

ENDOCRINE SYSTEM

Course Description The endocrine system of the body consists of a number of glands that secrete chemical substances called hormones. Hormones influence and regulate many body activities, including metabolism, growth, mental development and emotional behavior. Because hormones are secreted directly into the lymph and bloodstream and not through the tubes, the endocrine glands are also called the ductless glands of internal secretion.

Course Objective. One of the most important endocrine glands is the pituitary, a pea-sized gland located almost in the center of the skull. Because it secretes a number of hormones that stimulate the other glandular systems, the pituitary is often called the master endocrine gland. The glands that are stimulated by pituitary hormones are called target glands.

THE ENDOCRINE SYSTEM

General function

A- Endocrine glands secrete chemical (hormones) into the blood

B- Hormones perform general functions of communication and control - but a slower, longer-lasting type of control than that provided by nerve impulses.

C- Cells acted on by hormones are called target organ cells.

Hormones are the main regulators of metabolism, growth and development, reproduction, and many other body activities. They play roles of the utmost importance in maintaining homeostasis-- fluid and electrolyte balance, acid-base balance, and energy balance.

Hormones make the difference between normal and all sorts of abnormalities such as dwarfism, gigantism, and sterility.

The most widely accepted theory of hormone action is called the "second messenger hypothesis". The second messenger hypothesis is a theory that attempts to explain why hormones cause specific effects in target organs but do not "recognize" or act on other organs of the body.

A hormone acts as a "first messenger", it delivers its chemical messenger from the cells of an endocrine gland to highly specific membrane receptor sites on the cells of a target organ. After the hormone is attached to its specific receptor site, a number of chemical reactions occur that change energy rich ATP molecules inside the cell into cyclic AMP. Cyclic AMP serves as the "second messenger" delivering information inside the cell that causes the cell to respond by performing its specialized function. Cyclic AMP causes thyroid cells to secrete thyroid hormones.

Steroid Hormones are lipid soluble, they can pass intact through the cell membrane of the target organ cell. Inside the cell they combine with specific proteins and then enter the nucleus to influence cell activity by acting on specific genes.

The regulation of hormone levels in the blood is dependent on a highly specialized homeostatic mechanism called "Negative Feedback".

PROSTAGLANDINS

They are called tissue hormones.

A- Prostaglandins (PGs) are powerful substances found in a wide variety of body tissues.

B- PGs are often produced in a tissue and diffuse only a short distance to act on cells in that tissue.

C- Several classes of PGs: PGA, PGB, PGP.

D- PGs influence many body functions, including respiration, blood pressure, gastrointestinal secretions, and reproduction.

Endocrine diseases.

Diseases of the endocrine glands are numerous, varied, and sometimes spectacular. Tumors or other abnormalities frequently cause the gland to secrete too much or too little of their hormones. Production of too much hormone by a diseased gland is called "hypersecretion". If too little hormone is produced, the condition is called "hyposcretion".

Production of "natural" painkillers.

Both endorphins and enkephalins, the naturally occurring morphinelike painkillers are formed from a precursor substance called beta-lipotropin that is produced in the anterior pituitary gland.

PITUITARY GLAND / HYPOPHYSIS

Is a master gland. Has 2 lobes and both are attached to the hypothalamus and are controlled by it.

A- Location:

1. It lies in the cranial cavity, in the small depression of the sphenoid bone that is shaped like a saddle- sella turcica.

2. The pituitary stalk attaches the gland to the undersurface of the brain.

3. The stalk attaches the pituitary body to the hypothalamus, which controls its secretions.

B- It consists of two endocrine glands:

1. Anterior Pituitary Gland or Adenohypophysis

a. It is considered the master gland.

b. 7 hormones are secreted from this gland.

c. 4 out of the 7 are considered trophic hormones:

- 1) Thyroid-stimulating hormone--TSH
- 2) Adrecorticotropic hormone--ACTH
- 3) Follicle stimulating hormone--FSH
- 4) Luteinizing hormone--LH

d. Trophic hormone target cells are other endocrine glands.

e. The 7 hormones:

1. Thyroid stimulating Hormone --TSH-- Thyrotropin
a- Promotes and maintains growth and development of its target gland the thyroid.

b- It stimulates the thyroid gland to increase its secretion of thyroid hormone-- thyroxin.

2. Adrecorticotropic Hormone --ACTH

a- stimulates the adrenal cortex to increase in size.

b- stimulates the adrenal cortex to secrete cortisol (hydro cortisone)

3. Follicle- stimulating hormone -FSH

A- Stimulates primary follicles to start growing and to continue developing to maturity to the point of ovulation.

B- Stimulates the follicle cells to secrete estrogens(females)

C- Stimulates development of seminiferous tubules, to grow and form .

4. Luteinizing Hormone --LH

A- Performs 4 functions:

1) Stimulates a follicle and ovum to complete their growth to maturity.

2) stimulates follicle cells to secrete estrogen

3) It causes ovulation - rupturing of a mature follicle with expulsion of a ripe ovum.

4) stimulates formation of the corpus luteum.

b- Stimulates interstitial cells in the testes to develop and secrete testosterone.

5. Melanocyte-stimulating hormone --KSH

Causes a rapid increase in the synthesis and dispersion of melanine granules in skin cells.

