

Endocrine system

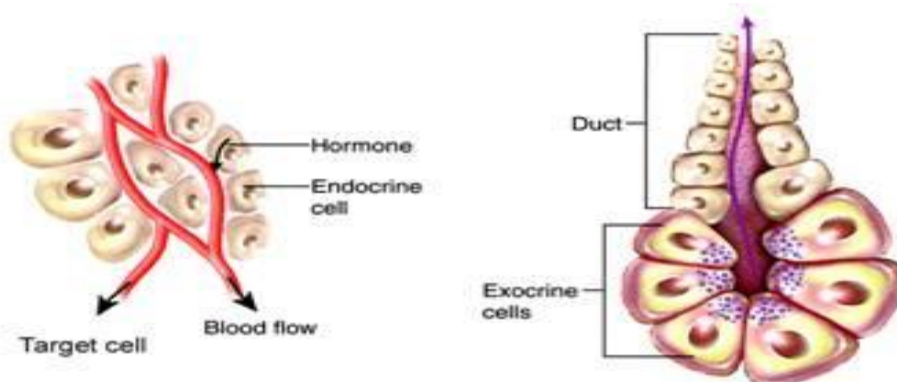
These are the systems of the body:

- ❖ The nervous system, skeletal, cardiovascular, respiratory, digestive, urinary, endocrine, reproductive, lymphatic, and immune. These systems form the body of the humans and mammals.
 - From these systems just two systems control the human body: **nervous system** and **endocrine system**, one for immediate action and the second for delayed action.
 - Endocrine system for delayed action and sometimes for immediate action like the release of adrenaline from the adrenal medulla, Nervous system for immediate action.
- ❖ Now we compare these two systems:

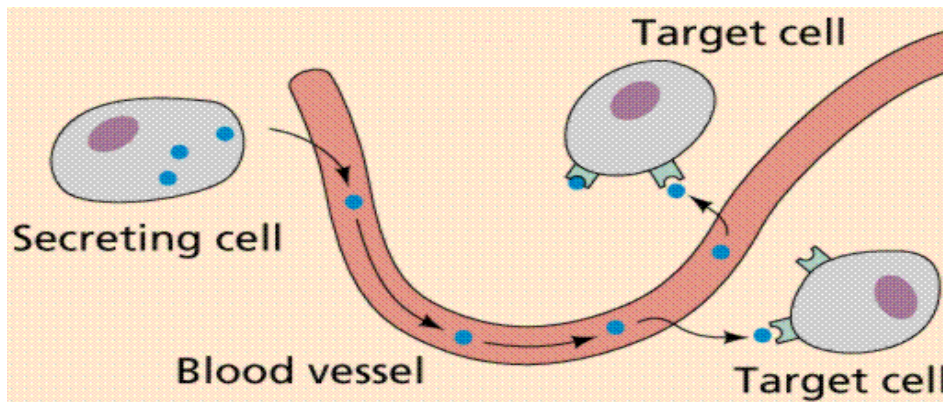
Characteristic	Nervous System	Endocrine system
Mechanism of control	Neurotransmitters release in response to nerve impulse, from neuron to neuron, from neuron to muscle cell, from neuron to gland cells.	Hormones are delivered usually directly in the blood to tissues.
Cells affected	Nerves, muscles, gland cells.	Almost all the cells of the body.
Types of actions	Neuron to neuron: action potential in the second nerve. Neuron to muscle: muscle contraction. Neuron to glandular cells: secretions of enzymes or hormones.	Changing in metabolism either anabolism or catabolism.
Time to onset of action	Usually immediate	Usually delayed sometimes immediate
Duration of action	Generally brief	Generally longer

The types of hormones or glands :

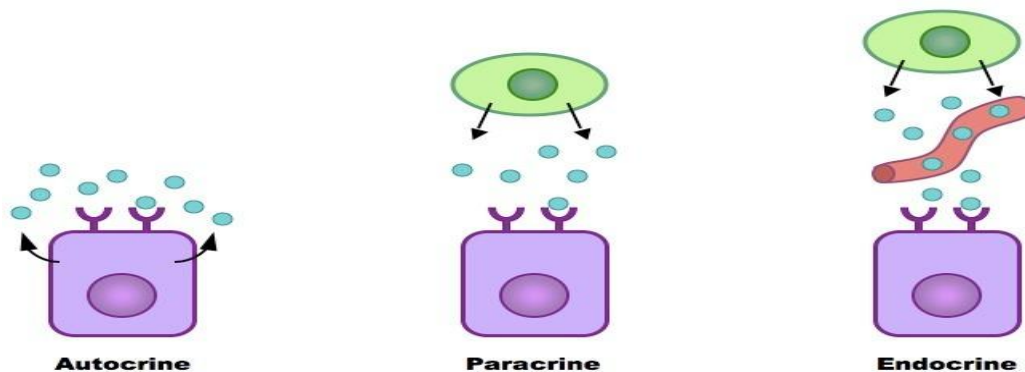
- ❖ **Exocrine glands** their secretions are released into a duct open either inside the body into a lumen such as the intestine or outside the body such as sweat glands.
- ❖ **Endocrine glands**, there are two types of endocrine glands (ductless glands) classic endocrine glands and other endocrine glands:



