

Hormones

A. Introduction

1. Hormones are defined as the chemical messengers sent by one part of the body to another via blood stream.
2. Hormones aid in control and coordination of organism, phenotype and homeostasis.
3. Endocrine glands are hormone glands that do not have a duct or passageway; secretions go directly into blood.
4. Target organ - the specific organ for which a hormone was produced.
5. Types of hormones
 - a. Peptides - large amino acid proteins that cannot go through membrane.
 - b. Steroids - small, can go through membrane.

Pituitary Gland

A. General

1. There are two parts - anterior and posterior;
2. Hypothalamus - a part of the brain connected to the posterior pituitary by a stalk.
 - a. Anterior is not connected structurally but by a network of blood vessels called a portal system.
3. The Hypothalamus is the Controller
 - a. Produces hormones secreted by the posterior pituitary. Substances are stored in nerve endings in posterior pituitary.
 - b. Produces releasing factors to control the anterior pituitary; releasing factors transported by portal system;

c. Posterior pituitary

1) Hormones released: ADH or oxytocin

- a) ADH - antidiuretic hormone or vasopression; this hormone increases the permeability of distal convoluted tubule and collecting duct; results: more H₂O is absorbed.

<u>Blood volume</u>	<u>Urine</u>
More ADH = blood is diluted (more H ₂ O)	Less
Less ADH = blood is concentrated (less H ₂ O)	More

- b) Oxytocin - causes uterine contraction; also stimulates release of milk from breast.

4. Example:

- Cells denote concentrated blood;
- ADH is released by the hypothalamus nerves for secretion by the posterior pituitary;
- ADH enters blood stream and meets the target organ, the kidney. The kidney reabsorbs H₂O.
- When sensory cells of the hypothalamus sense dilute blood the nerves in the posterior pituitary cease ADH's release.

Diabetes insipidus - watery urine, lack of necessary ADH production.

d. Anterior pituitary

- 1) Hormones causing general effect on the body:
GH Growth Hormone (somatotropin and lactogenic hormone).
 - a) Somatotropin - growth - causes all tissues to grow. GH produced during growth years determines size: too little = midget; too much = giant.
 - b) Lactogenic hormone - prolaction - produced after child birth; causes milk production.
- e. Anterior pituitary - master gland
 - 1) Anterior is so called because it controls the secretions of other endocrine glands;
 - 2) It controls: thyroid, adrenal cortex, gonads.
5. Thyroid gland - located in neck, attached to trachea below larynx
 - a. Control - anterior pituitary
 - 1) Procedure
 - a) Hypothalamus produces a releasing factor into the portal system → anterior pituitary;
 - b) Anterior pituitary secretes TSH (thyroid stimulatIn hormone) called thyrotropin;
 - c) TSH enters blood → target organ thyroid;
 - d) Thyroid secretes thyroxin;
 - e) Thyroxin doesn't have a target organ but stimulates the metabolic rate of most body cells;

f) When the increased thyroxin level is denoted by the hypothalamus, it ceases releasing factors and anterior pituitary stops producing TSH. Iodine is needed for the thyroxin concentration.

b. Diseases

1) Hypothyroidism - low thyroxin in blood

a) Simple goiter - thyroxin is low, anterior pituitary stimulates thyroid with TSH → thyroid enlarges to produce enough;

b) Cretin - Thyroid doesn't develop properly; retardation;

c) Myxedema - thyroid slows down in older adults: metabolic rate decreases;

2) Hyperthyroidism - too much thyroxin, thyroid is oversized.

6. Adrenal glands - (outer and inner cortex)

a. Adrenal medulla (middle)

1) Secretes adrenalin and noradrenalin; hormones act in stressful situations;

2) Effect - extreme alert look, respiratory and heart rates increased.

b. Adrenal cortex

1) Secretes glucocorticoids and mineralocorticoids (not under pituitary);

2) Glucocorticoids;

Procedure for production:

- a. Stress triggers hypothalamus to secrete a releasing factor through portal system to the anterior pituitary;
 - b. Anterior pituitary secretes ACTH (adrenocorticotrophic hormone) which reaches the target organ the adrenal cortex;
 - c. Cortex produces glucocorticoids which makes glucose from amino acids, also aids in adjustment to stress.
- 3) Mineralocorticoids - aldosterone (not under control of pituitary)
- a) Controls level of sodium and potassium in blood; the target organ is the kidney where sodium is absorbed and potassium excretion occurs.

7. Sodium affects H₂O reabsorption in kidneys

	Sodium Level	Water Level	Water Absorption	Blood Volume
Hypertension	High	High	Increased	Increased
Hypotension	Low	Low	Decreased	Decreased

1. Disorders

- A. Addison's Disease - lack of glucocorticoids, low glucose level;
- B. Cushing's Syndrome - high secretions, enlarged trunk, fat, etc.

2. Parathyroids - located in thyroid - two pairs.

A. General

1. Controls calcium and phosphate levels;
2. Located in the thyroid;
3. Methods of increasing calcium, parathormone

caused:

- a. Absorption from gut;
- b. Reabsorption of calcium by kidney tubules;
- c. Demineralization of bone - hormone stimulates the bone cell that breaks bone down (osteocasts).

B. Malfunctions

1. Too much parathormone causes weak bones;
2. Too little causes tetany, shakes, muscular

contraction.

C. Feedback

1. Calcium level in blood regulates parathyroid's production of parathormone, target organs: kidney, gut, and bones.

8. Pancreas

A. General

1. Located between spleen and duodenum of small intestine;
2. Produces two types of tissues;
 - a. One type produces pancreatic juice (digestive system);
 - b. The other type produces hormones insulin and glucagons which affect glucose level in blood.

3. **Insulin causes cells to remove more glucose from blood (lowers glucose level);**
4. **Glucagon - is produced only when starvation occurs; causes cells to secrete glucose into blood.**

B. Diabetes mellitus

1. Symptoms

- a. **High blood sugar level; also a lot in urine;**
- b. **H₂O loss - to try and dilute the filtrate**