Endocrine system

A system of communication between body parts by signal molecules (hormones) secreted into the bloodstream

- The endocrine system regulates functions such as growth, development, metabolism, and reproduction

- Endocrine gland = An organ that sends a signal by secreting a hormone into the bloodstream

- Hormone = A molecule that functions as a chemical signal that travels in the blood

  √ There are dozens of hormones; each has a unique molecular structure and unique functions in the body

  √ There are three types of hormone molecules:

  - Amine hormones = Hormones that are modified amino acids

  - Peptide/Protein hormones = Hormones that are polymers of amino acids

  - Steroid hormones = Hormones that have a backbone of four fused carbon rings

- Target organ = The organ that receives the signal by binding the hormone with a receptor specific for the hormone

  √ The target organ is preprogrammed to take a specific action when its receptor binds the hormone

Figs 17.2, 17.3, and 17.5; Tables 17.1 and 17.2

Tropic hormones (releasing hormones)

Hormones that stimulate endocrine glands to secretes hormones

The pituitary gland

An endocrine gland located under and connected to the brain's hypothalamus region

- The hypothalamus controls the secretion of hormones from the pituitary glands
- The pituitary gland is composed of two parts: The anterior pituitary and posterior pituitary
  - √ The anterior pituitary secretes the hormones growth hormone, prolactin, and tropic hormones that control the thyroid gland, the adrenal gland, and the gonads
  - √ The posterior pituitary secretes the hormones oxytocin and antidiuretic hormone

Figs 17.2, 17.7, and 17.11; Table 17.3

Endocrine system disorders

Disorders caused by over secretion or under secretion of hormones

- Over secretion can be caused by a tumor in an endocrine gland
  - √ The tumor can be in the gland that controls the target organ or in a gland that secretes tropic hormones to control the gland that controls the target organ
- Under secretion can be caused by damage to an endocrine gland

Growth hormone (GH)

A hormone that causes growth of bone and muscle but decreases fatty tissue

- GH is necessary for normal growth from infancy to adulthood

  √ After puberty, bones lose their ability to grow in response to GH

- GH over secretion before puberty = Giantism

  √ GH over secretion after puberty causes growth in cartilage but no increase in height (acromegaly)

- GH under secretion before puberty = Dwarfism

Fig 17.10; Table 17.2

The thyroid gland

An endocrine gland at the base of the throat

- The thyroid secretes thyroid hormone

√ Thyroid hormone (Thyroxine, T4) = An iodine-containing hormone that increases the body's BMR (basal metabolic rate, calories used per hour) by increasing each cell's use of glucose for energy

√ Graves Disease (hyperthyroid) = Over secretion of thyroid hormone. Symptoms include nervousness/fidgeting, weight loss, high temperature, and bulging of eyes

√ Hypothyroid = Under secretion of thyroid hormone. Symptoms in adults include weight gain, low energy and low temperature, and apathy. In infants, hypothyroid causes stunted growth and mental retardation (cretinism)

- One cause of hypothyroid is lack of iodine in diet. This type of hypothyroid also causes a goiter (a swollen thyroid gland)

- The thyroid also secretes the hormone calcitonin

√ Calcitonin = A hormone that decreases calcium levels in the blood

Figs 6.24, 17.2, 17.12, and 17.14; Tables 17.2 and 17.4

The parathyroid glands

Small endocrine glands located on the thyroid gland

- The parathyroids secrete parathyroid hormone (PTH)

√ PTH = A hormone that increases calcium levels in the blood

Figs 6.24, 17.2, and 17.12; Tables 17.2 and 17.4

Calcium levels in the blood are controlled by the mutually antagonistic effects of the hormones calcitonin and PTH

- High blood Ca^{2+} = More calcitonin released = Stimulates bone cells to construct more bone, lowering calcium levels

- Low blood Ca^{2+} = More PTH released = Stimulates bone cells to dissolve bone, raising calcium levels

Figs 6.24 and 17.16; Tables 17.2 and 17.4

Adrenal glands

A pair of endocrine glands, one atop each kidney

- Each adrenal gland has two parts, the cortex (outer region) and the medulla (inner region)

- The cortex releases several steroid hormones: Aldosterone (regulates blood Na^+ concentration), glucocorticoids (regulate the body's response to long-term stress), and very small amounts of testosterone and estrogen (the male and female sex hormones)

- The medulla releases epinephrine and norepinephrine (regulate the body's response to short-term stress)

Figs 17.2 and 17.17; Tables 17.2 and 17.5

The glucocorticoids (cortisone and cortisol)

Steroid hormones released from the adrenal cortex in response to long-term stress

- They cause stored fats and proteins to be converted into blood glucose

- They also decrease the immune system's activity

  √ Synthetic glucocorticoids are given to reduce immune system activity (examples: To treat inflammation and autoimmune diseases)

- Cushing's syndrome = Over secretion of glucocorticoids. Symptoms include high blood sugar, muscle degeneration, and fatty deposits on neck and face.

- Addison's disease = Under secretion of all steroid hormones from the adrenal cortex. Symptoms include sodium imbalance, low blood sugar, dehydration, and weakness.

Fig 17.17; Tables 17.2 and 17.5

Epinephrine and norepinephrine

Two substances released form the adrenal medulla in response to short-term stress (the "fight or flight" response)

- The adrenal medulla is nervous tissue; it releases epinephrine and norepinephrine when stimulated by the sympathetic division of the nervous system

- Epinephrine (a hormone, formally known as adrenaline) and norepinephrine (a neurotransmitter) prepare that body for an immediate crisis situation

  √ They increase heart rate, breathing rate, and blood glucose

  √ They dilate the air passages and the blood vessels in the muscles, heart, and lungs

  √ They decrease digestive system activity

Figs 17.2 and 17.17; Tables 17.2 and 17.5