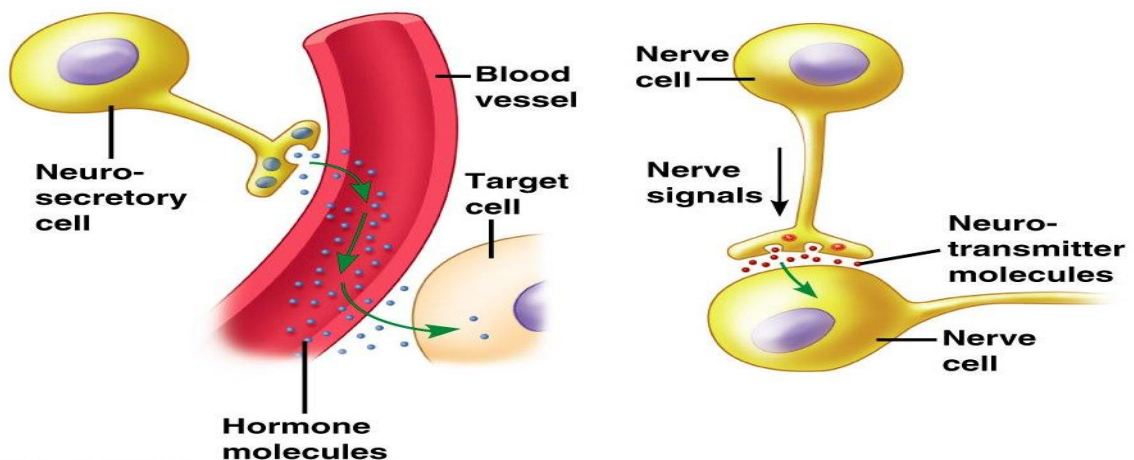
- **Classic endocrine glands** are group of cells synthesis and secrete chemical substances called hormones, directly into the blood, and through the blood the hormones reach their target cell, these are classic endocrine glands, and the hormones also are classic hormones.



- Other endocrine glands do not release their hormone directly into the blood, but these are minor glands:
 - **Autocrine glands:** hormones synthesized in endocrine cells and sometimes released into the interstitial spaces, bind to specific receptor on the cell of origin.
 - **Paracrine glands:** hormones synthesized in endocrine cells and sometimes released into the interstitial spaces, bind to specific receptor of nearby cells affecting their function.



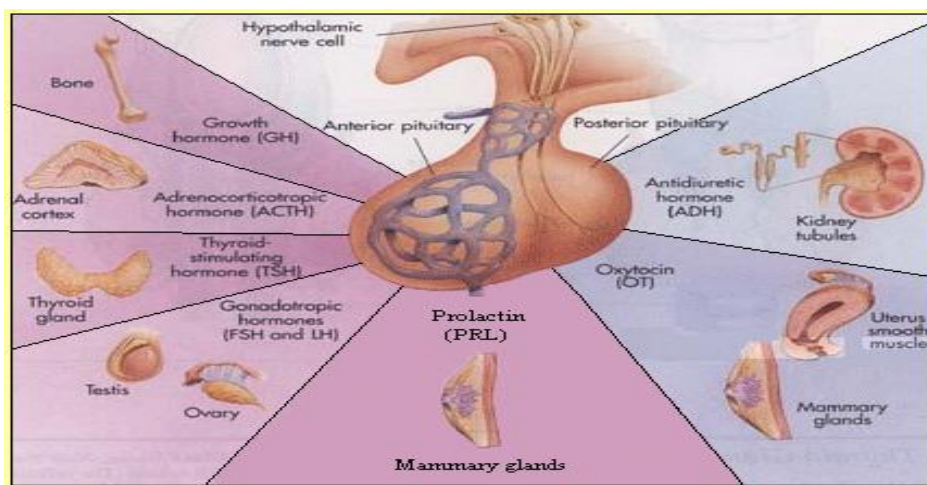
- ✓ **Neuroendocrine:** two subtypes; the first subtype is hormone produce by neurons and release directly into the blood, example: posterior pituitary. The second subtype is hormone produce by neurons and release into the cleft affecting the post synaptic neurons, so these hormones are neurohormones either release into the bold or into the synaptic cleft, example: Adrenalin from the sympathetic nervous system.



