**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!**
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.
   
   Nuclei = ____________________________
   ____________________________
   Neurohormones = ____________ & __________

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. ____________________________

Releasing hormones (RH)

Inhibiting hormones (IH)
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!

NOT IN BOOK!

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 hormone (CRH)</td>
<td>ACTH</td>
<td>Stimulates secretion of adrenocorticotropic hormone</td>
</tr>
<tr>
<td>Gonadotropin-releasing hormone (GnRH)</td>
<td>FSH &amp; LH</td>
<td>Stimulates secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH)</td>
</tr>
<tr>
<td>Prolactin-inhibiting hormone (PIH)</td>
<td>GH</td>
<td>Inhibits prolactin secretion</td>
</tr>
<tr>
<td>Somatostatin (GHIH)</td>
<td></td>
<td>Inhibits secretion of growth hormone</td>
</tr>
<tr>
<td>Thyrotropin-releasing hormone (TRH)</td>
<td>TSH</td>
<td>Stimulates secretion of thyroxin-stimulating hormone</td>
</tr>
<tr>
<td>Growth hormone-releasing hormone (GHRH)</td>
<td></td>
<td>Stimulates growth hormone secretion</td>
</tr>
</tbody>
</table>

GH
How hypothalamus & neg. feedback regulates anterior pituitary

### Table 11.6 | 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>

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

**Effects:**

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

**Effects:**

- Produce T3 & T4 to regulate metabolism
- Produce Sex steroids - Cortisol
- Mature eggs & sperm
- Produce estrogen & testosterone
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

Fig 8.9

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 Bronzing of skin

**Causes:**
- ↓ hypothalamic CRH or pituitary ACTH.
- Adrenal cortex tumor or autoimmune disorder.

**Clinical Presentation:**
- Hyponatremia =
- Hyperkalemia =
- Hypovolemia =
- Hypotension =
- Anorexia =
- 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 =
- 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
- 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!)
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