Anatomy and physiology of endocrine system

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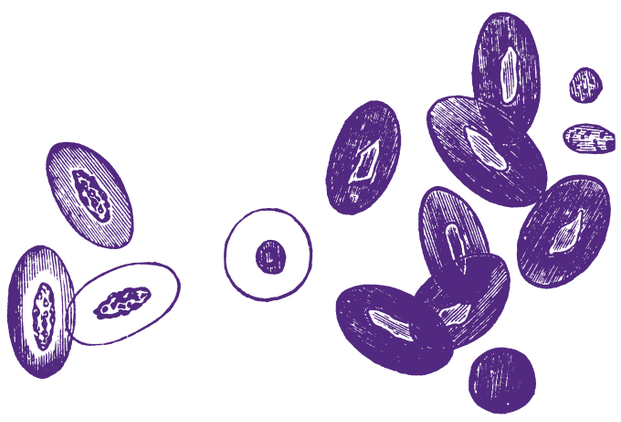

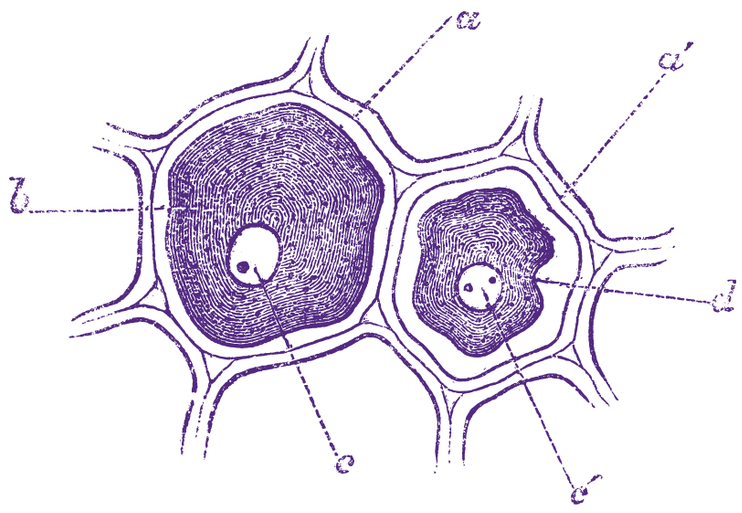

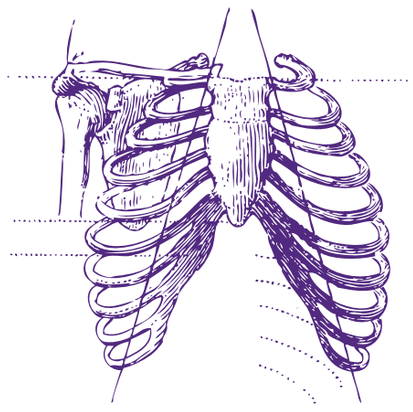

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OVERVIEW

The endocrine system – communication system in the body is a network of glands in the body that produce hormones, chemical substances released into the bloodstream to guide processes such as metabolism, growth, and sexual development. Hormones are also involved in regulating emotional life. They're responsible for almost every cell, organ, and function in the body. If endocrine system isn't healthy, might have problems developing during puberty, getting pregnant or managing stress. Also might gain weight easily, have weak bones, or lack energy because too much sugar stays in the blood instead of moving into cells where it's needed for energy.

CONTENT

Anatomy and physiology of endocrine system

What Is a Gland?

General characteristics of the endocrine glands

All glands of the body are usually divided into two groups. The first group includes glands that have excretory ducts and perform an exocrine function - exocrine, the second group includes glands that do not have excretory ducts and secrete their ion directly into the intercellular clefts. From the intercellular gaps, the ion enters the blood, lymph or cerebrospinal fluid. Such glands are called endocrine, or endocrine glands.

Endocrine glands are located in different parts of the body and have a varied morphological structure. They develop from epithelial tissue, interstitial cells, neuroglia, and nerve tissue. The products of the activity of the endocrine glands, in contrast to the secretions, are called hormones.

The term "hormone" (from the Greek hormao - move, excite, induce) was proposed by the English physiologists Baileys and Starling (1905), who isolated a special substance from the duodenal mucosa - secretin, which promotes the formation of pancreatic juice.

Hormones are produced in the endocrine glands of two types: 1) glands with mixed function carrying out along with internal and external secretion; 2) glands performing only the function of organs of internal secretion. The first group includes the sex glands - the gonads, and the pancreas, the second - the pituitary gland, pineal gland, thyroid, parathyroid, thymus and adrenal glands.

Hormones are chemical compounds with high biological activity and, in small amounts, give a significant physiological effect.

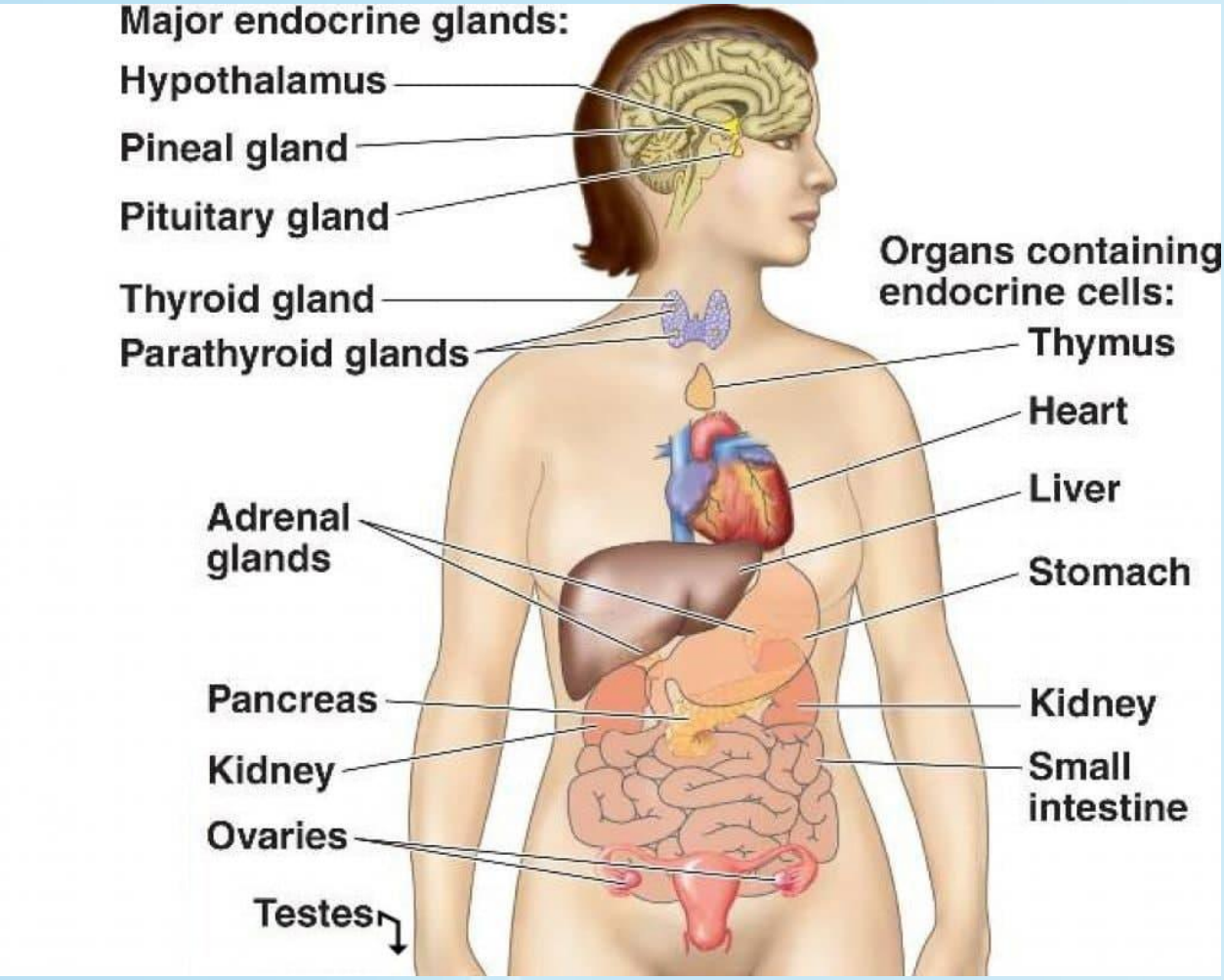
The endocrine glands are abundantly supplied with receptors and are innervated by the autonomic nervous system. According to their chemical nature, hormones are divided into three groups: 1) polypeptides and proteins; 2) amino acids and their derivatives; 3) steroids.

Hormones circulate in the blood in a free state and in the form of compounds with proteins. In connection with proteins, hormones tend to become inactive.

Properties of hormones. 1) Distant nature of the action... Organs and systems on which hormones act are usually located far from their place of formation in the endocrine glands. So, in the pituitary gland located at the base of the brain, tropic hormones are produced, the action of which is realized in the thyroid and gonads, as well as in the adrenal glands. Female sex hormones are formed in the ovary, but their action is carried out in the mammary gland, uterus, and vagina.

2) Strict specificity of action... The reactions of organs and tissues to hormones are strictly specific and cannot be caused by other biologically active substances. For example, the removal of the pituitary gland in a young growing organism leads to a growth arrest, which is associated with the loss of growth hormone action. At the same time, atrophy of the thyroid gland, gonads and adrenal glands occurs. To prevent growth retardation and atrophy of these glands after hypophysectomy, you can either transplant the pituitary gland or take injections of a suspension of the pituitary gland or purified tropic hormones.

3) High biological activity... Hormones are produced by the endocrine glands in small amounts. When administered externally, they are also effective at very low concentrations. The daily dose of the adrenal hormone prednisolone, which supports the life of a person who has both adrenal glands removed, is only 10 mg.



The effect of hormones on the functions of organs and body systems is mediated by two main mechanisms. Hormones can exert their influence through the nervous system, as well as humoral, by directly affecting the activity of organs, tissues and cells. A gland is an organ that makes and puts out hormones that do a specific job in your body. Endocrine glands release the substances they make into your bloodstream.

Types of effects of hormones on the body... The physiological effects of hormones are very diverse. They have a pronounced effect on metabolism, tissue and organ differentiation, growth and metamorphosis. Hormones have the ability to change the intensity of the functions of organs and the body as a whole.

The mechanism of action of hormones is very complex. Their main function - the influence on metabolic processes, growth and puberty - they carry out in close connection with the central nervous system and acting on the enzyme systems of the body.

Hormones can change the intensity of enzyme synthesis, activate some enzyme systems and block others. For example, one of the hormones of the islets of Langerhans in the pancreas - glucagon - activates the liver enzyme phosphorylase and thereby enhances the transition of glycogen to glucose. At the same time, it increases the activity of the liver enzyme insulinase, which destroys the excess insulin produced by the beta cells of the islets of Langerhans. As a result of the action of these hormones, the regulation of carbohydrate metabolism is carried out.

Along with the direct effect on the enzyme systems of tissues, the effect of hormones on the structure and functions of the body can be carried out in more complex ways with the participation of the nervous system. For example, hormones can act on interoreceptors that have a specific sensitivity to them. Such chemoreceptors are located in the walls of various blood vessels. They are probably also present in tissues.

Thus, hormones transported by the blood throughout the body can act on the effector organs in two ways: directly, without the participation of the nervous mechanism and through the nervous system. In the latter case, irritation of the chemoreceptors serves as the beginning of a reflex reaction, which changes the functional state of the nerve centers.

The physiological role of the endocrine glands... 1) Hormones are involved in the regulation and integration of body functions - In complex animal organisms, there are two mechanisms of regulation, nervous and endocrine. Both mechanisms are closely related to each other and carry out a single neuroendocrine regulation. At the same time, neurons at various levels of the central nervous system, including its higher section, the cerebral cortex, are involved in the regulation of the functions of the endocrine glands. The endocrine glands, under the influence of nerve impulses, release hormones into the bloodstream, especially during periods when the body is exposed to any adverse effects or needs more than the initial amount of the hormone.