- ✓ **Pheromones:** are volatile hormones released into the environment act on olfactory cells of another individual, so they are substance produced by an animal usually that act at distance to produce hormonal, behavioral, or other physiologic changes in another animal of the same species :
 - In animals the deers produce the musk it affect the other deers and it is produced by the males not the females, also the amber produced by whales.
 - And these pheromones might be present in human beings, people getting attracted to each other by these pheromones.

❖ Some important points about the endocrine system :

- A single endocrine gland may produce many hormones such as anterior pituitary, pancreas.



- Some hormones have multiple actions in their target tissues called tropic hormones or effects, this phenomenon occur when single hormone regulates several functions in the target tissue, example: in skeletal muscles insulin stimulates glucose uptake, glycolysis, glycogenesis, inhibit glycogenolysis, stimulates amino acids uptake, stimulates protein synthesis and inhibit protein degradation. The same for insulin in the liver or adipose tissue.
- Single hormone may be secreted by more than one endocrine gland such as somatostatin secreted by the hypothalamus and the pancreas.
- Some hormones are known to have several effect in several different target cells, example the testosterone, the male sex steroid hormone, for normal sperm formulation in the testes, stimulates growth of accessory sex organs or glands such the prostate and the seminal vesicle and promotes the developmental of several secondary sex characteristics such as beard growth and deepening of the voice.
- There is also multiplicity of regulation in the endocrine system the input of information from several sources allows highly integrated response to many stimuli which is of ultimate benefit to the whole animal, for example: several different hormones insulin, glucagon, epinephrine, thyroid hormones, adrenal glucocorticoids may regulate liver glycogen metabolism, they produce simply the normal plasma glucose level all these hormones together.

- Single target cell may be influenced by more than one hormone, some cells contain many types of receptors responding in different ways to different hormones, to illustrate: insulin promotes the conversion of glucose into glycogen within the liver cells by stimulating one particular hepatic enzyme, whereas another hormone which is "Glucagon" enhances the degradation of liver glycogen, so the insulin increases the glucose level in the blood and the glucagon decreases the glucose level in the blood, because the same cells in the liver have different receptors, some receptors for insulin and some others for the glucagon.
- The same chemical messenger may be either a hormone or neurotransmitter, such as somatostatin either neurotransmitter produced by the hypothalamus or hormone produced by the pancreas.
- Some glands in the body produce just hormones, but there are other organs in the body that produce hormones in addition to other functions such as intestine (produce hormones as well as enzymes or other secretions), ovaries (produce hormones as well as producing ova), testes (produce hormones as well as sperms).
 - In this figure you see the only endocrine glands, also you see the mixed organs; they have nonendocrine function in addition to secretion of hormones such as stomach, pancreas, ovaries, lungs, heart, kidney, intestine etc...(refer to slides)

❖ The general functions of the hormones:

- **Metabolism:** hormones regulate the metabolism either anabolism or catabolism.
- **Reproduction:** there is no reproduction without hormones, no sperms without testosterone and other androgens or estrogen (because the estrogen also has a role in the production of the sperms), no ova without estrogen and progesterone.
- **Digestion:** digestive system does not function without hormones; it needs hormones to function properly.
- **Blood circulation:** cardiac output, blood pressure, vasoconstriction, vasodilatation and control the blood volume and consequently the body fluid volume, all these are controlled by hormones, and any wrong especially in some specific hormones all previously mentioned things are disturbed.
- **Transport of substances to tissues:** many substances are transported by hormones or increased or decreased its concentration in the blood.
- **Defense against pathogens:** immune system responses are regulated by hormones, such as inflammation, antibody production and fever.
- **Growth:** it does not occur properly without growth hormones, deficiency in GH leads to dwarfism as well as cretinism.
- **Stress response:** regulate the body's response to stresses.
- **Behavior:** hormones affect the behavior; the behavior of the females is different from the behavior of the males because of hormones, females shy and cannot fight because of the estrogen, males fight because of testosterone.