

UNIT 7 - ENDOCRINE SYSTEM

LECTURE NOTES

7.01 GENERAL FUNCTIONS OF THE ENDOCRINE SYSTEM

The endocrine system is responsible for coordinating and regulating body cells, tissues, organs, and systems to maintain homeostasis by secreting chemicals known as hormones. Unlike the nervous system, the effects of the endocrine system are sustained and work for longer periods of time. The endocrine system works primarily on negative feedback mechanisms.

7.02 DESCRIBE A "HORMONE"

Hormones are chemical messengers released by one tissue (gland) and transported by the bloodstream to reach the target tissues. The target tissue is where the effect of the hormone actually occurs.

7.03 MAJOR ENDOCRINE GLANDS AND THEIR SECRETIONS

A. Pituitary Gland

1. Description

The pituitary gland or the hypophysis is found in the brain. It is attached to the hypothalamus by a small stalk called the infundibulum and sits in a bony depression of the sphenoid bone called the sella turcica. The pituitary gland is divided into anterior and posterior regions. It is nicknamed the "master gland" since it produces or stores nine hormones.

2. Hormones

a. Growth Hormone (GH)

Growth hormone is also known as the human growth hormone or hGH. GH stimulates cell growth by increasing protein synthesis. Virtually every body tissue is affected by this hormone. GH mobilizes energy reserves by stimulating the breakdown of glycogen to release glucose, breaks down stored fat, and helps in the use of amino acids into making new proteins.

b. Thyroid Stimulating Hormone (TSH)

The target tissue of TSH is the thyroid gland which stimulates the release of the thyroid hormones.

c. Adrenocorticotrophic Hormone (ACTH)

ACTH stimulates the release of steroid hormones (glucocorticoids such as cortisol) from the adrenal glands.

B. Thyroid Gland

1. Description

The thyroid gland is located just below the thyroid cartilage (Adam's apple) of the larynx. It has a bow-tie shape and is reddish-brown in color.

2. Thyroxine

Another name for thyroxine is T4. It requires the mineral iodine in order to be made. Thyroxine targets most body cells and acts to increase metabolism by improving energy utilization, oxygen consumption, growth and development.

C. Adrenals

1. Description

There are two adrenal glands, each superior to a kidney. Each adrenal gland has two parts -- an outer adrenal cortex and an inner adrenal medulla. Each section produces its own hormones. The adrenal cortex appears yellow in color due to the presence of lipids. It produces more than two dozen steroid hormones known as corticosteroids, including the glucocorticoids and the mineralcorticoids. The adrenal medulla is reddish brown in color due to the large number of blood vessels. It contains many sympathetic nerve cells and functions with the sympathetic division of the nervous system.

2. Hormones

a. **Epinephrine**

Epinephrine accounts for 80 percent of the secretions from the adrenal medulla. The target tissues of epinephrine include skeletal muscles, adipose tissue, and the liver. The effects of epinephrine include the breakdown of glycogen to form glucose to provide more ATP, increased muscular power and endurance, and increased heart rate and force of contractions. Epinephrine increases blood flow to the vital organs, such as the brain, increased mental alertness, enlarged airways, and increased breathing rate. In other words, it helps the body cope with emergency and stress situations.

b. **Norepinephrine**

Norepinephrine accounts for 20 percent of the secretions from the adrenal medulla. The target tissues for norepinephrine include the skeletal muscles, adipose tissue, and the liver. The effects include the breakdown of glycogen to form glucose to provide more ATP, increased muscular power and endurance, and increased heart rate. Norepinephrine increases blood flow to the vital organs, such as the brain, increased mental alertness, enlarged airways, and increased breathing rate. In other words, it helps the body cope with emergency and stress situations.

c. **Cortisol**

Cortisol is one of the glucocorticoids produced by the adrenal cortex. The primary role of cortisol is to promote glucose production and glycogen destruction in the liver in a process called gluconeogenesis which provides the body cells with adequate glucose to produce ATP. The adrenal cortex provides back up for the stress responses created by the adrenal medulla. Other effects of cortisol include suppressing inflammation and inhibiting allergens.

D. Pancreas

1. Description

The pancreas lies in the fold of the duodenum posterior to the stomach and the peritoneal membranes. It is a pink organ with a nodular appearance. It contains both exocrine cells which produce digestive enzymes and endocrine cells which produce hormones.

2. Hormones

a. Glucagon

Produced by the alpha cells of the pancreas, glucagon functions to increase blood glucose (sugar) levels by stimulating the liver to convert glycogen to glucose. When the blood glucose level rises, glucagon is inhibited.

b. Insulin

Produced by the beta cells of the pancreas, insulin functions to decrease blood sugar levels by stimulating the liver to convert glucose to glycogen and to facilitate the diffusion of glucose into the body cells where it can be used for energy or stored as lipids. When the blood glucose level falls, insulin is inhibited.

7.04 Diseases and Disorders of the Endocrine System

A. **Acromegaly**

Acromegaly is a hypersecretion of the growth hormone during adulthood. Characteristics of this disease include enlargement of the bones of the hands, feet, jaws, and cheeks. A prominent forehead and large nose are also typical features of this disease.

B. **Cretinism**

Cretinism is the hyposecretion of the thyroid hormones during infancy and childhood which results in low metabolism, retarded growth, and often mental retardation. It is treated with synthetic hormones which prevent the onset of symptoms.

C. **Diabetes Mellitus**

Diabetes mellitus is the inability of the body to regulate one's blood glucose level. Type 1 diabetes mellitus occurs when the body fails to produce sufficient insulin. Type 2 diabetes mellitus occurs when the body cells become resistant to the effects of insulin. The most common reasons diabetes mellitus occurs in the United States are poor nutrition, inadequate exercise, and increasing obesity rates. The major symptoms include polydipsia, polyphagia, and polyuria. Type 1 diabetes mellitus is controlled with insulin injections and diet. Type 2 diabetes mellitus is controlled with diet, weight loss, pills to improve the effect of insulin, and sometimes insulin injections.

D. **Dwarfism**

Dwarfism is due to a hyposecretion of the growth hormone during childhood resulting in a small person who has a body frame of normal proportions.

E. **Gigantism**

Gigantism is due to a hypersecretion of the growth hormone during childhood resulting in a person who grows to a very large size.

F. Hyperthyroidism

Hyperthyroidism is due to the hypersecretion of the thyroid hormones. There is a dramatic increase in the metabolic rate which results in weight loss, increased appetite, irritability, restless, and active. Many patients have characteristic protruding eyeballs or exophthalmia. It is treated with medications to reduce the production of the thyroid hormone or sometimes radiation to destroy part of the thyroid gland reducing its secretions.

G. Hypothyroidism / Myxedema

Hypothyroidism is due to the hyposecretion of the thyroid hormones. It may be the result of inadequate iodine intake or unknown causes. The adult form of hypothyroidism is called myxedema which leads to reduced mental and physical energy, loss of hair, swelling, and weight gain. It is treated with a synthetic thyroid hormone.