Hormones, in contrast to nervous influences, realize their action slowly, therefore, the biological processes caused by them also proceed slowly. This feature of

hormones provides them with an essential role in the regulation of morphogenetic phenomena that develop over a wide time interval.

2) Hormones adapt the body to the changing conditions of the internal and external environment of the body... For example, hyperglycemia stimulates insulin secretion by the pancreas, which leads to the restoration of blood glucose levels.

3) Hormones restore the altered balance of the internal environment of the body... For example, when the level of glucose in the blood decreases, a large amount of adrenaline is released from the adrenal medulla, which increases glycogenolysis in the liver, as a result of which the level of glucose in the blood is normalized.

Thus, the main role of hormones in the body is associated with their influence on morphogenesis, metabolic processes and homeostasis, that is, with maintaining the constancy of the composition and properties of the internal environment of the body.

Regulation of hormone production... The production of hormones in the endocrine glands is regulated by the autonomic nervous system, the diencephalon (hypothalamus) and the cerebral cortex.

The hormones of the endocrine glands, in turn, have a strong effect on the functions of the central nervous system, especially on the state of the neurons of the cerebral cortex. Consequently, the connection between the endocrine glands and the central nervous system is two-way.

In the hormonal regulation of endocrine activity, the principle of autoregulation is of great importance. For example, the anterior pituitary dose tropic hormones regulate the functions of the peripheral endocrine glands. With an increase in the level of hormones of these glands in the blood, the hormone-forming function of the anterior pituitary gland is inhibited. The principle of autoregulation is also carried out on the basis of shifts in the chemical composition of the blood. Thus, insulin lowers blood glucose, which leads to increased entry into the vascular bed of the antagonist hormone - adrenaline, which, by mobilizing liver glycogen, restores the composition of the universal internal environment of the body.

The fate of hormones... Hormones in the process of metabolism change functionally and structurally. In addition, some of the hormones are utilized by the cells of the body, while others are excreted in the urine. Hormones are inactivated due to the connection with proteins, the formation of compounds with glucuronic acid, the activity of liver enzymes, oxidation processes.etc.

Methods for studying the functions of the endocrine glands... There are clinical, anatomical, histological and experimental methods for studying the activity of the endocrine glands.

Experimental methods include: extirpation (removal), transplantation (transplantation) of glands, extirpation followed by transplantation of the removed gland, loading the animal's body with hormones, irritation of nerves or denervation of the gland, the method of conditioned reflexes.

In all cases, the behavior of animals is monitored, and altered functions and metabolism in the body are established and studied.

Modern methods of studying the functions of endocrine glands include the following: 1) use chemicals (alloxan) to damage the beta cells of the islets of Langerhans and blockade of enzymes (methylthiouracil) of the thyroid gland involved in the formation of hormones; 2) use the method of radioactive isotopes, for example 131I, to study the hormone-forming function of the thyroid gland; 3) widely used biochemical methods for determining the content of hormones in the blood, cerebrospinal fluid and urine.

The functions of the endocrine glands can be decreased (hypofunction) or increased (hyperfunction).

Endocrine System Functions

Your endocrine system:

- Makes hormones that control your moods, growth and development, metabolism, organs, and reproduction
- Controls how your hormones are released
- Sends those hormones into your bloodstream so they can travel to other body parts

Parts of the Endocrine System

Many glands make up the endocrine system. The hypothalamus, pituitary gland, and pineal gland are in your brain. The thyroid and parathyroid glands are in your neck. The thymus is between your lungs, the adrenals are on top of your kidneys, and the pancreas is behind your stomach. Your ovaries (if you're a woman) or testes (if you're a man) are in your pelvic region.

- **Hypothalamus.** This organ connects your endocrine system with your nervous system. Its main job is to tell your pituitary gland to start or stop making hormones.
- **Pituitary gland.** This is your endocrine system's master gland. It uses information it gets from your brain to tell other glands in your body what to do. It makes many important hormones, including growth hormone; prolactin, which helps breastfeeding moms make milk; and luteinizing hormone, which manages estrogen
- **Pineal gland.** It makes a chemical called melatonin that helps your body get ready to go to sleep.
- **Thyroid gland.** This gland makes thyroid hormone, which controls your metabolism. If this gland doesn't make enough (a condition called hypothyroidism), everything happens more slowly. Your heart rate might slow down. You could get constipated. And you might gain weight. If it makes too much (hyperthyroidism), everything speeds up. Your heart might race. You could have diarrhea. And you might lose weight without trying.
- **Parathyroid.** This is a set of four small glands behind your thyroid. They play a role in bone health. The glands control your levels of calcium and phosphorus.
- **Thymus.** This gland makes white blood cells called T-lymphocytes that fight infection and are crucial as a child's immune system develops. The thymus starts to shrink after puberty.

Thymus gland (thymus)

The thymus gland is a paired lobular organ located in the upper part of the anterior mediastinum. It consists of two lobes of unequal sizes, interconnected by a layer of connective tissue. Each lobe of the thymus gland includes small lobules in which the cortex and medulla are distinguished. The cortical substance is represented by the parenchyma, which contains a large number of lymphocytes. The medulla contains epithelial and lipoid cells.

The thymus gland is well supplied with blood. The innervation of the gland is carried out by parasympathetic (vagus) and sympathetic nerves originating from the lower cervical and upper thoracic sympathetic ganglia.

Physiological role of the thymus gland... The endocrine function of the thymus gland is still not fully understood. Attempts to obtain the hormone from this gland have not yet been crowned with success.

It is believed that the thymus gland plays an important role in the regulation of the body's immune processes, stimulating the formation of antibodies that provide a response to a foreign protein. The thymus gland controls the development and distribution of lymphocytes involved in immune responses. It has been shown that undifferentiated stem cells that are formed in the bone marrow enter the bloodstream and enter the thymus gland. In it, they multiply and differentiate into lymphocytes of thymic origin (T-lymphocytes). It is believed that these lymphocytes are responsible for the development of cellular immunity. T-lymphocytes make up the majority of the lymphocytes circulating in the blood.

The thymus gland reaches its maximum development in childhood. After the onset of puberty, its development stops and the gland begins atrophy. In this regard, it is believed that it stimulates the growth of the body and inhibits the development of the reproductive system. It has been suggested that the thymus gland affects calcium metabolism and nucleic acid metabolism.

The physiological significance of the thymus gland also lies in the fact that it contains a large amount of vitamin C, seconded only by the adrenal gland.

With an increase in the thymus gland in children, thymic-lymphatic status occurs. It is believed that this condition is an innate constitutional feature of the organism.

With this status, in addition to the enlargement of the thymus gland, the proliferation of lymphatic tissue occurs. The patient's appearance is characteristic: pasty puffy face, loose subcutaneous tissue, obesity, thin skin, soft hair.

- **Adrenals.** Best known for making the "fight or flight" hormone adrenaline (also called epinephrine), these two glands also make hormones called corticosteroids. They affect your metabolism and sexual function, among other things.
- **Pancreas.** This organ is part of both your digestive and endocrine systems. It makes digestive enzymes that break down food. It also makes the hormones insulin and glucagon. These ensure you have the right amount of sugar in your bloodstream and your cells.

The pancreas is a mixed gland. The acinous tissue of this gland produces pancreatic juice, which through the excretorythe duct is secreted into the duodenal cavity. The intrasecretory activity of the pancreas is manifested in its ability to form hormones that flow from the gland directly into the blood.

The islets of Langerhans, scattered among its glandular tissue, serve as a morphological substrate for the endocrine function of the pancreas. The islets are unevenly located throughout the gland: mainly in its tail and only a small number in the head of the gland.

The islets of Langerhans are composed of three types of cells: alpha, beta, and gamma cells. The bulk of the islets of Langerhans are beta cells. Of the total number of cells is accounted for by alpha cells, which are larger in size than beta cells and are located mainly along the periphery of the gland. It has been shown that in humans there are 2700 to 25250 islets of Langerhans per 1 g of the gland.

The pancreas is innervated by sympathetic nerves coming from the solar plexus and by branches of the vagus nerve. However, the innervation of acinous tissue and cells of the islets of Langerhans is carried out completely separately. The nerve fibers that innervate the islets of Langerhans do not connect with the nerves of the exocrine glandular apparatus of the pancreas. Each islet contains a

significant number of ganglion cells belonging to the autonomic nervous system.

It is histochemically established that the islet tissue of the gland contains a large amount of zinc. Zinc is also part of insulin. The gland has an abundant blood supply.

Pancreatic hormones... It has been shown that beta cells of the islets of Langerhans form the hormone insulin, alpha cells synthesize glucagon... In the epithelium of small excretory ducts, a lipocic substance is formed, which some researchers refer to as pancreatic hormones, while others regard it as a substance of an enzymatic nature.

Physiological significance of insulin... Insulin is involved in the regulation of carbohydrate metabolism. Under the influence of the hormone, the concentration of sugar in the blood decreases - hypoglycemia occurs. If the blood sugar level is normally 4.45-6.65 mmol / l (80-120 mg%), then under the influence of insulin, depending on the administered dose, it becomes lower than 4.45 mmol / l (80 mg%). The decrease in blood glucose levels under the influence of insulin is due to the fact that the hormone promotes the conversion of glucose into glycogen in the liver and muscles. In addition, insulin increases the permeability of cell membranes for glucose. In this regard, there is an enhanced penetration of glucose into the cell, where it is utilized.

The importance of insulin in the regulation of carbohydrate metabolism lies in the fact that it prevents the breakdown of proteins and converts them into glucose. Insulin also stimulates protein synthesis from amino acids and their active transport into cells. Insulin regulates fat metabolism by promoting the formation of higher fatty acids from carbohydrate metabolism products. The hormone inhibits the mobilization of fat from adipose tissue.

Insulin activity is expressed in laboratory and clinical units. The laboratory, unit is the amount of hormone that in a healthy 2 kg rabbit reduces blood sugar to 2.22 mmol / L (40 mg%). For one unit of action (ED), or international unit (IE), the

activity of 0.04082 mg of crystalline insulin is taken. The clinical unit is one/3 laboratory.

Regulation of insulin secretion... The regulation of insulin secretion is based on normal blood glucose levels. Hyperglycemia leads to an increase in the flow of insulin into the blood. Hypoglycemia reduces the formation and flow of the hormone into the vascular bed. It has been established that the paraventricular nuclei (higher autonomic centers of the parasympathetic nervous system) of the hypothalamic region are directly involved in the regulation of the formation and secretion of insulin by the pancreas. With an increase in the concentration of sugar in the blood, the activity of the nervouscells of the paraventricular nucleus. Nerve impulses arising in neurons are transmitted to the dorsal nuclei of the vagus nerve, located in the medulla oblongata. From the nerve cells of these nuclei, excitation along the fibers of the vagus nerve spreads to the ganglia located directly in the tissue of the pancreas. Further, along the axons of the nerve cells of these ganglia, impulses are delivered to the beta cells of the islets of Langerhans, which leads to an increase in the formation and secretion of insulin. Insulin converts glucose into glycogen, and blood sugar is restored to normal levels. If the amount of glucose becomes below normal and hypoglycemia occurs, then the activity of the paraventricular nuclei of the hypothalamus is inhibited and, as a consequence, it excites not only the neurons of the paraventricular nuclei, but also the receptor apparatus of the islets of Langerhans itself, which also causes an increase in insulin secretion.

Experiments with the transplantation of several pancreas into dogs are a confirmation of the position that insulin production is regulated by the level of glucose in the blood. A dog with four pancreas did not have a decrease in blood glucose. Consequently, the four pancreas in the dog's body adjusted their hormone-forming function to the blood glucose level and did not induce a hypoglycemic state.

