Endocrine System

BGY 2001 Sem 1 2013/4

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Environmental pollutants can interfere the action of hormones (endocrine disruptors)
The **Endocrine System** is a system of glands, each of which secretes a type of hormone directly into the bloodstream to regulate the body.

**Hormones** are substances (chemical mediators) released from endocrine tissue into the bloodstream where they travel to target tissue and generate a response.

Helps to regulate body’s functions, including:

- Energy use
- Metabolism
- Growth and development
- Tissue function
- Mood
Hormone/endocrine system

- more focus on long term effect to your body
- works with nervous system to control/regulate body

Basic mechanism:
1) Gland release hormone into blood
2) Hormone binds to receptor protein of target cell
3) Target cell carries out response

Types of hormones:
1) Lipid/steroids (non polar molecule)
   - bind to intracellular receptors, activate/inhibit genes.
2) Peptides and amines (a polar molecule)
   - typically bind to receptor on plasma membrane, activating ‘second messenger’
Endocrine system - happens slowly, such as cell growth.

Faster processes like breathing and body movement - controlled by the nervous system.

Nervous system and endocrine system - work together to help the body function properly.

**Endocrine organs and secreted hormones**

- Central nervous system
- Alimentary system
- Reproductive
Endocrine System

Hormones
As the body's chemical messengers, hormones transfer information and instructions from one set of cells to another.

Hormone levels can be influenced by factors such as stress, infection, and changes in the balance of fluid and minerals in blood.

Glands
A gland is a group of cells that produces and secretes, or gives off, chemicals.

Exocrine glands: sweat and salivary glands

Endocrine glands; directly into the bloodstream where they can be transported to cells in other parts of the body.
Hormones

• Chemical messengers

• Produced in one part of the body, have an effect on another part

• Carried in bloodstream
Chemical Signals

(a) Nerve cell
- Direction of nerve signal
- Synapse
- Neurotransmitter molecules
- Target nerve cell

(b) Neurosecretory cell
- Hormone molecules
- Target cell

(c) Endocrine cell
- Hormone molecules
- Target cell
- Blood vessel
Hormone Activity

- Affect only target cells
- Hormone must bind to a receptor
- Receptor activates chain of events
Endocrine System

