

UNIT 10**ENDOCRINE SYSTEM**

The endocrine system consists of group of ductless glands (endocrine glands), which secrete one or more hormones. The study of endocrine glands and hormones is known as endocrinology.

GLANDS

Gland is the group of epithelial cells (columnar or cuboidal cells) which produce specialized secretions (hormones and enzymes). All the glandular epithelium has a rich blood supply. The gland selects the necessary materials from blood stream. These materials are utilized for making the secretions.

Types of Glands

On the basis of present of ducts, the glands are classified into two different types:

Differences between Exocrine and Endocrine glands

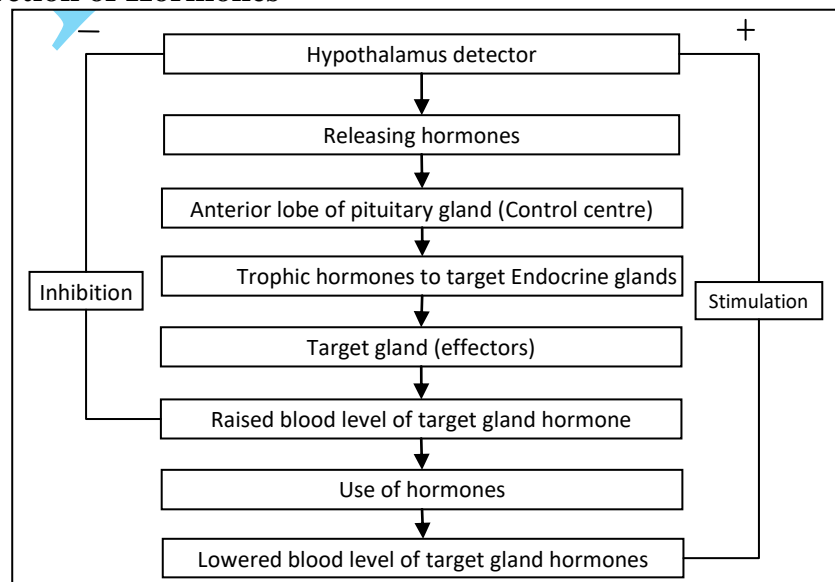
No.	Exocrine glands	Endocrine glands
1.	It has duct glands.	It has ductless glands.
2.	They discharge their secretions into the ducts.	They discharge their secretions directly into the blood.
3.	The glands are present near the site of action.	The glands may be present at a far away site than action.
4.	The secretions are known as enzymes.	The secretions are known as hormones.
5.	Examples. Salivary gland, gastric gland etc.	Examples: Pituitary gland, thyroid gland, parathyroid gland etc.

HORMONES

Hormones are the chemical messengers produced by the endocrine glands, organs or parts of the body, which is carried through the blood to another parts of the body. The hormones are derived from the Greek word it means "to set in motion."

Functions of Hormone

1. It stimulates growth in all organs or tissues. Examples: Growth hormone.
2. It helps in metabolism. Examples: Insulin.
3. It helps in reproduction. Example: Sex hormones.
4. It maintains homeostasis. Examples: Hormones of hypothalamus,
5. It regulates water and electrolytes balance within the body. Examples: ADH, aldosterone.
6. It helps in anti stress action. Example: Adrenalin.

Regulation of Secretion of Hormones

Difference between Hormones and Enzymes

No	Hormones	Enzymes
1.	They are produced at one site and are passed by blood to another site for action.	They may act at site where they are produced or carried to another site for action.
2.	They may act slowly or quickly.	They act slowly.
3.	They are used up in their action.	They are not used up in their action.
4.	They have low molecular weight.	They have very high molecular weight.
5.	It may be steroids, peptides, proteins or amino acid derivates.	They are simple proteins.
6.	The chemical controlled reactions are not reversible.	The chemical controlled reactions are reversible.
7.	Excess or deficiency of hormones may cause disorders.	Excess or deficiency of enzymes which catalyzed the chemical reactions.

ENDOCRINE GLANDS OF THE BODY

The important endocrine glands of the body are as follows:

1. Pituitary gland and Hypothalamus
2. Thyroid glands
3. Parathyroid glands
4. Adrenal glands
5. Islets of langerhans
6. Pineal gland

Endocrine functions of other organs

- | | |
|--------------------|-------------|
| 1. Testes in male | 4. Kidney |
| 2. Ovary in female | 5. Placenta |
| 3. Thymus gland | 6. Heart |

HYPOTHALAMUS

Hypothalamus is the part of diencephalon and lies below hypothalamic sulcus on the lateral wall of third ventricle. It links with the posterior lobe of the pituitary gland by nerves and to anterior lobe by a complex system of blood vessels. The hormones released by hypothalamus are known as releasing factors (RF) or releasing hormones (RH) that stimulate the pituitary to secrete specific hormones. The hormones released by hypothalamus and their effect on pituitary are given below:

1. **Growth hormone releasing hormone (GHRH):** It stimulates the anterior pituitary to release its growth hormone (GH) or somatotrophin.
2. **Growth inhibiting hormone (GIH):** It inhibits the secretion of growth hormone (GH) from the anterior lobe of the pituitary gland.
3. **Thyrotrophin releasing hormone (TRH):** It stimulates the anterior pituitary gland to secrete its thyroid stimulating hormone (TSH).
4. **Adrenocorticotrophic releasing Hormones (ARH):** It stimulates the anterior pituitary gland to secrete its adrenocorticotrophic hormone (ACTH) or adrenocorticotrophic.
5. **Prolactin releasing hormone (PRH):** It stimulates the anterior pituitary gland to secrete its prolactin.
6. **Prolactin inhibiting hormone (PIH):** It inhibits the secretion of prolactin from the anterior pituitary gland.
7. **Gonadotrophin releasing hormone (GRH):** It stimulates the anterior pituitary to secrete its follicle stimulating hormone (FSH) and luteinizing hormone (LH).

PITUITARY GLAND (HYPOPHYSIS, MASTER GLAND)

Pituitary gland is situated in the hypophyseal fossae of the sphenoid bone below the hypothalamus of the brain. It consists of two lobes:

- | | |
|------------------|-------------------|
| A. Anterior lobe | B. Posterior lobe |
|------------------|-------------------|

A. ANTERIOR LOBE (ADENOHYPHYSIS)

It is the largest part of the pituitary gland. The hormones secreted by the anterior lobe of pituitary gland are of two different kinds, first controlling the functioning of other endocrine glands and second controlling the target organ. The anterior pituitary secretes several hormones like:

- Growth hormone/Somatotrophic hormone (GH)
- Thyroid stimulating hormone (TSH)
- Adrenocorticotrophic hormone (ACTH)
- Prolactin
- Follicle stimulating hormone (FSH)
- Luteinizing hormone (LH)

1. **Growth hormone** is necessary for the normal growth and development of the body,
2. **Thyroid stimulating hormone (TSH)** regulates the synthesis of thyroid hormone in the thyroid gland.
3. **Adrenocorticotrophic hormone (ACTH)** stimulate the adrenal cortex to synthesis its hormones.
4. **Prolactin** stimulates milk production in females.
5. **Follicle stimulating hormone (FSH):** It stimulates:
 - Ovary in females to synthesis oestrogen.
 - Testes in males to produce spermatozoa.
6. **Luteinizing hormone (LH):** It stimulates:
 - Ovary in females to produce progesterone.
 - Testes in males to produce testosterone.

B. POSTERIOR LOBE (NEUROPHYSIS)

The posterior lobe of pituitary gland secretes two hormones. They are oxytocin and vasopressin.

1. **Oxytocin:** Its functions are:
 - Contraction of uterus during labour (delivery) and to bring about parturition (i.e. birth of baby).
 - Ejection of milk from the breast.
2. **Antidiuretic hormone (ADH)/Vasopressin:**
 - It increases the reabsorption of water from distal convoluted tube and collecting duct in the kidneys.
 - It increases blood pressure by contraction of arterioles and capillaries.

THYROID GLAND

Thyroid gland is largest endocrine gland of the body. It is situated in the neck region in front of larynx and trachea at the level of the 5th cervical vertebra to 1st thoracic vertebra. It consists of two lobes each lying on either side of the trachea.

Hormones of Thyroid Gland

The thyroid gland secretes three hormones:

- Thyroxine (T₄)
- Triiodothyronine (T₃)
- Calcitonin

Functions of Thyroid Hormones (T₃ & T₄)

1. Increase in the basal metabolic rate (BMR).
2. Increase in the rate of cholesterol synthesis in liver.
3. Storage of iodine.
4. Synthesis of proteins in the cells.
5. Increase in oxygen consumption and heat production in tissue.
6. Increase in the absorption and utilization of glucose.
7. Myelination of central nervous system.

Functions of Calcitonin

1. It stimulates osteoblast activity and facilitates the deposition of calcium on bones.

2. It increases excretion of calcium through the urine by inhibiting the reabsorption from the renal tubules.
3. It prevents the absorption of calcium from intestine into the blood.

PARATHYROID GLANDS

Parathyroid glands are four small, round shaped like pea size gland. It is situated in the posterior surface of each lobe of the thyroid gland.

Functions of Parathormone (PTH)

1. Increases absorption of calcium in the gastrointestinal tract.
2. Increases reabsorption of calcium in the renal tubule.
3. Mobilization of calcium of bone into the extracellular fluids.

ADRENAL GLANDS

Adrenal glands are paired (two) structure situated at the tip of each kidney. Because of the situation, adrenal glands are known as suprarenal glands.