It was found that the function of the islets of Langerhans also depends on the functional relationships between the pituitary gland and the paraventricular nuclei

of the hypothalamus. The pituitary gland inhibits the activity of neurons in the paraventricular nuclei, which leads to a decrease in the production of insulin by the beta cells of the islets of Langerhans of the pancreas. The weakening of the influence of the pituitary gland on the paraventricular nuclei is accompanied by the stimulation of insulin secretion.

Insulin secretion is regulated by the autonomic nervous system: stimulation of the vagus nerves stimulates the formation and secretion of the hormone, and the sympathetic nerves inhibit these processes.

Insulin secretion also occurs reflexively when the receptors of a number of reflexogenic zones are irritated. Thus, in a hyperglycemic state, chemoreceptors of the carotid sinuses are excited, as a result of which a reflex release of insulin into the bloodstream is carried out and the blood sugar level is normalized.

The amount of insulin in the blood depends on the activity of the enzyme insulinase, which breaks down the hormone. The largest amount of the enzyme is found in the liver and skeletal muscles. With a single flow of blood through the liver, insulinase destroys up to 50% of insulin.

Insufficiency of the intrasecretory function of the pancreas, accompanied by a decrease in insulin secretion, leads to a disease that has received the The main manifestations of this disease are hyperglycemia, glucosuria (the appearance of sugar in the urine), polyuria (increased up to 10 l / day, urine excretion), polyphagia (increased appetite), polydipsia (increased thirst) resulting from the loss of water and salts.

The increase in blood sugar in diabetic patients, the amount of which can be 16.65-44.00 mmol / l (300-800 mg%), is the result of a weakening of glycogenesis in the liver and muscles, as well as a violation of glucose utilization by the cells of the body. In patients with diabetes, not only carbohydrate metabolism is disturbed, but also the metabolism of proteins and fats.

Physiological significance of glucagon... Glucagon is involved in the regulation of carbohydrate metabolism. By the nature of its action on carbohydrate metabolism, it is an insulin antagonist. Under the influence of glucagon, glycogen is broken

down in the liver to glucose. As a result, the concentration of glucose in the blood rises. In addition, glucagon stimulates the breakdown of fat in adipose tissue.

Regulation of glucagon secretion... The formation of glucagon in the alpha cells of the islets of Langerhans is influenced by the amount of glucose in the blood. With an increase in blood glucose, glucagon secretion is inhibited, and with a decrease, the level of the hormone increases. The value of the concentration of glucose in the blood in the formation of glucagon was shown in experiments with the perfusion of an isolated pancreas: if the amount of glucose in the perfused fluid was increased, then a decrease in the release of glucagon from the gland into the outflowing fluid was observed. The formation of glucagon in alpha cells is also influenced by the anterior pituitary gland. It was found that growth hormone - somatotropin - increases the activity of alpha cells and they intensively produce glucagon.

Physiological significance of lipocaine... The hormone promotes fat utilization by stimulating the formation of lipids and the oxidation of fatty acids in the liver. Lipocaine prevents fatty degeneration of the liver in animals after removal of the pancreas.

- If you don't make insulin, which is the case for people with type 1 diabetes, your blood sugar levels can get dangerously high. In type 2 diabetes, the pancreas usually makes some insulin but not enough.
- **Ovaries.** In women, these organs make estrogen and progesterone. These hormones help develop breasts at puberty, regulate the menstrual cycle, and support a pregnancy.
- **Testes.** In men, the testes make testosterone. It helps them grow facial and body hair at puberty. It also tells the penis to grow larger and plays a role in making sperm.

Health Issues

As you get older, it's natural to notice some things related to your endocrine system. Your metabolism tends to slow down. So you might gain weight even

though you haven't changed how you eat or exercise. Hormonal shifts also explain, at least in part, why you're more likely to have heart disease, osteoporosis, and type 2 diabetes as you age.

No matter how old you are, stress, infections, and being around certain chemicals can also mess with parts of your endocrine system. And genetics or lifestyle habits can increase your chances of an endocrine disorder like hypothyroidism, diabetes, or osteoporosis.

Endocrine System Disorders

- **Acromegaly.** Sometimes the pituitary gland makes too much growth hormone and your bones get bigger. It usually affects your hands, feet, and face. It usually starts in middle age.
- **Adrenal insufficiency.** When you have this, your adrenal glands don't make enough of certain hormones, like cortisol, which controls stress.
- **Cushing's disease.** In this, your body makes too much cortisol. You could gain weight, get stretch marks, bruise easily at first, then get weakened muscles and bones and possibly develop a hump on your upper back.
- **Hyperthyroidism.** This is when your thyroid gland makes more hormones than your body needs. You might hear it called overactive thyroid. It makes your system run fast and you might feel nervous, lose weight, and have a rapid heartbeat or trouble sleeping.
- **Hypothyroidism.** When your body doesn't make enough thyroid hormone, your system slows down. You might feel tired, gain weight, have a slow heartbeat, and get joint and muscle pains.
- **Hypopituitarism.** Sometimes your pituitary gland doesn't make enough of certain hormones and your adrenal and thyroid glands can't work right.
- **Multiple endocrine neoplasia.** This is a group of disorders that affect your endocrine system. It causes tumors on at least two endocrine glands or in other organs and tissues.
- **Polycystic ovary syndrome.** An imbalance of reproductive hormones can cause your ovaries to either not make an egg or not release it

during ovulation. This can throw off your periods, cause acne, and make hair to grow on your face or chin.

- **Precocious puberty.** When glands that control reproduction don't work properly, some kids start puberty abnormally early -- around 8 in girls and 9 in boys.

ENDOCRINE SYSTEM

 The endocrine system is a system in the body that plays an important role in hormones.

TYPES OF GLANDS

 Endocrine glands are ductless glands that secrete hormones directly into the bloodstream or surrounding tissues.

 In contrast**, exocrine glands**, or glands with ducts, such as salivary and sweat glands, secrete their products directly into ducts that open to specific areas

FUNCTIONS OF ENDOCRINE SYSTEM

 Growth and development.

 Homeostasis (the internal balance of body systems).

 Metabolism (body energy levels).

 Reproduction.

 Response to stimuli (stress and/or injury).

HORMONES

 Hormones are chemicals that essentially function as messengers of the body.

 These chemicals are secreted by special glands known as the endocrine glands.

 These endocrine glands are distributed throughout the body.

 These messengers control many physiological functions as well as psychological health.

 They are also quite important in maintaining homeostasis in the body.

CHARACTERISTICS OF HORMONES

1. Action and low concentration
2. Storage, metabolism and excretion
3. Distant target organ

Functions of hormones:

- Food metabolism.
- Growth and development.
- Controlling thirst and hunger.
- Maintaining body temperature.
- Regulating mood and cognitive functions.
- Initiating and maintaining sexual development and reproduction.

Classification of hormones

- Amino acid derived – Examples include melatonin and thyroxine .
- Eicosanoids – hormones derived from lipids such as arachidonic acid, lipoxins and prostaglandins.
- Steroid – Hormones derived from cholesterol.

Some Important Hormones

1. **Estrogen**-

This is the main sex hormone present in women which bring about puberty, prepares the uterus and body for pregnancy and even regulates the menstrual cycle. Estrogen level changes during menopause because of which women experience many uncomfortable symptoms.

2. **Progesterone** –

It is a female sex hormone also responsible for menstrual cycle, pregnancy and embryo genesis.

3. **Cortisol** –

It has been named as the "stress hormone" as it helps the body in responding to stress. This is done by

increasing the heart rate, elevating blood sugar levels etc.

4. **Melatonin** –

It primarily controls the circadian rhythm or sleep cycles.

5. **Testosterone** –

This is the main sex hormone present in men which cause puberty, muscle mass growth, and strength, increases bone density and handles facial hair growth.

Mechanism of Hormone Action

Each hormone has receptors that are found on the cell membrane of the target organ.

Once the hormones bind to its designated receptor, a series of actions are initiated to release secondary messengers inside the cell.

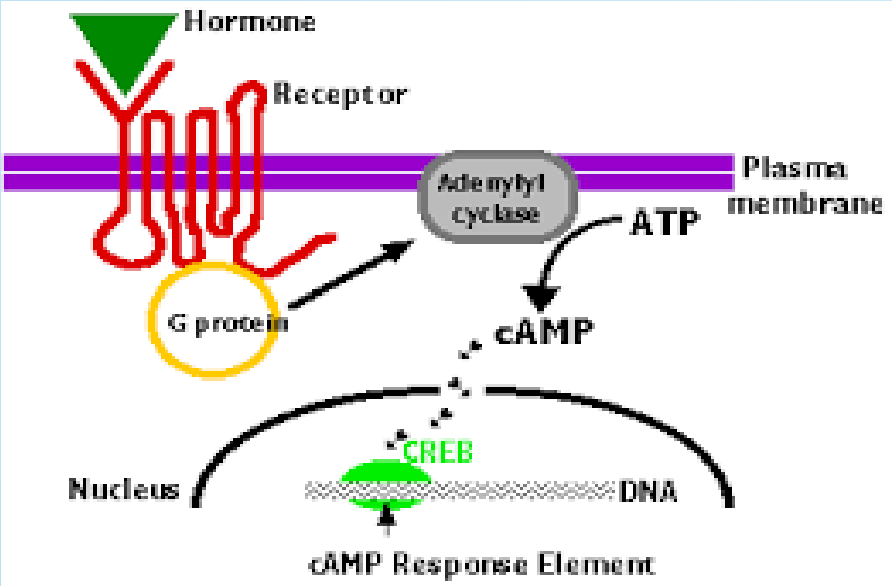
These secondary messengers are responsible for relaying information to the nucleus or other organelles. Based on their structure, receptors are of different types:

1. Internal receptors– they can be either nuclear or cytoplasmic. Nuclear receptors are found on the nuclear membrane while the cytoplasmic receptors are found in the cytoplasm of the cell. These receptors are for the steroid hormones.

2. External receptors– These are the transmembrane receptors which are embedded in the lipid layer of the cell membrane. These receptors are for the protein ones.

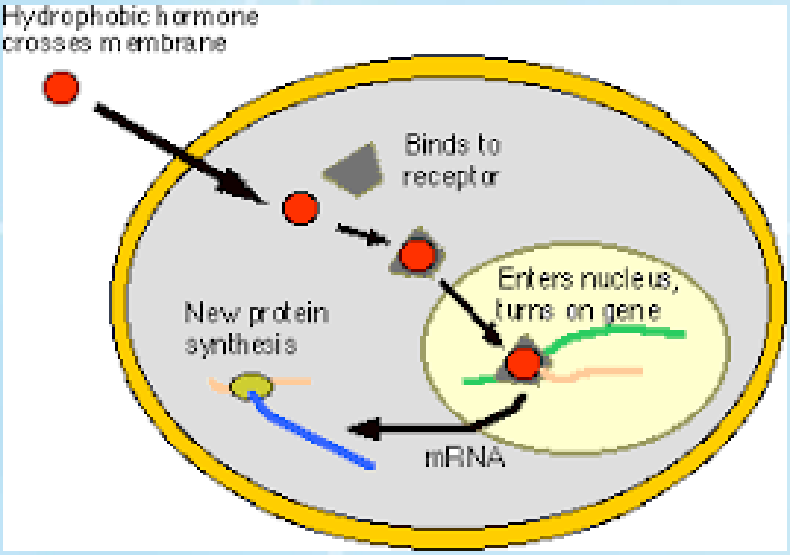
The mechanism of action hormone can be of two types: First, where the receptors are fixed and the second, where the receptors are mobile.

