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.

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!

<table>
<thead>
<tr>
<th>Hypothalamic Hormone</th>
<th>Structure</th>
<th>Effect on Anterior Pituitary</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRH</td>
<td></td>
<td>ACTH</td>
</tr>
<tr>
<td>GnRH</td>
<td></td>
<td>FSH &amp; LH</td>
</tr>
<tr>
<td>PIH</td>
<td></td>
<td>TSH</td>
</tr>
<tr>
<td>GHIH</td>
<td></td>
<td>GHRH</td>
</tr>
<tr>
<td>TRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth hormone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Not in Book!

<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></td>
</tr>
<tr>
<td>TSH</td>
<td>Thyroid gland</td>
<td>Stimulates secretion of thyroid hormones</td>
<td></td>
</tr>
<tr>
<td>GH</td>
<td>Most tissue</td>
<td>Promotes protein synthesis and growth; lipolysis and increased blood glucose</td>
<td></td>
</tr>
<tr>
<td>FSH</td>
<td>Gonads</td>
<td>Promotes gamete production and stimulates estrogen production in females</td>
<td></td>
</tr>
<tr>
<td>PRL</td>
<td>Mammary glands and other sex accessory organs</td>
<td>Promotes milk production in lactating females; additional actions in other organs</td>
<td></td>
</tr>
<tr>
<td>LH</td>
<td>Gonads</td>
<td>Stimulates sex hormone secretion; ovulation and corpus luteum formation in females; stimulates testosterone secretion in males</td>
<td></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

**Fig 8.6**
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? _________________

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**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

2. Mineralcorticoids
   Ex. - ________________________

3. Glucocorticoids
   Ex. - ________________________

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

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

Causes:
- Excess hypothalamic CRH or pituitary ACTH
- Adrenal gland tumor

Clinical Presentation:
- Hyperglycemia =
- Hyperlipidema =
- Hypervolemia = (“moon face”)
- Hypertension =

B. Addison’s Disease – Insufficient Aldosterone

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)**
   - Increase body metabolism
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**