6. Growth Hormone --GH

a) Promotes bodily growth indirectly by accelerating amino acid transport from the blood into cells.

b) Accelerates fat catabolism, but slows glucose catabolism (less glucose leaves the blood to enter and therefore the amount of glucose in the blood increases).

c) GH tends to increase the blood glucose level: Hyperglycemia.

d) Insulin tends to decrease the blood glucose: Hypoglycemia.

cells

e) Gigantism- Excessive secretion of GH (bones grow more rapidly than normal).

f) Dwarfism- Undersecretion of GH

g) Acromegaly- Over secretion of GH after adulthood. Long hands and feet.

7. Prolactin Hormone

stimulates the mammary glands to start secreting milk soon after delivery of an infant.

POSTERIOR PITUITARY GLAND / NEUROHYPOPHYSIS

a. Serves as a storage area for the release of two hormones

b. They triggered by nervous stimulation.

c. The 2 hormones are:

1) Antidiuretic Hormone --ADH Alcohol inhibits secretion of ADH.

Acts to decrease

urine volume

Increases water reabsorption.

- Diabetes IDsipidus- abnormally large amount of urine is excreted.

Diuresis- increased amount of urination.

2) oxytocin

- stimulates powerful contractions by the pregnant uterus

Causes milk ejection from the breasts.

THYROID GLAND

A. Location: neck

- Largest of the endocrine glands.

This gland stores its hormones unlike any other gland

B. *HORMONES*

1. Thyroxin

a) Main hormone of the thyroid gland

b) Protein bound iodine- when it is secreted it binds to proteins in the blood and travels on the proteins until it gets to the capillaries where it is released as thyroxin.

2. Triiodothyronine The less abundant.

3. CALCITONIN

From blood to bone. Inhibits bone breakdown.

- a) Acts on bone to inhibit its breakdown and the release of calcium.
- b) Helps to maintain blood calcium homeostasis and prevent harmful hypercalcemia.

D- Diseases

1. Goiter: Hypersecretion of the thyroid hormone
2. cretinism:

PARATHYROID GLAND

Malformed dwarfism. Mentally retarded.

From bone to blood. stimulates breakdown of bone.

- A. There are usually 4 of them.
- B. They are found on the back of the thyroid gland.
- C. Parathyroid hormone --PTH
 1. Helps to maintain homeostasis of. blood calcium concentration by increasing the concentration in the blood.
 2. Too little secretion of the PTH, muscles can go into spasms: tetany.

ADRENAL GLANDS

- A. Lie atop of the kidneys, fitting like a cap over the organs.
- B. Cortex - outer portion
- C. Medulla - inner portion
- D. They function as 2 separate endocrine glands:

Adrenal cortex:

There 3 different layers:
Hormones secreted by the 3 layers are called corticosteroids.

- a. Zona Glomerulosa - outer zone
 - secretes mineralocorticoids.
 - Aldosterone is the main mineralocorticoids. It increases the amount of sodium and decrease the amount of potassium in the blood by influencing the kidney tubules.
 - Regulates mineral salt metabolism.
- ~. Zona Fasciculata - middle zone
 - Secretes glucocorticoids.

It affects literally every cell in the body

- Increases gluconeogenesis- process that converts amino acids or fatty acids to glucose and that is carried on mainly by the liver cells.
 - Accelerates breakdown of proteins to amino acids.
 - Maintain normal blood pressure
- If a person is injured cortisol will help to decrease the inflammation.
 - Increases during stress.

c. Zona Reticularis

- secretes sex hormones

2. Adrenal Medulla

Secretes hormones Epinephrine and Norepinephrine

They are catecholamines

80% is secreted as epinephrine

They affect:

- 1) Smooth muscle
- 2) Cardiac muscle

of the body's first response to stress

in "fight or flight" - also known as Adrenaline

- Epinephrine increases blood pressure and raises heartrate.

ISLETS OF LANGERHANS

A. Located in the pancreas both an exocrine and endocrine gland.

B. 2 types of cells:

1) Alpha cells:

Secrete Glucagon

- Accelerate the liver glycogenolysis- process by which the glucose stored in the liver cells in the form of glycogen is converted to glucose.

Increases the blood glucose concentration.

2) Beta cells:

- Secrete Insulin
- Insulin is to decrease the blood concentration of these food compounds and to promote their metabolism.

- Insulin tend to accelerate the movement of glucose, amino acids, and fatty acids out of the blood and through the cell membrane into their cytoplasm.

- When sugar is not burned it means insulin is decreased.

C. Diabetes Mellitus

- Islets of Langerhans secrete too little insulin, less glucose leaves the blood to enter the cells so the blood glucose increases.

OVARIES

A. Produce 2 kinds of hormones:

1. Estrogen hormone

-This hormone parallels the male hormone testosterone

2. Progesterone

TESTES

A. Interstitial cells

- Secrete testosterone (steroid hormone classed as an androgen).

PINEAL GLAND

A. A small cone-shaped gland that lies near the roof of the third ventricle of the brain.

B. Melatonin Hormone - has an inhibitory effects on the ovary and may influence the menstrual cycle.

THYMUS

A. Primary organ of the lymphatic system.

B. Located in the mediastinum

C. Hormone

- Thymosin:

- needed for maturation and development of the immune system.

- promotes and increase in many types of lymphocytes function.

PLACBNTA

A. Functions as a temporary endocrine gland

B. Chorionic Gonadotropin hormone

1. Located in outermost fetal membrane

2. Produces estrogen

3. maintain the corpus luteum