A. Fixed Receptor Mechanism



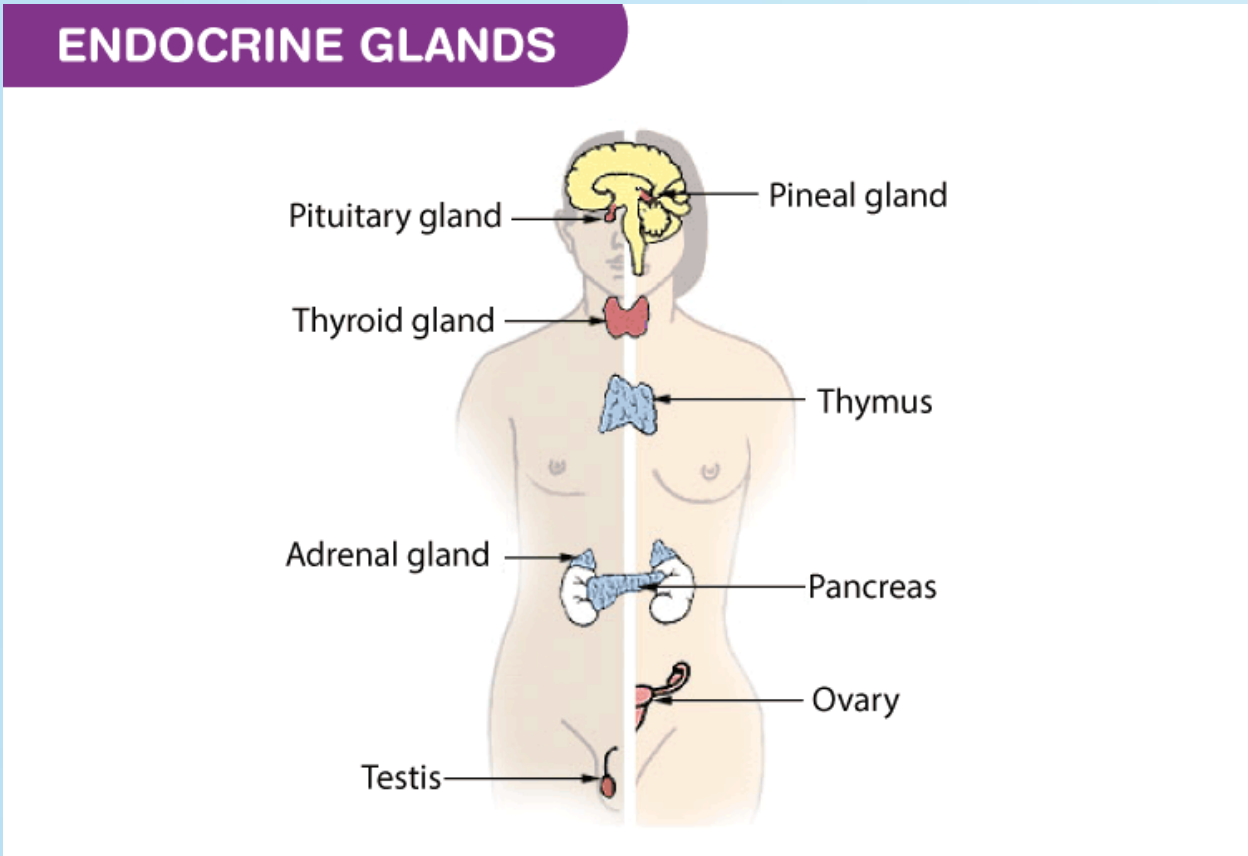
This mechanism of action hormone is seen in the protein hormones such as Adrenaline, insulin, ADH, TSH etc. As mentioned earlier, since they are water soluble, they cannot pass through the cell membrane as it is made up of a lipid layer. So, they bind to their extracellular receptors present on the membrane.

Once the protein hormone binds to the receptor, a series of reactions occur beginning with the production of adenyl cyclase enzyme. This enzyme leads to the production of cyclic AMP or cAMP which is the secondary messenger. This cAMP can now enter the cell and cause the effect it was meant to bring about.



This kind of mechanism is seen in the steroid hormone that is insoluble in water. They are made up of fats and therefore can freely cause the lipid layer of the cell membrane. Their receptors are intracellular and not extracellular like those for the protein ones. The intracellular receptors can be floating in the cytoplasm, on the

nuclear membrane or inside the nucleus. For this reason, their receptors are known as mobile receptors



ENDOCRINE GLANDS

Unlike exocrine glands (sweat, salivary), endocrine glands secrete their respective substances directly into the bloodstream rather than through a duct, that is they are ductless glands.

These endocrine glands belong to the body's control system and they produce hormones which help to regulate the functions of cells and tissues.

Some glands are specific to either male (testes) or female (ovaries)

Endocrine glands include;

- Pituitary gland
- Thyroid gland
- Pancreas
- Adrenal glands
- Hypothalamus
- Parathyroid glands

- Pineal gland
- Ovaries

Pituitary Gland

In the system of endocrine glands, the pituitary gland occupies a special position. The pituitary gland is referred to as the central gland for internal secretion. This is due to the fact that the pituitary gland, due to its special tropic hormones, regulates the activity of other, so-called peripheral glands.

The pituitary gland is located in the pituitary fossa of the sella turcica of the sphenoid bone of the skull. With the help of short blood ressels it is connected to the base of the brain.

The structure of the pituitary gland: By its structure, the pituitary gland is a complex organ. It consists of the adenohypophysis, which includes the anterior and middle lobes, and the neurohypophysis, which includes the posterior lobe. The adenohypophysis is of epithelial origin, the neurohypophysis and its pedicle are neurogenic.

The pituitary gland is well supplied with blood. A feature of the circulation of the anterior lobe of the pituitary gland is the presence of a portal (portal) vascular system, which connects it with the hypothalamus. It was found that the blood flow in the portal system is directed from the hypothalamus to the pituitary gland.

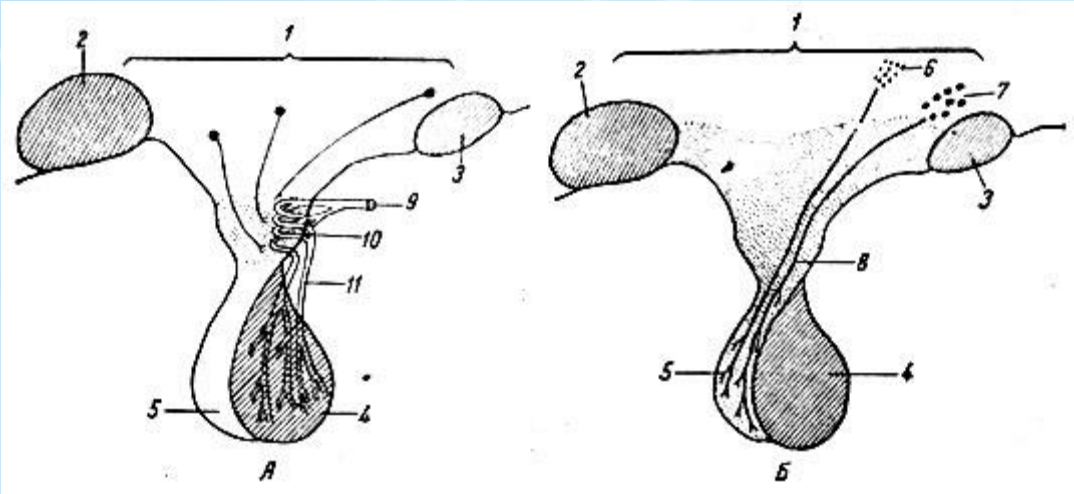
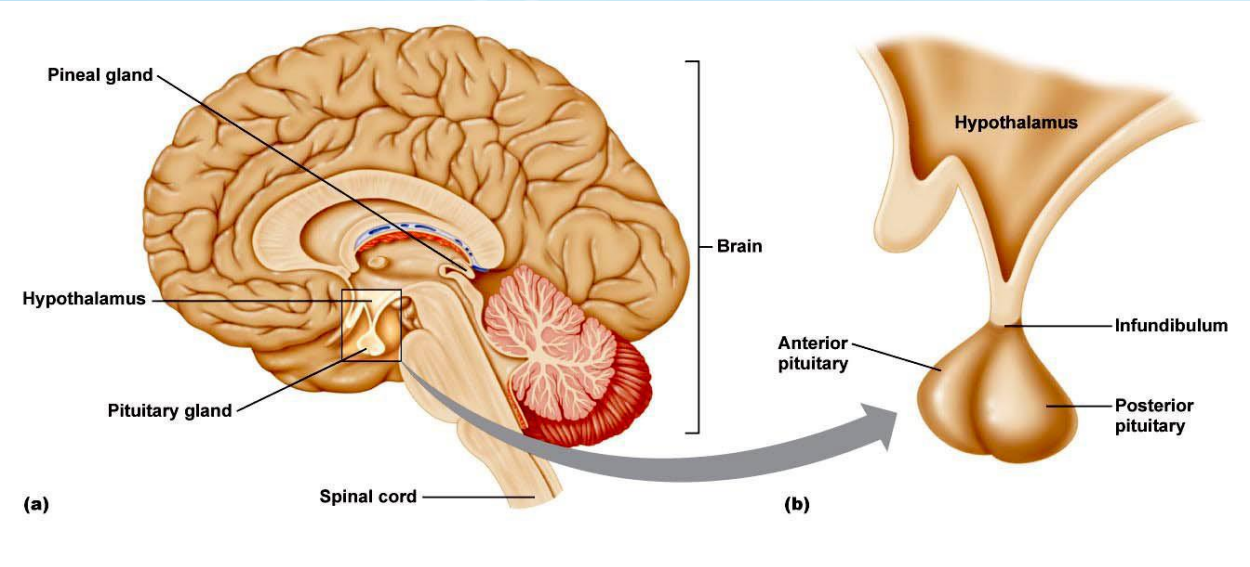


Figure: 1. Diagram of the vascular connection of the hypothalamus and the anterior lobe of the pituitary gland (A), as well as the nervous connection of

the hypothalamus and the posterior lobe of the pituitary gland (B). 1 - diencephalon; 2 - mamillary bodies; 3 - the cross of the optic nerve; 4 - the anterior lobe of the pituitary gland; 5 - the posterior lobe of the pituitary gland; 6 - paraventricular nucleus of the hypothalamus; 7 - supraoptic nucleus; 8 - hypothalamic-pituitary tract; 9 - artery; 10 - primary capillary network; 11 - hypothalamic-pituitary portal network

The innervation of the anterior pituitary gland is represented by sympathetic and parasympathetic nerve fibers. The posterior lobe of the pituitary gland is innervated by nerve fibers originating from the nerve cells of the supraoptic and paraventricular nuclei of the hypothalamus.

- This gland has its location at the base of the brain.
- It is known as the master gland, because it is responsible to control the function of other glands to put forth their hormones.
- Growth, body metabolism, sexual development, and reproduction happen to be the elements which come under the domain of the pituitary gland.
- It develops the hormones that trigger growth and development.



Functions of pituitary gland

- Growth
- Blood pressure

- Sex organ functions
- Pain relief
- Temperature regulation
- Water and osmolarity regulations in the body

Hormones of the anterior pituitary gland: Hormones formed in the anterior pituitary gland are usually divided into two groups. The first group includes growth hormone (somatotropin) and prolactin. The second group includes tropic (crinotropic) hormones: thyroid-stimulating hormone (thyrotropin), adrenocorticotropic hormone (corticotropin) and gonadotropic hormones (gonadotropins)*...

* (The names of the hormones recommended by the Commission on Biochemical Nomenclature of the International Society of Pure and Applied Chemistry and the International Biochemical Society are indicated in brackets.)

A growth hormone (somatotropin) is involved in the regulation of growth, which is due to its ability to enhance the formation of protein in the body. The most pronounced effect of the hormone are on bone and cartilage tissue. Under the influence of somatotropin, an increased growth of epiphyseal cartilage occurs in the long bones of the upper and lower extremities, which leads to an increase in their length.

Hormones produced

- **Antidiuretic hormone (vasopressin)** – Its primary function is to help the kidneys to retain water in the body.
- **Corticotropin (ACTH)** – These hormones are there for regulating the hormones of the adrenal glands.
- **Human growth hormone** – it is associated with the growth and development of the body. It is also known to encourage the production of protein.
- **Luteinizing hormone and follicle-stimulating hormone** – Important functions like the production of sperm and semen, and menstruation, are looked after by this particular hormone. Secondary sexual characteristics such as hair growth pattern, muscles, texture and thickness of the skin, nature of the voice, etc.

