – Clitoris rather than penis, hip & breast development at puberty. No female repro structures inside. Testes retained in abdomen (must be removed!)

Pineal gland
- Makes melatonin at night
- helps regulate circadian rhythm

Pancreas
- Makes insulin and glucagon

Clinical App ONLINE Diabetes mellitus & Physiology in Health & Disease Pg 220

Gonads

<table>
<thead>
<tr>
<th>Testes</th>
<th>Ovaries</th>
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<tbody>
<tr>
<td>Response to LH = testosterone</td>
<td>Response to LH = estrogen &amp; ovulation</td>
</tr>
<tr>
<td>Response to FSH = male sperm</td>
<td>Response to FSH = mature eggs</td>
</tr>
</tbody>
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GI Tract

1. Gastrin (stomach) = stimulates HCL production (by parietal cells)

2. Secretin (sm. intestine) = stimulate water and bicarbonate secretion from pancreas

3. Cholecystokinin (sm. intestine)
   - stimulates gallbladder contraction (get bile into duodenum)
   - stimulates pancreatic enzyme secretion

4. Gastric inhibitory peptide (sm. intestine) =
   - slows gastric motility (slow down)
   - stimulates pancreatic insulin.
Review

• Endocrine glands of body
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• Endocrine disorders