Structure of Adrenal Glands

Each adrenal gland is made up of two distinct parts:

1. Adrenal cortex
2. Adrenal medulla

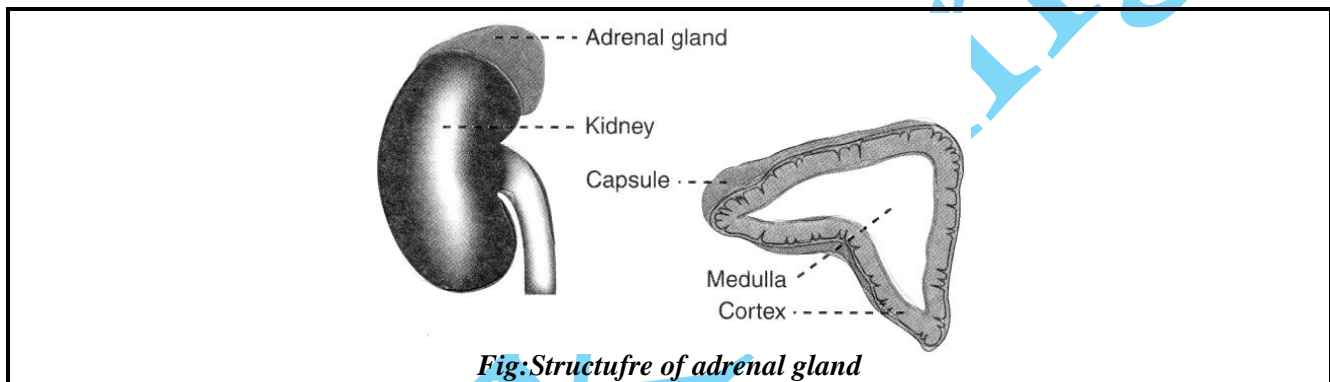


Fig: Structure of adrenal gland

ADRENAL CORTEX

The outer portion of adrenal gland is known as adrenal cortex. It forms 80 % mass of adrenal gland. The adrenal cortex is formed by three layers of structure which are distinct from one another.

- The outer layer is known as zona glomerulosa, it secretes mineralocorticoids.
- The middle layer is known as zona fasciculata, it secretes glucocorticoids and small quantity of sex hormones.
- The inner layer is known as zona reticularis, it secretes sex hormones and small quantity of glucocorticoids.

Functions of Glucocorticoids

1. It increases blood glucose level.
2. It increases breakdown of protein into amino acid.
3. It helps in the breakdown of fat into fatty acid and glycerol.
4. It blocks the inflammatory response to allergic reaction.
5. It decreases body's immunity.
6. It decreases the production of eosinophils and lymphocytes.
7. It redistributes the fat.

Functions of Mineralocorticoids

Mineralocorticoids are group of hormones. The main hormone of the group is aldosterone. The main functions of mineralocorticoids are as follows:

1. Increases the reabsorption of sodium ions in the renal tubule.
2. Increases the potassium excretion through the renal tubules.

Functions of Androgens

1. It maintains growth and development of reproductive organs.
2. It develops secondary sexual characteristics.

3. It helps in process of spermatogenesis (Formation of spermatozoa).
4. It helps in male pattern of aggressive behavior.
5. It promotes RNA synthesis and protein synthesis.
6. It increases glycolysis, and also increases fatty acid synthesis and citric cycle.
7. It is also responsible for bone maturation.

II. ADRENAL MEDULLA

Adrenal medulla is the inner part of the adrenal gland and forms 20% of mass of adrenal gland. Mainly hormones are secreted by the adrenal medulla is known as catecholamine.

Hormones of Adrenal Medulla

- Adrenaline (Epinephrine)
- Noradrenalin (Nor-epinephrine)

Functions of Adrenaline and Nor-adrenaline

1. Vasoconstriction and increase in the blood pressure
2. Dilatation of the pupil.
3. Relaxation of the intestine.
4. Contraction of splenic capsule and released of red blood cells.
5. Erection of hair due to contraction of erector pili muscle.

ISLETS OF LANGERHANS (PANCREAS)

The endocrine part of the pancreas takes the form of many small clusters of cells known as islet of langerhans. The pancreas has about one million islets of langerhans. Each islet of langerhans consists of four types of cells such as:

- a. **Alpha cells (α cells):** It secretes glucagon hormone which increases the sugar level in blood.
- b. **Beta cells (β cells):** It secretes insulin hormone which converts excess glucose into glycogen in the liver and muscles. Deficiency of insulin causes diabetes mellitus.
- c. **Delta cells (δ cells):** It secretes somatostatin (ss) hormone which decreases the rate of nutrient absorption into the blood from GI tract. It also inhibits the secretion of growth hormone from the anterior lobe of pituitary gland.
- d. **Pancreatic polypeptide cells (PP-Cells or PF cells):** It secretes pancreatic polypeptide (PP) hormone which inhibits the release of pancreatic juice.

PINEAL GLAND

The pineal gland is a small gland attached to the roof of the third ventricle and is connected to it by a short stalk containing nerves. The pineal gland secretes melatonin hormone.

Functions of Melatonin

1. Coordination of the circadian rhythms.
2. Inhibition of growth and development of the sex organs before puberty, possibly by preventing synthesis of gonadotropins.

Note: Study of Testis from Male Reproductive System, Ovary from Female Reproductive System, Thymus Gland from Lymphatic System, kidneys from Urinary System, Placenta form Female Reproductive System and Heart from Cardiovascular System.

ENDOCRINE SYSTEM