 Oxytocin – Helps contraction of the uterus muscles and mammary ducts in the breast.

 Prolactin – The process of milk production in the mammary glands is carried out by this hormone. Prolactin promotes the formation of milk in the alveoli of the mammary gland. Its effect on the mammary gland exerts after a preliminary effect on it of female sex hormones - estrogen and progesterone. Estrogens cause the growth of the ducts of the mammary gland, progesterone - the development of its alveoli. After childbirth, the secretion of prolactin by the pituitary gland increases and lactation occurs. An important factor contributing to the secretion of prolactin is the act of sucking, which through the neuro-reflex mechanism stimulates the formation and release of prolactin by the anterior pituitary gland.

 Thyroid-stimulating hormone – Again, as the name suggests, this hormone is responsible for the functions of the hormones of the thyroid gland. Thyroid-stimulating hormone (thyrotropin) selectively acts on the thyroid gland, stimulating its function. If the pituitary gland is removed or destroyed in animals, then thyroid atrophy occurs. The introduction of thyrotropin, on the contrary, causes the proliferation of thyroid tissue, and its hypertrophy occurs.

Under the influence of the hormone, histological changes in the thyroid gland also occur, indicating an increase in its activity: the amount of colloid in the cavities of the follicles decreases, its vacuolization occurs, and then liquefaction. Follicular cells acquire a cylindrical shape.

Thyrotropin activates proteolytic enzymes, under the influence of which thyroglobulin breaks down and the hormones thyroxine and triiodogyronine are released from it. Thyrotropin also has the ability to stimulate the formation of thyroglobulin protein in the cells of the thyroid follicles and its entry into the follicular cavity.

Adrenocorticotropic hormone (corticotropin) is a physiological stimulator of the fascicular and reticular areas of the adrenal cortex, which form glucocorticoid hormones.

Removal of the pituitary gland in animals leads to atrophy of the adrenal cortex. Atrophic processes cover all zones of the cortex, but the most profound changes occur in the cells of the reticular and fascicular zones.

Corticotropin causes breakdown and inhibits protein synthesis in the body. In this regard, the hormone isgrowth hormone antagonist, which enhances protein synthesis. Corticotropin, like glucocorticoids, inhibits the development of the basic substance of connective tissue, reduces capillary permeability. These effects underlie the hormone's anti-inflammatory action. Under the influence of adrenocorticotropic hormone, the size and mass of the lymph nodes, spleen and especially the thymus gland decreases, the number of lymphocytes in the peripheral blood decreases, and eosinopenia occurs.

Three hormones are referred to gonadotropins: follicle-stimulating (follitropin), luteinizing (lutropin) and luteotropic hormone.

Follicle-stimulating hormone stimulates the growth of the vesicular follicle in the ovary, the secretion of follicular fluid, the formation of the membranes surrounding the follicle. The effect of follitropin on the formation of female sex hormones - estrogens - is small. This hormone is found in both women and men. In men, under the influence of follitropin, the formation of germ cells - spermatozoa occurs.

Luteinizing hormone is necessary for the growth of the vesicular ovarian follicle in the stages preceding ovulation, and for ovulation itself. Without this hormone, ovulation does not occur and neither the formation of a corpus luteum at the site of the bursting follicle occors. Lutropin stimulates the formation of estrogen. However, in order for this hormone to exert its effect on the ovary (follicle growth, ovulation, estrogen secretion), a long-term effect of lutropin on the vesicular follicles is necessary.

Under the influence of luteinizing hormone, the formation of a corpus luteum from a burst follicle also occurs. Lutropin is available in both women and men. In men, this hormone promotes the formation of male sex hormones - androgens.

Luteotropic hormone promotes the functioning of the corpus luteum and the formation of the hormone progesterone.

Hormone of the middle lobe of the pituitary gland... A hormone is produced in the middle lobe of the pituitary gland melanotropin, or sideshow, which affects pigment metabolism. If the pituitary gland is destroyed in a frog, then after a while the color of the frog's skin changes - it becomes lighter.

Posterior pituitary hormones... The posterior lobe of the pituitary gland is closely connected with the supraoptic and paraventricular nuclei of the hypothalamic region. The cells of these nuclei are capable of neurosecretion. The formed neurosecret ion is transported along the axons of the neurons of these nuclei (along the so-called hypothalamic-pituitary tract) to the posterior lobe of the pituitary gland. It was found that the hormone oxytocin is formed in the nerve cells of the paraventricular nucleus, and vasopressin is formed in the neurons of the supraoptic nucleus. Hormones accumulate in the cells of the posterior lobe of the pituitary gland - pituicitis. However, pituicites of the neurohypophysis are not passive hormone depots: in these cells, hormones are converted into an active form.

Vasopressin performs two functions in the body. The first is associated with the effect of the hormone on the smooth muscles of the arterioles, the tone of which it increases, which leads to an increase in blood pressure. The second and main function is associated with the antidiuretic action of vasopressin. The antidiuretic effect of vasopressin is expressed in its ability to enhance the reabsorption of water from the kidney tubules into the blood. According to the Soviet physiologist A.G. Genetsinsky, this is due to the fact that vasopressin increases the activity of the enzyme hyaluronidase, which enhances the breakdown of the sealing substance in the kidney tubules - hyaluronic acid. As a result, the tubules of the kidneys lose their waterproofing and water is absorbed into the blood.

A decrease in the formation of vasopressin is the cause of diabetes insipidus (diabetes insipidus). With this disease, a large amount of urine (sometimes tens of liters per day) is excreted, which does not contain sugar (unlike diabetes mellitus). At the same time, such patients have a strong thirst.

Oxytocin selectively acts on the smooth muscles of the uterus, increasing its contraction. The contraction of the uterus increases sharply if it was previously

under the influence of estrogen. During pregnancy, oxytocin does not affect the uterus, since under the action of the corpus luteum hormone progesterone, it becomes insensitive to all irritations.

Oxytocin also stimulates milk production. Under the influence of oxytocin, it is the excretion of milk that is enhanced, and not its secretion, which is under the control of the hormone of the anterior pituitary gland prolactin. The act of sucking reflexively stimulates the release of oxytocin from the neurohypophysis.

Regulation of the formation of pituitary hormones... The regulation of the formation of pituitary hormones is quite complex and is carried out by several mechanisms.

Hypothalamic regulation... It has been proven that hypothalamic neurons have the ability to produce a neurosecret, which contains compounds of a protein nature. These substances, through the vessels connecting the hypothalamus and the adenohypophysis, enter the adenohypophysis, where they exert their specific effect, stimulating or inhibiting the formation of hormones by the anterior and middle lobes of the pituitary gland.

Regulation of the formation of hormones in the anterior lobe of the pituitary gland is carried out by the feedback principle... There is a bilateral relationship between the anterior pituitary gland and the peripheral endocrine glands: crinotropic hormones of the anterior pituitary gland activate the activity of peripheral endocrine glands, which, depending on their functional state, affect the production of tropic hormones of the anterior pituitary gland. So, if the level of thyroxine in the blood decreases, then an increased formation of thyroid-stimulating hormone in the anterior lobe of the pituitary gland occurs. On the contrary, with an excessive concentration of thyroxine in the blood, it inhibits the formation of thyroid-stimulating hormone in the pituitary gland. This relationship is called plus-minus interaction. Tropic hormones of the anterior pituitary gland stimulate (plus) the function of peripheral glands, and hormones of the peripheral glands suppress (minus) the production and release of hormones of the anterior pituitary gland.

Recently, it has been established that there is an inverse relationship between the hypothalamus and the tropic hormones of the anterior pituitary gland. For example, the hypothalamus stimulates the secretion of thyrotropin in the anterior pituitary gland. An increase in the concentration of this hormone in the blood leads to inhibition of the secretory activity of the hypothalamic neurons involved in the release of thyrotropin in the pituitary gland.

The formation of hormones in the anterior lobe of the pituitary gland is strongly influenced by autonomic nervous system: its sympathetic department enhances the production of crinotropic hormones while the parasympathetic inhibits.

Epiphysis (pineal gland)

The epiphysis is a cone-shaped formation that hangs over the upper tubercles of the quadruple. In appearance, the iron resembles a spruce cone, which gave rise to its name.

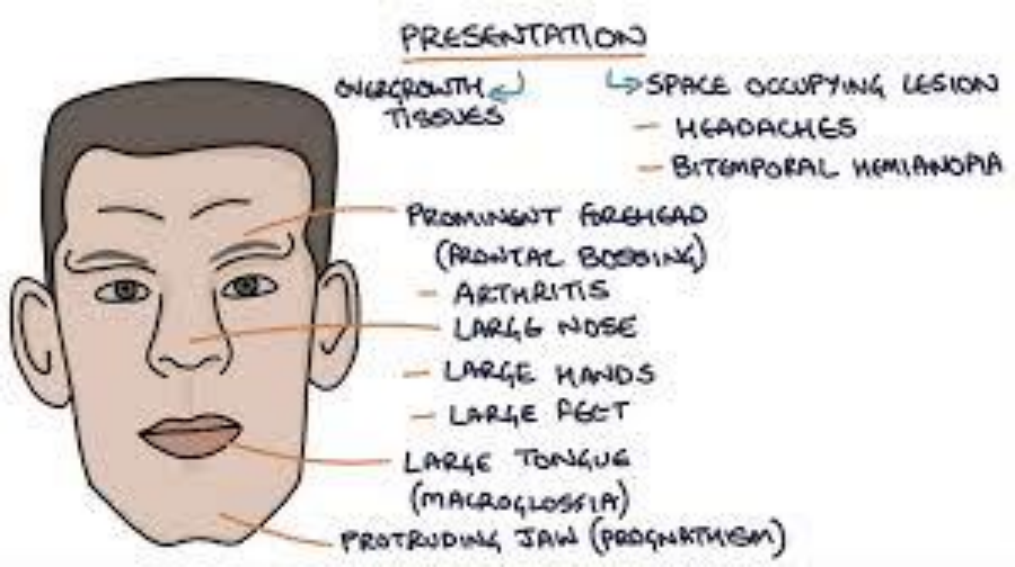
The pineal gland consists of the parenchyma and the connective tissue stroma. The parenchyma contains large light cells called pineal cells.

The blood supply to the pineal gland is carried out by the blood vessels of the pia mater. The innervation of the gland is not well understood, but it is known that this organ receives nerve fibers directly from the central nervous system and the sympathetic division of the autonomic nervous system.

