

# **Classification of Hormones**

## **Lecture 1**

# Definition

- **Hormones:** are substances produced by highly specialized tissues called the "Endocrine" or "ductless glands", carried by blood stream to a remote tissue or viscera called the "Target organ" on which they exert characteristic physiological effects.
- **Hormones affect the following important functions:**
  1. Metabolism.
  2. Growth and sexual maturation.
  3. Reproduction.
  4. Adaptation to the environment.

# Classification of Hormones

1. Steroidal hormones:
  2. Protein hormones
  3. Amino acid derivatives
- **Hormones exert their actions as:**
    1. *Endocrine action*
    2. *Paracrine action*
    3. *Autocrine action*

# Mode of action of hormones

## ***1. Hormones which are lipophilic and/or are transported in plasma by special proteins:***

- They have relatively long half-life, their action is prolonged.
- They enter the cells of the target organ and bind to receptor protein in the cytoplasm or the nucleus.
- They exert their action by altering the function of a portion of DNA.
- Steroid hormones of the adrenal cortex, testis and ovary belong to this group.
- Thyroid hormones which are water soluble and easily transportable also act in this manner.

# Mode of action of hormones

## ***2. Hormones which are water soluble and easily transported in plasma in a free state:***

- Their half-life is very short and their action is also for a very short time.
- They bind to receptors on the cell membrane and their further action is mediated through a second messenger, the hormone itself being the first messenger.
- Most peptide hormones like insulin, glucagon, and hormones of the pituitary gland belong to this group.

# Hormonal Receptors

- **Hormone receptors have two mandatory characteristics:**
  1. The receptor must identify a unique binding site within the hormone in order to distinguish the hormone from all other molecules.
  2. The receptor must be able to transmit the signal caused by binding with the hormone into a cellular response.

# Classification of Hormonal receptors

## ***1. Intracellular Receptors:***

- These are located inside target cells, in the cytoplasm or nucleus, and function as ligand-dependent transcription factors.
- The hormone-receptor complex binds to promoter regions of responsive genes and stimulates or sometimes inhibits transcription from those genes.
- Intracellular Receptors are composed of a single polypeptide chain that has three distinct domains: The amino-terminus, DNA binding domain, and the carboxy-terminus or ligand-binding domain.
- Steroid and thyroid hormones act on these receptors.

# Classification of Hormonal receptors

## 2. *Cell surface receptors:*

- These are located on the plasma membrane of target cells.
- Binding of hormone to receptor initiates a series of events which leads to generation of *second messengers* within the cell.
- The second messengers then trigger a series of molecular interactions that alter the physiologic state of the cell (*signal transduction*).
- Cell surface receptors are integral membrane proteins; they are composed of three parts: Extracellular domains, Transmembrane domains and Cytoplasmic or intracellular domains.
- Protein and peptide hormones and catecholamines act on these receptors.



# ***Second Messenger Systems***

- Water soluble hormones act through binding to cell surface receptors and activation of one of the second messenger systems.
- Multiple hormones utilize the same second messenger system. Also a single hormone can utilize more than one system.
- The small signal generated by hormone binding to its receptor is amplified within the cell into a cascade of actions that changes the cell's physiologic state.
- Examples are: Cyclic AMP, Protein kinase activity, Cyclic GMP, and Calcium and/or Phosphatidylinositide.

# Endocrine Glands

1. *The pituitary gland : it is composed of :*

*A. The Anterior pituitary secretes:*

- Luteinizing hormone (**LH**) and follicular stimulating hormone (**FSH**), which act on the gonads.
- Prolactin (**PRL**) which acts on the mammary gland
- Adrenocorticotrophic hormone (**ACTH**), which acts on the adrenal cortex to regulate the secretion of glucocorticoids.
- Growth hormone (**GH**), which acts on bone, muscle and liver.
- Thyroid stimulating hormone or thyrotropin (**TSH**) which stimulates the release of thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ ) from thyroid gland

# Endocrine Glands

*1. The pituitary gland : it is composed of :*

*B. The posterior pituitary secretes:*

- Antidiuretic hormone (**ADH**) also called vasopressin which controls excreted water from kidney.
- Oxytocin which controls labour.

# Endocrine Glands

2. *The hypothalamus secretes:*

- Corticotropin-releasing hormone (CRH) which stimulates the release of ACTH from anterior pituitary.
- Gonadotropin-releasing hormone (GnRH) which stimulates the release of FSH and LH from anterior pituitary.
- Growth hormone-releasing hormone (GHRH) which stimulates the release GH from anterior pituitary.
- Prolactin releasing hormone (PRH) which stimulates the release of prolactin from anterior pituitary
- Thyrotropin-releasing hormone (TRH) which stimulates the release thyroid-stimulating hormone (primarily), also stimulate prolactin release.

# Endocrine Glands

3. *The thyroid gland secretes:*

- Thyroxine ( $T_4$ ) and Triiodothyronine ( $T_3$ ), acting on metabolism.

4. *Parathyroid glands secrete:*

- Parathyroid hormone (**PTH**), which regulates calcium homeostasis.

5. *Pancreas secretes:*

- Insulin and Glucagon; both control glucose level in the blood.

# Endocrine Glands

*6. The Adrenal gland: is composed of*

*A. Adrenal cortex secretes:*

- Aldosterone which increase blood volume by reabsorption of sodium in kidneys.
- Cortisol which affects glucose metabolism and immune status.
- Androstenedione which is an anabolic male hormone and/or substrate for estrogen.

*B. Adrenal Medulla secretes:*

- Catecholamines include Epinephrine and Norepinephrine, which act also as neurotransmitters.

# Endocrine Glands

7. *Gonads* : these are either

A. *Testes secretes:*

- Androgens; the male sex hormones including Testosterone and Dihydrotestosterone.

B. *Ovary secretes:*

- Estrogens; the female sex hormones including Estradiol and Estrone.