• Hormonal system of vertebrates

• Endocrine glands secrete hormones
  – Ductless
  – Empty into bloodstream

• Exocrine glands
  – Secrete products into ducts
Hormone Actions

• Affects parts distant from gland

• May affect numerous parts of the body

• Effects take longer than nervous system

• Effects may be long lasting
Types of Hormonal Control

- Regulation
- Response
- Reproduction
- Growth & development
<table>
<thead>
<tr>
<th>Endocrine Gland and Hormone</th>
<th>Target Tissue</th>
<th>Principal Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothalamus</td>
<td>Anterior pituitary</td>
<td>Stimulate the release of hormones by the anterior pituitary</td>
</tr>
<tr>
<td>Releasing hormones</td>
<td></td>
<td></td>
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<tr>
<td>Anterior pituitary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follicle-stimulating hormone (FSH) (gonadotropin hormone)</td>
<td>Sex organs</td>
<td>Stimulates ovarian follicle, spermatogenesis</td>
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<tr>
<td>Luteinizing hormone (LH) (gonadotropin hormone)</td>
<td>Sex organs</td>
<td>Stimulates ovulation and corpus luteum formation in females, and testosterone production in males</td>
</tr>
<tr>
<td>Adrenocorticotropic hormone (ACTH)</td>
<td>Adrenal cortex</td>
<td>Stimulates secretion of adrenal cortical hormones</td>
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<tr>
<td>Thyroid-stimulating hormone (TSH)</td>
<td>Thyroid</td>
<td>Stimulates secretion of thyroid hormones</td>
</tr>
<tr>
<td>Growth hormone (GH)</td>
<td>Cartilage and bone cells, skeletal muscle cells</td>
<td>Stimulates division of cartilage and bone cells, growth of muscle cells, and deposition of minerals</td>
</tr>
<tr>
<td>Prolactin</td>
<td>Mammary glands</td>
<td>Stimulates milk production</td>
</tr>
<tr>
<td>Melanocyte-stimulating hormone (MSH)</td>
<td>Melanocytes</td>
<td>Stimulates production of melanin</td>
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<tr>
<td>Posterior pituitary</td>
<td></td>
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<tr>
<td>Oxytocin</td>
<td>Mammary glands</td>
<td>Stimulates contraction of uterus and milk release</td>
</tr>
<tr>
<td>Antidiuretic hormone (ADH)</td>
<td>Kidneys and smooth muscle</td>
<td>Stimulates reabsorption of water by the kidneys</td>
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<tr>
<td>Pineal gland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melatonin</td>
<td>Hypothalamus and/or reproductive organs</td>
<td>Possible stimulation of immune system; inhibits secretion of GnRH; other specific actions unknown</td>
</tr>
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<td>----------------------------</td>
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<tr>
<td><strong>Thyroid</strong></td>
<td>General</td>
<td>Regulate metabolism</td>
</tr>
<tr>
<td>Thyroid hormones</td>
<td>Bone</td>
<td>Regulates calcium levels in blood</td>
</tr>
<tr>
<td>Calcitonin (CT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Parathyroid</strong></td>
<td>Bone, kidney, small intestine</td>
<td>Regulates calcium levels in blood</td>
</tr>
<tr>
<td>Parathyroid hormone (PTH)</td>
<td></td>
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<tr>
<td><strong>Adrenal Cortex</strong></td>
<td>Kidney</td>
<td>Increases sodium and water reabsorption and potassium excretion</td>
</tr>
<tr>
<td>Aldosterone</td>
<td>General</td>
<td>Stimulate breakdown of glycogen to glucose</td>
</tr>
<tr>
<td>Glucocorticoids</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adrenal Medulla</strong></td>
<td>Heart, blood vessels, liver, fat cells</td>
<td>Regulate fight-or-flight response: increase cardiac output, blood flow to muscles and heart, conversion of glycogen to glucose</td>
</tr>
<tr>
<td>Adrenaline and noradrenaline</td>
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<td></td>
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<tr>
<td><strong>Pancreas (Islets of Langerhans)</strong></td>
<td>Liver, skeletal muscle, fat</td>
<td>Decreases blood glucose levels by stimulating movement of glucose into cells</td>
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<tr>
<td>Insulin</td>
<td></td>
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<tr>
<td>Glucagon</td>
<td>Liver</td>
<td>Increases blood glucose levels by converting glycogen to glucose</td>
</tr>
<tr>
<td><strong>Ovary</strong></td>
<td>General, female reproductive organs</td>
<td>Stimulate development of secondary sex characteristics in females; control monthly preparation of uterus for pregnancy</td>
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<tr>
<td>Estrogens</td>
<td></td>
<td></td>
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<tr>
<td>Progesterone</td>
<td>Uterus</td>
<td>Completes preparation of uterus for pregnancy</td>
</tr>
<tr>
<td><strong>Testis</strong></td>
<td>General</td>
<td>Stimulates development of secondary sex characteristics in males and growth spurt at puberty</td>
</tr>
<tr>
<td>Testosterone</td>
<td>Male reproductive structures</td>
<td>Stimulates development of sex organs, spermatogenesis</td>
</tr>
<tr>
<td><strong>Thymus</strong></td>
<td></td>
<td></td>
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<tr>
<td>Thymosins</td>
<td>T lymphocytes</td>
<td>Promotes the maturation of T lymphocytes</td>
</tr>
</tbody>
</table>
Pineal Gland

- Embedded within brain

- Produces melatonin
  - Increase in secretion at night
  - Helps set circadian rhythms
Thyroid Gland

• Below level of voice box

• Hormones that regulate metabolism

• Most body cells have receptors

• Negative feedback loop regulates release
Adrenal Hormones

• Adrenal cortex
  – Corticosteroids
    • Mineralocorticoids
    • Glucocorticoids

• Adrenal medulla
  – Cells similar to neurosecretory cells
  – Epinephrine & norepinephrine
Alarm Reaction to Stress

1. Nerve signal from hypothalamus
2. ACTH from anterior pituitary
3. Glucocorticoids
4. Breakdown of glycogen to glucose.
5. Adrenaline and noradrenaline
6. Increased heart rate, breathing rate, and blood sugar level

Hypothalamus

Medulla

Cortex

Adrenal gland

Kidney
Pancreas

- Endocrine portion in islets of Langerhans
- Hormones that regulate levels of glucose
Pancreas with islets of Langerhans

High blood glucose levels → INSULIN

Helps body cells transport glucose across membranes and acts on liver to convert glucose into glycogen and fat for storage

Low blood glucose levels → GLUCAGON

Acts on liver to convert glycogen to glucose
Diabetes

• High levels of glucose in blood
  – Lack of insulin
  – Inability of tissue to respond to insulin

• Two types
  – Type I = insulin dependent
    • Pancreas does not produce enough insulin
  – Type II
    • Often occurs later in life