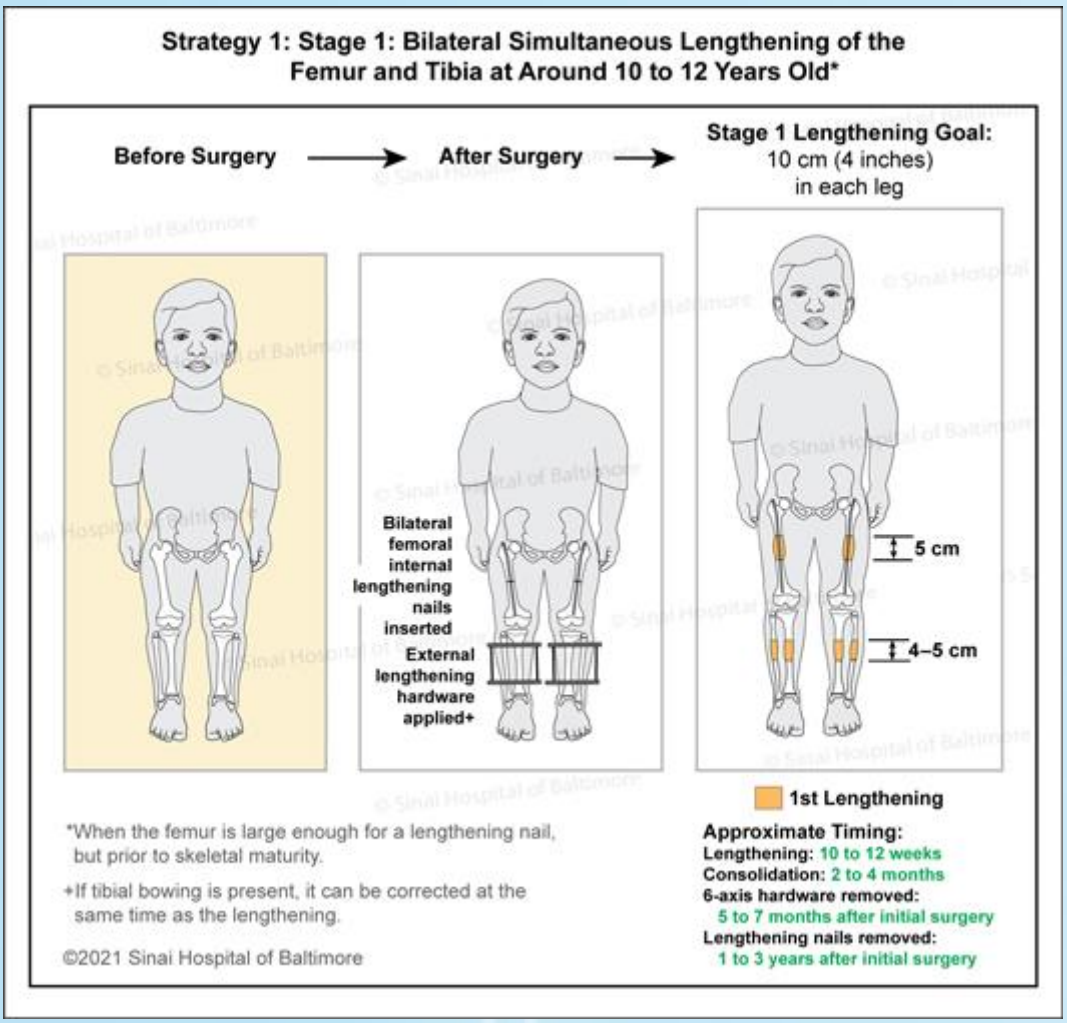
The physiological role of the pineal gland: Two compounds have been isolated from the tissue of the pineal gland - melatonin and glomerulotropin. Melatonin participates in the regulation of pigment metabolism - it discolors melanophores, i.e. has an effect opposite to the action of the hormone of the middle lobe of the pituitary gland intermedin. Glomerulotropin participates in the stimulation of the secretion of the hormone aldosterone by the adrenal cortex. However, this effect of glomerulotropin is not recognized by everyone.

Disorders

Depending on the period of life in which there is a violation of the somatotropic function of the pituitary gland, various changes in the growth and development of the human body are detected. If the activity of the anterior lobe of the pituitary gland (hyperfunction) occurs in the child's body, then this leads to increased growth of the body in length - gigantism.



With a decrease in the function of the anterior lobe of the pituitary gland (hypofunction) in a growing organism, there is a sharp growth retardation – dwarfism.



Excessive production of the hormone in an adult does not affect the growth of the body as a whole, since it has already been completed. There is an increase in the size of those parts of the body that still retain the ability to grow (fingers and toes, hands and feet, nose and lower jaw, tongue, chest andabdominal cavity). This disease is called acromegaly (from the Greek. Akros - limb, megas - large).

 Gigantism and acromegaly caused by an excess of growth hormone in childhood and adult respectively. Acromegaly is a rare condition where the body produces too much growth hormone, causing body tissues and bones to grow more quickly. Over time, this leads to abnormally large hands and feet, and a wide range of other symptoms.

Acromegaly is usually diagnosed in adults aged 30 to 50, but it can affect people of any age. When it develops before the end of puberty, it's known as "gigantism".

Symptoms of acromegaly

Acromegaly can cause a wide range of symptoms, which tend to develop very slowly over time.

Early symptoms include:

- swollen hands and feet – you may notice a change in your ring or shoe size
- tiredness and difficulty sleeping, and sometimes sleep apnoea
- gradual changes in your facial features, such as your brow, lower jaw and nose getting larger, or your teeth becoming more widely spaced
- numbness and weakness in your hands, caused by a compressed nerve (carpal tunnel syndrome)

Children and teenagers will be abnormally tall.

As time goes on, common symptoms include:

- abnormally large hands and feet
- large, prominent facial features (such as the nose and lips) and an enlarged tongue
- skin changes – such as thick, coarse, oily skin, skin tags, or sweating too much
- deepening of the voice as a result of enlarged sinuses and vocal cords
- joint pain
- tiredness and weakness
- headaches
- blurred or reduced vision
- loss of sex drive
- abnormal periods (in women) and erection problems (in men)

Symptoms often become more noticeable as you get older.

See a GP straight away if you think you have acromegaly.

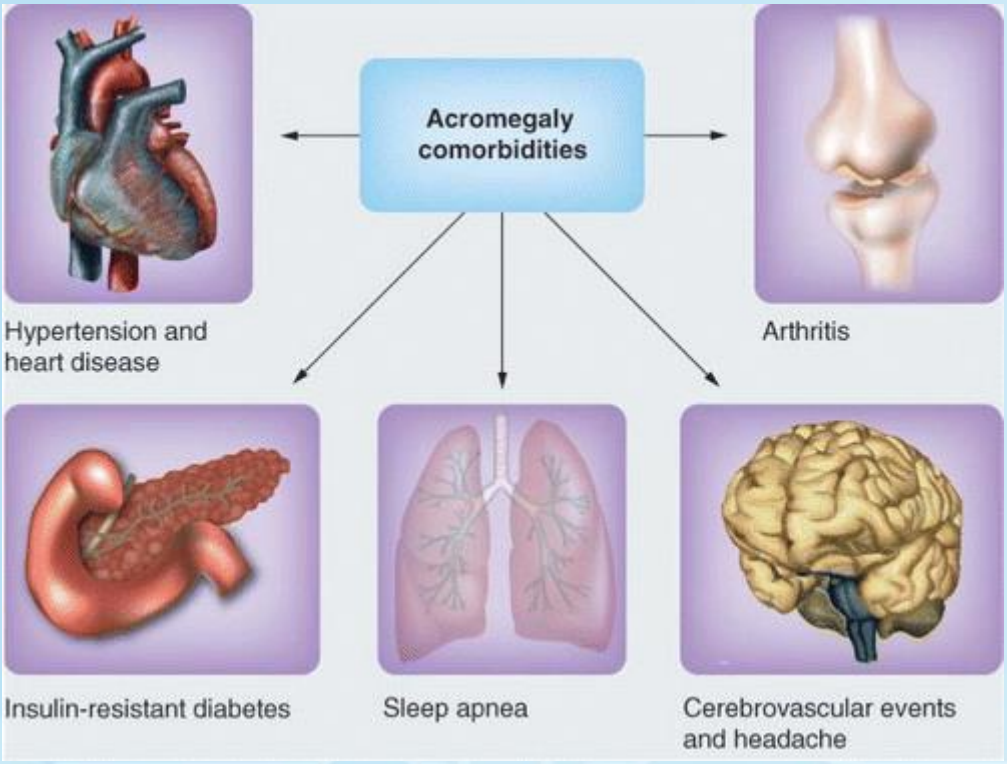
Acromegaly can usually be successfully treated, but early diagnosis and treatment is important to prevent the symptoms getting worse and reduce the chance of complications.

Risks of acromegaly

If you do not get treatment, you may be at risk of developing:

- type 2 diabetes
- high blood pressure (hypertension)
- heart disease
- disease of the heart muscle (cardiomyopathy)
- arthritis
- bowel polyps, which can potentially turn into bowel cancer if left untreated

Because of the risk of bowel polyps, a procedure known as a colonoscopy might be recommended if you've been diagnosed with acromegaly. Regular colonoscopy screening may also be necessary.



 Hypothyroidism caused by a deficiency of thyroid-stimulating hormone.

Hypothyroidism, also called underactive thyroid disease, is a common disorder. With hypothyroidism, your thyroid gland does not make enough thyroid hormone. The thyroid gland is located in the front lower part of your neck. The thyroid gland consists of two lobes located on the neck on both sides of the trachea below the thyroid cartilage.

The thyroid gland is well supplied with blood and occupies one of the first places in the body for blood supply. The gland is innervated by a network of nerve fibers

coming to it from several sources: from the middle cervicalsympathetic node, vagus, glossopharyngeal and hypoglossal nerves.

The thyroid gland has a lobular structure. The tissue of each lobe of the gland consists of many closed glandular vesicles called follicles. The wall of each follicle is formed by one layer of epithelial cells, the shape of which, depending on the functional state of the thyroid gland, varies from cubic to prismatic. The follicle cavity is filled with a homogeneous, viscous, yellowish mass called a colloid. The amount of colloid and its consistency depend on the phase of secretory activity and may differ in different follicles of the same gland. The colloid of the thyroid gland contains the iodine-containing protein thyroglobulin.

Thyroid hormones... The thyroid gland produces iodinated hormones - thyroxine (tetraiodothyronine) and triiodothyronine... The content of thyroxine in the blood is higher than that of triiodothyronine. However, the activity of triiodothyronine is 4-10 times higher than that of thyroxine. It is now known that there is a special hormone in the human and animal organism - thyrocalcitonin, which is involved in the regulation of calcium metabolism. The main source of this hormone in mammals is the thyroid gland. Thyrocalcitonin is formed by parafollicular cells of the thyroid gland, which are located outside the glandular follicles. Under the influence of thyrocalcitonin, the level of calcium in the blood decreases. The hormone inhibits the excretion of calcium from bone tissue and increases its deposition in it. Thyrocalcitonin inhibits the function of osteoclasts, which destroy bone tissue, and activates the function of osteoblasts involved in the formation of new bone tissue.

Transport of thyroid hormones... The main thyroid hormone circulating in the blood is thyroxine. In addition to thyroxine, small amounts of triiodothyronine are present in the blood. Both hormones are not found in the blood in free form, but in conjunction with proteins of the globulin fraction.

When thyroxine enters the bloodstream, it is captured, in particular, by the liver cells, where it forms paired compounds with glucuronic acid, which do not have hormonal activity and are excreted by bile into the gastrointestinal tract.

The formation of paired compounds of thyroxine with glucuronic acid is considered as a way of inactivating the hormone, due to which it prevents excessive saturation of the blood with it.

Experiments with radioactive 131I showed that in the body of an adult, about 300 μg of thyroxine and triiodothyronine on average are completely destroyed daily.

Regulation of the formation of thyroid hormones... The hormone of the anterior pituitary gland, thyrotropin, affects all stages of the formation of iodinated hormones in the thyroid gland. When the pituitary gland is removed from animals, the intensity of the formation of hormones in the thyroid gland sharply decreases.

Between the thyroid-stimulating hormone of the pituitary gland and the hormones of the thyroid gland, there is a relationship of the type of direct and feedback: thyrotropin stimulates the formation of hormones in the thyroid gland, and an excess of thyroid hormones in the blood inhibits the production of thyroid-stimulating hormone in the anterior lobe of the pituitary gland.

The relationship between the iodine content and the hormone-forming activity of the thyroid gland has been established. Small doses of iodine stimulate, and large doses inhibit the processes of hormonopoiesis.

An important role in the regulation of the formation of hormones in the thyroid gland is played by the autonomic nervous system. Excitation of its sympathetic division leads to an increase, and the predominance of parasympathetic tone causes a decrease in the hormone-forming function of this gland.

The hypothalamic region also has a pronounced effect on the formation of hormones in the thyroid gland. In the neurons of the hypothalamus, substances are formed which,when enter the anterior lobe of the pituitary gland, stimulate the synthesis of thyrotropin. With a lack of thyroid hormones in the blood, an increased formation of these substances in the hypothalamus occurs, and with an excess content, their synthesis is inhibited, which in turn reduces the production of thyrotropin in the anterior pituitary gland.

