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.

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!**
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 ________________
   - Paraventricular nucleus secretes ________________

2. **Hypothalamus** secretes ________________ or ________________ which controls anterior pituitary.

3. **Hypothalamus** controls autonomic sympathetic secretion of ________________ by the ________________

Hypothalamus Directs Anterior Pituitary Secretions

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

**Hypothalamus secretes:**

1. ________________
2. ________________
3. ________________
4. ________________
5. ________________
6. ________________
Anterior Pituitary Secretions (in response to hypothalamus)

Anterior Pituitary Response:
1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
5. __________________________________________
6. __________________________________________

Hypothalamus Directs Anterior Pituitary Secretions
Know hypothalamic hormone (acronym) and what it causes anterior pituitary to secrete!

Table 11.7 | Hypothalamic Hormones Involved in the Control of the Anterior Pituitary

<table>
<thead>
<tr>
<th>Hypothalamic Hormone</th>
<th>Structure</th>
<th>Effect on Anterior Pituitary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corticotropin-releasing</td>
<td>CRH</td>
<td>Stimulates secretion of adrenocorticotropic hormone</td>
</tr>
<tr>
<td>hormone (CRH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gonadotropin-releasing</td>
<td>GnRH</td>
<td>Stimulates secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH)</td>
</tr>
<tr>
<td>hormone (GnRH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prolactin-inhibiting</td>
<td>PIH</td>
<td>Inhibits prolactin secretion</td>
</tr>
<tr>
<td>hormone (PIH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somatostatin</td>
<td>GHIH</td>
<td>Inhibits secretion of growth hormone</td>
</tr>
<tr>
<td>TSH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thyrotropin-releasing</td>
<td>TRH</td>
<td>Stimulates secretion of thyroid-stimulating hormone (TSH)</td>
</tr>
<tr>
<td>hormone (TRH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth hormone-releasing</td>
<td>GHRH</td>
<td>Stimulates growth hormone secretion</td>
</tr>
<tr>
<td>hormone (GHRH)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 11.5: Anterior Pituitary Hormones

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Target Tissue</th>
<th>Principal Actions</th>
<th>Regulation of Secretion</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>Adrenal cortex</td>
<td>Stimulates secretion of glucocorticoids</td>
<td>Stimulated by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibited by</td>
</tr>
<tr>
<td>TSH</td>
<td>Thyroid gland</td>
<td>Stimulates secretion of thyroid hormones</td>
<td>Stimulated by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibited by</td>
</tr>
<tr>
<td>GH</td>
<td>Most tissue</td>
<td>Promotes protein synthesis and growth; lipolysis and increased blood glucose</td>
<td>Stimulated by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibited by</td>
</tr>
<tr>
<td>FSH</td>
<td>Gonads</td>
<td>Promotes gamete production and stimulates estrogen production in females</td>
<td>Stimulated by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibited by</td>
</tr>
<tr>
<td>PRL</td>
<td>Mammary glands &amp; other sex accessory organs</td>
<td>Promotes milk production in lactating females; additional actions in other organs</td>
<td>Stimulated by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibited by</td>
</tr>
<tr>
<td>LH</td>
<td>Gonads</td>
<td>Stimulates sex hormone secretion; ovulation and corpus luteum formation in females</td>
<td>Stimulated by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibited by</td>
</tr>
</tbody>
</table>

### Effects

**Anterior Pituitary secretions & their effects on target organs or glands:**

**Effects:**

- Stimulates mammary glands to make milk (lactation)
- Stimulates body tissues to grow!

**Effects:**

- Proces T3 & T4 to regulate metabolism
- Produce Sex steroids - Cortisol
- Mature eggs & sperm
- Produce estrogen & testosterone
### Practice Endocrine Flow Chart!

<table>
<thead>
<tr>
<th>HYPOTHALAMUS SECRETES:</th>
<th>ANTERIOR PITUITARY RESPONSE:</th>
<th>BODY'S RESPONSE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ________</td>
<td>1. ________</td>
<td></td>
</tr>
<tr>
<td>2. ________</td>
<td>2. ________</td>
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<td>3. ________</td>
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<td>4. ________</td>
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<td>5. ________</td>
<td>5. ________</td>
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</tr>
<tr>
<td>6. ________</td>
<td>6. ________</td>
<td></td>
</tr>
</tbody>
</table>

### How hypothalamus & neg. feedback regulates anterior pituitary secretions:

**QUES:**

If the hypothalamus “senses” GH in blood is too high what does it do? ______________

What happens to anterior pituitary secretions of GH? ______________________

If GH in blood is too low, hypothalamus does what? ________________________

What does pituitary then do? ______________________

If hypothalamus “senses” high estrogen or testosterone in blood it ______________

What does pituitary then do? ______________________

If hypothalamus “senses: low thyroid hormones in blood it ____________________

What does pituitary then do? ______________________
Review

- Hypothalamic controls endocrine system
  - Nuclei secrete ADH & oxytocin
  - 4 Releasing hormones (CRH, GnRH, TRH, GHRH)
  - 2 Inhibiting hormones (PIH, GHIH)
  - 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

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**
   - Ex. - estrogen, testosterone, progesterone

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

2. **Mineralcorticoids**
   - Ex. - ______________

3. **Glucocorticoids**
   - Ex. - ______________

Clinical App Pg 209 & [ONLINE](#)
Exogenous glucocorticoids and negative feedback on adrenal cortex

**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** =
- **Hyperlipidema** =
- **Hypervolemia** = (“moon face”)
- **Hypertension** =
**Adrenal Cortex Disorders:**

**B. Addison’s Disease – Insufficient Aldosterone**

Clinical View Pg 206 & **ONLINE**

*Clinical Presentation:*

- Hyponatremia =
- Hyperkalemia =
- Hypovolemia =
- Hypotension =
- Anorexia =
- Skin bronzing (overstimulation of melanocytes)

---

**Adrenal Medulla Disorders:**

**Pheochromocytoma** = excessive norepinephrine/epinephrine

Clinical App **ONLINE**

*Clinical Presentation: “fight or flight” symptoms*

- Tachycardia =
- Hypertension =
- Hyperventilation =
- Hyperglycemia =
- Hyperlipidema =
- 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
- Intolerant 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)

**Gonads**

**Testes**
- Response to LH = ______________
- Response to FSH = ______________

**Ovaries**
- Response to LH = ______________ & ______________
- Response to FSH = ______________
**Sex Steroid Disorders:**

**A. Kallmann Syndrome (Hypogonadism)** = 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!)

---

[Diagram showing the hypothalamus, pituitary, and gonads, illustrating GnRH production and its effects on LH and FSH.]
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

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
  – Pituitary, adrenals, thyroid, parathyroids, gonads, pineal gland, pancreas, GI tract

• Endocrine disorders