The function of the thyroid gland is also influenced by the reticular formation of the brainstem. It was shown that when neurons of the reticular formation are excited, the functional activity of the thyroid gland increases.

The cerebral cortex is also involved in regulating the activity of the thyroid gland. Thus, it was found that in the first period after removal of the cerebral cortex in animals, an increase in the activity of the thyroid gland is noted, but later the function of the gland is significantly reduced.

The physiological role of thyroid hormones... Iodine-containing hormones have a pronounced effect on the functions of the central nervous system, higher nervous activity, on the growth and development of the body, on all types of metabolism.

1) Influence on the functions of the central nervous system: Prolonged administration of large doses of thyroxine to dogs will lead to increased excitability, increased tendon reflexes and tremors of the limbs. Removal of the thyroid gland in animals sharply reduces their motor activity and weakens defensive reactions. The introduction of thyroxine increases the motor activity of dogs and restores the unconditioned reflexes which had weakened or disappeared after thyroidectomy.

2) Influence on higher nervous activity... Conditioned reflexes and differentiation inhibition are developed with great difficulty in dogs after removal of the thyroid gland. The formed conditioned reflex is lost the next day, and it has to be developed again. The introduction of thyroxine enhances the process of excitation in the cerebral cortex,which leads to the normalization of conditioned reflex activity of animals.

3) Influence on the processes of growth and development - In amphibians, thyroxine stimulates metamorphosis. If the rudiment of the thyroid gland is removed from tadpoles, then they lose the ability to turn into frogs.

Removal of the thyroid gland at a young age causes a growth retardation in the body of mammals. Skeleton development is impaired. Ossification centers appear late. Animals become dwarfs. The development of almost all organs and sex glands slows down.

4) Impact on metabolism - Thyroxine affects the metabolism of proteins, fats, carbohydrates and mineral metabolism. The hormone increases the consumption of all types of nutrients and increases the consumption of glucose by tissues. Under the influence of thyroxine in the body, the store of fat in the depot and glycogen in the liver noticeably decreases.

The multifaceted effect of iodinated hormones on metabolism is associated with their effect on the intracellular processes of oxidation and protein synthesis. Strengthening energy and oxidative processes under the influence of thyroid hormones is the cause of emaciation, which usually occurs with hyperthyroidism.

With the introduction of thyroid hormones to animals, a significant increase in the basal metabolism occurs. So, if you introduce a dog 1 mg of thyroxine, thendaily energy consumption increases by about 1000 kcal.

5) Influence on the autonomic functions of the body - Thyroxine increases the heart rate, respiratory rate, and sweating. The hormone reduces the blood's ability to clot and increases its fibrinolytic ability. This is due to the fact that the hormone reduces the formation in the liver, kidneys, lungs and heart of factors involved in the process of blood clotting, and increases the synthesis of anticoagulants, as well as substances that stimulate the fibrinolytic properties of blood.

Dysfunction of the thyroid gland can be accompanied by either an increase or a decrease in its hormone-forming activity.

If insufficient thyroid function (hypothyroidism) manifests itself in a person in childhood, then there is cretinism With this disease, there is a violation of body proportions, growth retardation, mental and sexual development. The cretin's appearance is characterized by a constantly open mouth and protruding tongue.

With insufficient functional activity of the thyroid gland, another pathological condition may occur, which is called myxedema (mucous edema). The disease occurs mainly in childhood and old age, as well as in women in the climacteric period.

In patients with myxedema, mental retardation, lethargy, drowsiness, decreased intelligence and excitability of the sympathetic division of the autonomic nervous system, and sexual dysfunction are noted. There is an inhibition of the intensity of all types of metabolism. Basal metabolism is reduced by 30-40%. Body weight is increased due to an increase in the amount of tissue fluid. Patients have a puffy face.

With an increase in the functional activity of the thyroid gland (hyperthyroidism), a disease occurs - thyrotoxicosis (Graves' disease). The characteristic signs of this disease are an enlargement of the thyroid gland, bulging, increased heart rate, increased metabolism, especially the main one, and body temperature, increased food intake and at the same time emaciation. Significant shifts are noted in the activity of the nervous and muscular systems. Increased excitability and irritability are observed, the ratio of the tone of the divisions of the autonomic nervous system changes, and excitation of the sympathetic nervous system prevails. Tendon reflexes are enhanced, sometimes muscle tremors are noted. In patients, muscle weakness and fatigue are found.

Parathyroid glands

The parathyroid glands are a paired organ. A person has two pairs of parathyroid glands, located on the surface or immersed in the thyroid gland.

The parathyroid glands are well supplied with blood. They have both sympathetic (from the cervical ganglia) and parasympathetic (vagus nerve) innervation.

Parathyroid hormone - The parathyroid glands produce parathyroid hormone, the formation of which occurs in the main and oxyphilic cells of these glands. From the parathyroid glands, the hormone enters the bloodstream directly.

Parathyroid hormone regulates calcium metabolism in the body and maintains a constant level of calcium in the blood. Normally, the calcium content in human blood is 2.25-2.75 mmol / l (9-11 mg%). When the parathyroid glands are deficient (hypoparathyroidism), there is a significant decrease in the level of calcium in the blood. On the contrary, with an increase in the activity of the parathyroid glands

(hyperparathyroidism), an increase in the concentration of calcium in the blood is observed.

It is known that the bone tissue of the skeleton is the main store of calcium in the body, therefore there is a certain relationship between the level of calcium in the blood and its content in the bone tissue. Parathyroid hormone regulates the processes of calcification and decalcification in bones. Influencing calcium metabolism, the hormone simultaneously affects the exchange of phosphorus in the body.

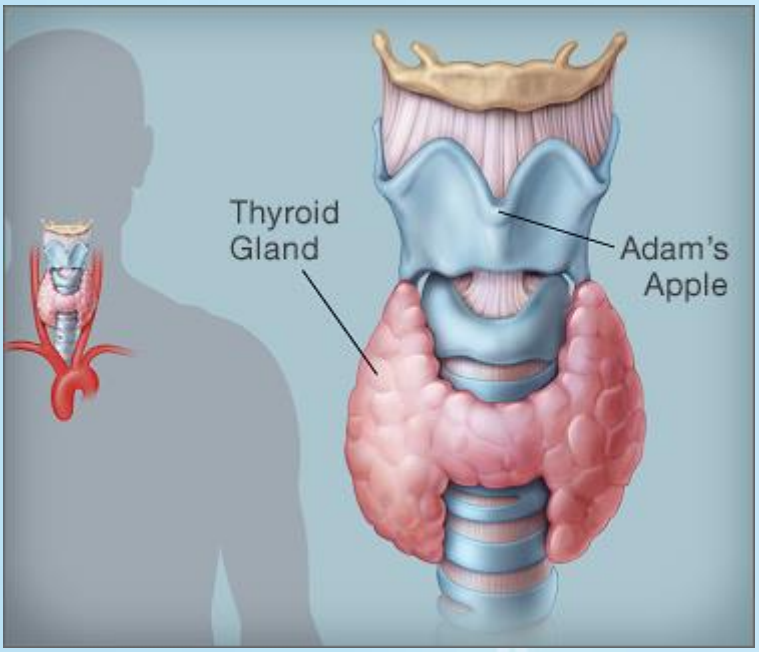
It is believed that parathyroid hormone weakens reabsorption and enhances the excretion of phosphates in the urine. With increased production of the hormone, a loss of phosphates is observed due to their mobilization from bone tissue. The calcium released from the compounds begins to accumulate in the blood in increased quantities. Thus, hypercalcemia is one of the indicators of increased function of the parathyroid glands.

After removal of the parathyroid glands in the blood, the level of calcium decreases and the content of phosphates increases. Therefore, there are inverse relationships between the concentration of calcium and phosphate in the blood.

Removal of the parathyroid glands in animals or their insufficient function in humans leads to the development of lethargy, loss of appetite, vomiting, fibrillar muscle twitching, spastic convulsions, turning into tetany. Fibrillar twitching of single muscles transforms into intense spastic contractions of muscle groups, mainly of the limbs, face and neck. Laryngeal spasm, respiratory muscle paralysis and cardiac arrest are fatal.

Regulation of the activity of the parathyroid glands.The activity of these glands is determined by the level of calcium in the blood. There is an inverse relationship between the hormone-forming function of the parathyroid glands and the level of calcium. If the concentration of calcium in the blood increases, then this leads to a decrease in the functional activity of the parathyroid glands. With a decrease in the level of calcium in the blood, the hormone-forming function of the parathyroid glands increases.

Hormones released by the gland travel through your bloodstream and affect nearly every part of your body, from your heart and brain, to your muscles and skin.



The thyroid controls how your body's cells use energy from food, a process called metabolism. Among other things, your metabolism affects your body's temperature, your heartbeat, and how well you burn calories. If you don't have enough thyroid hormone, your body processes slow down. That means your body makes less energy, and your metabolism becomes sluggish.

Symptoms of Hypothyroidism

Symptoms of hypothyroidism may be vague and can often mimic other conditions. They may include:

Changes in the menstrual cycle

Constipation

Depression

Dry hair and hair loss

Dry skin

Elevated cholesterol

Fatigue

Greater sensitivity to cold

Hoarse voice

Joint pain, stiffness, and swelling

Problems with memory

Muscle aches and stiffness

Muscle weakness

Puffy face

Slow heart rate

Swelling of the thyroid gland (goiter)

Unexplained weight gain or difficulty losing weight

Carpal tunnel syndrome

Babies with hypothyroidism may have no symptoms. If symptoms do occur, they can include:

Cold hands and feet

Constipation

Extreme sleepiness

Hoarse cry

Little or no growth

Low muscle tone (floppy infant)

Persistent jaundice (yellowing of the skin and whites of the eyes)

Poor feeding habits

Puffy face

Stomach bloating

Swollen tongue

Umbilical hernia

Make an appointment with your health care provider if you or your baby has any of these symptoms. It's important to note that these symptoms can be due to other medical conditions.

Children and teens may also have hypothyroidism with the signs and symptoms seen in adults. Kids and teens may also have:

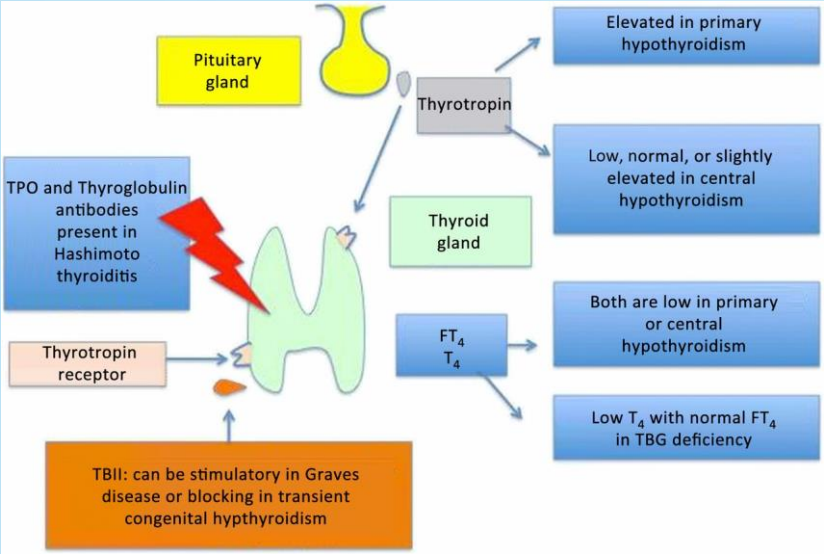
Delays in puberty

Delays in growth and shorter stature

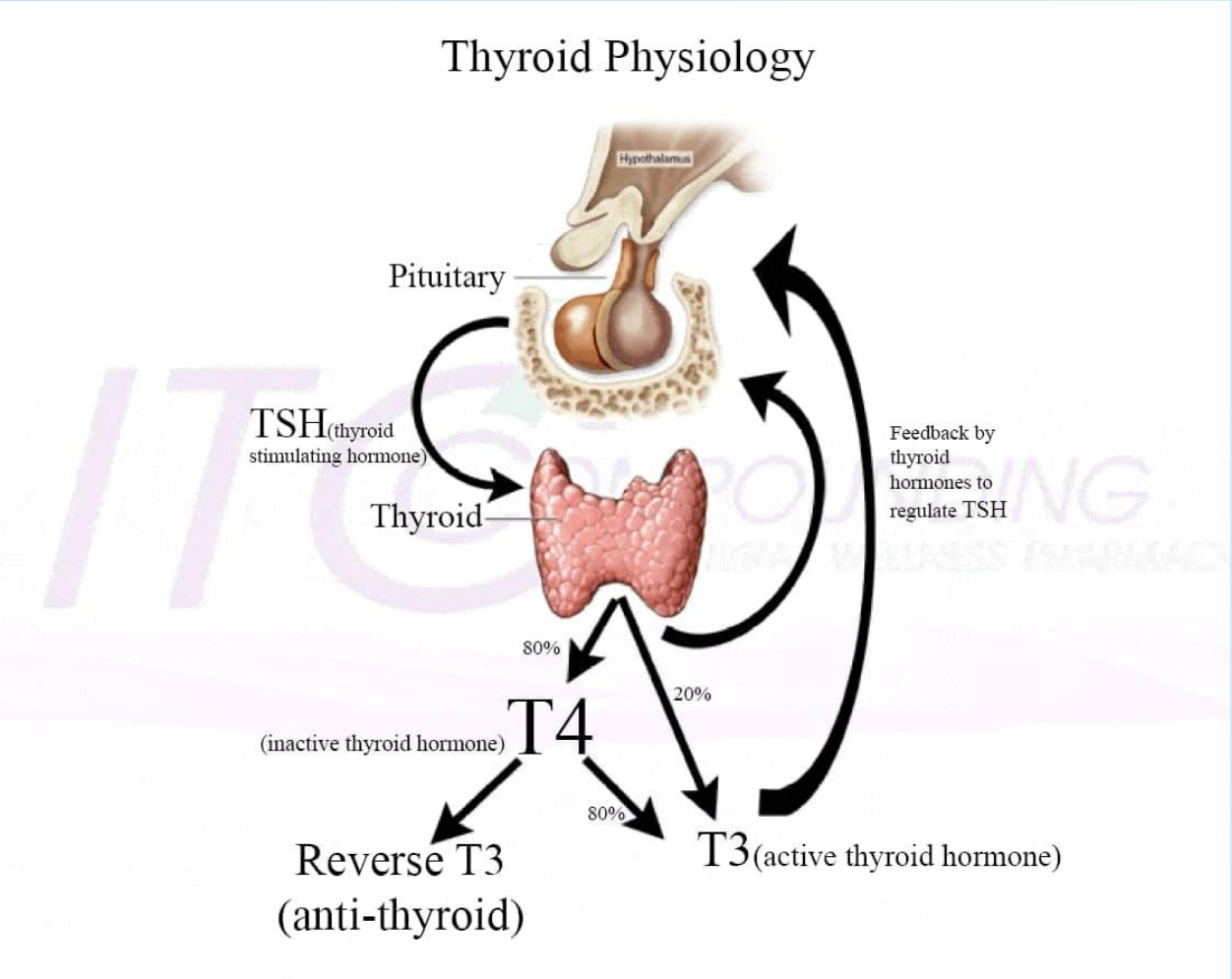
Slow mental development

Slower development of permanent teeth

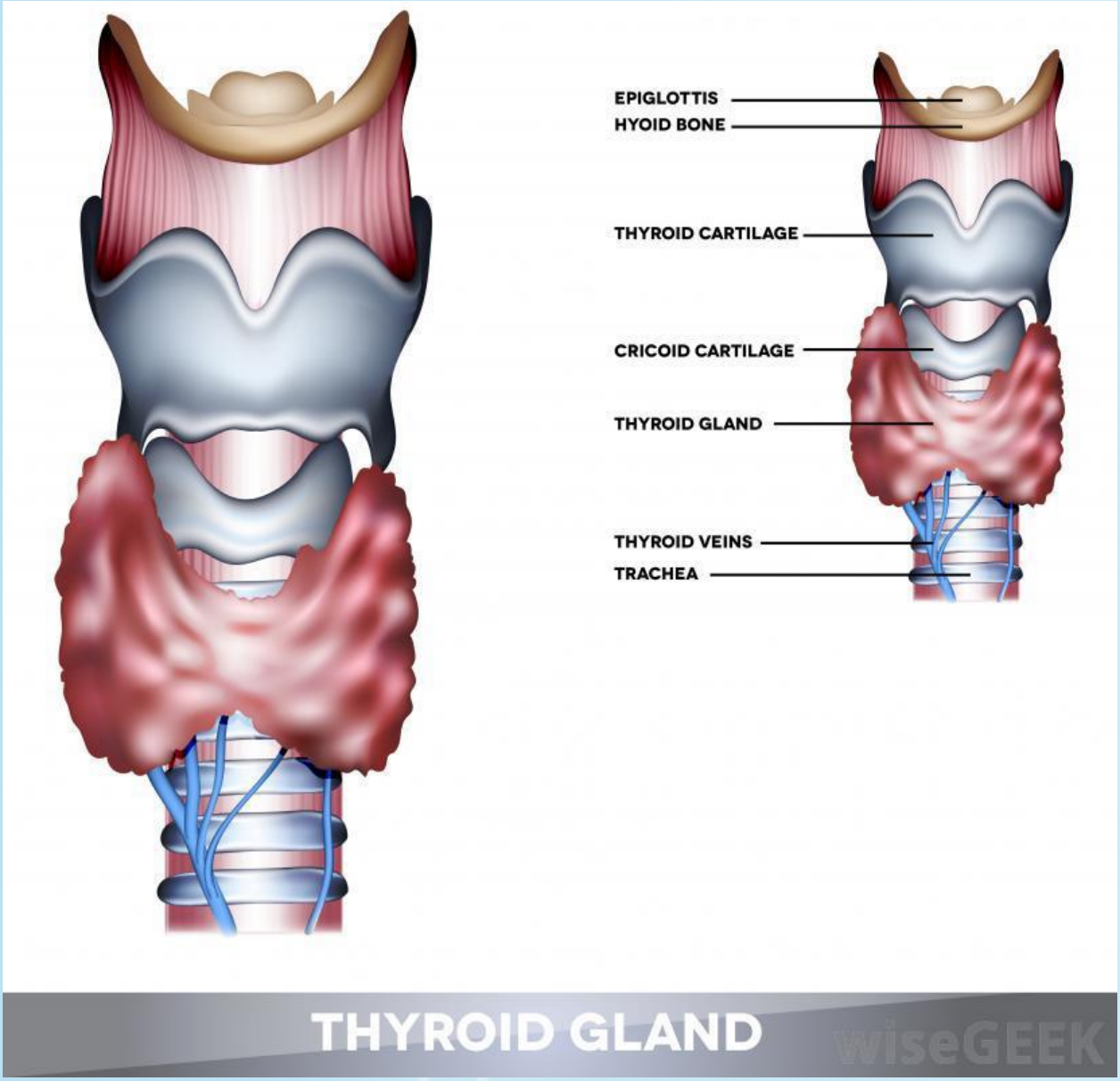
Causes of Hypothyroidism



Thyroid Gland



- Just below the Adam's apple, is located what is known as the thyroid gland.
- The thyroid gland releases two main hormones, thyroxine and triiodothyronine.
- It produces hormones that affect the heart rate and how calories are burnt.



Functions

- Controls how quickly the body uses energy
- Hormones control growth rate and function of many system in the body
- These hormones play vital roles in regulating metabolism and organ function

Hormones produced

- **Thyroid hormone** – The body's metabolic rate is controlled by this hormone.
- **Calcitonin** – It regulates calcium balance in species other than humans. Studies are still in progress to find its function in the human species.

Disorders

 Hyperthyroidism is characterized by excessive secretion of thyroid hormones

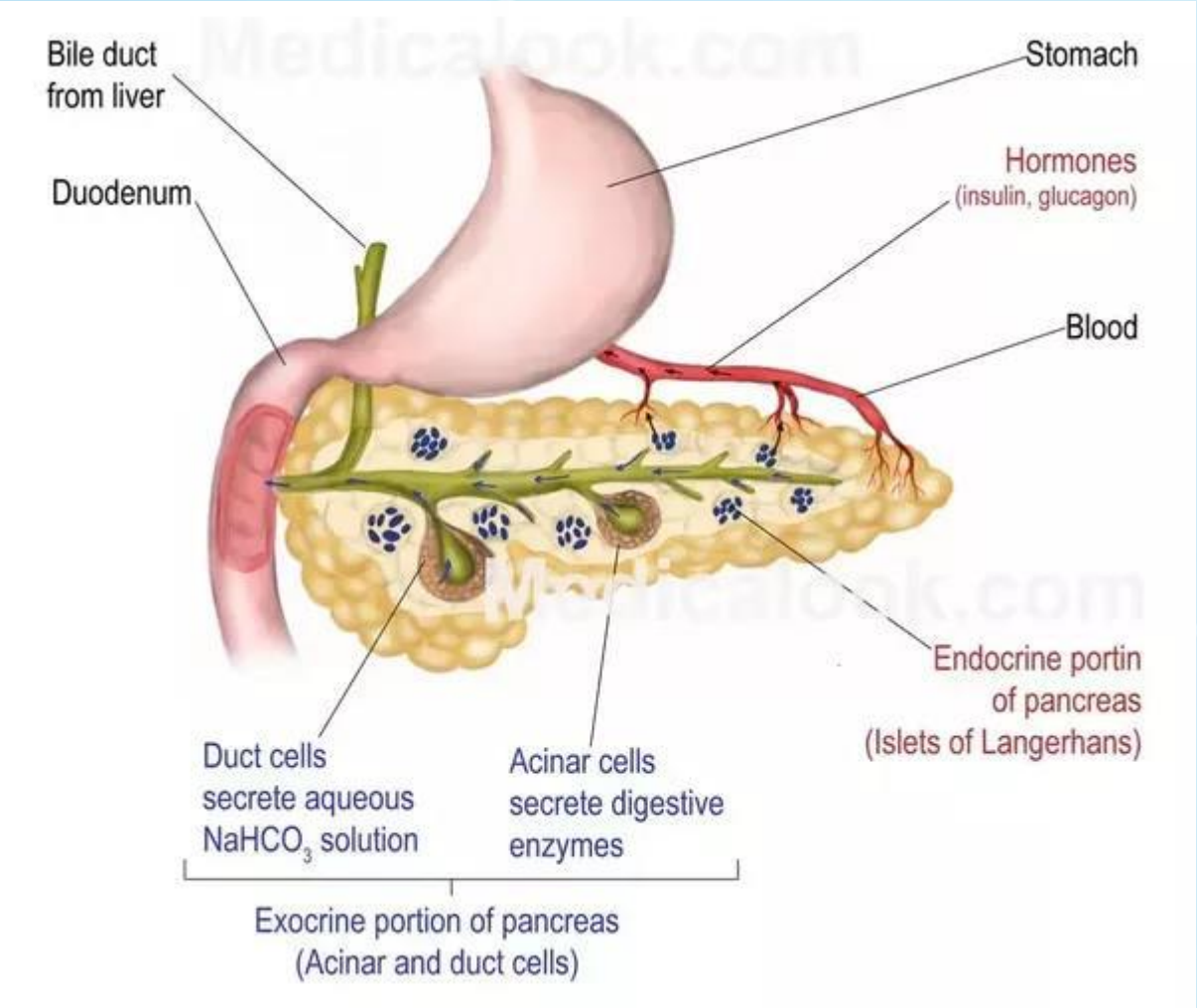
 Hypothyroidism is characterized by a deficient secretion of thyroid hormones

Pancreas

 Pancreas, as most of us must be knowing, are the endocrine glands that are situated in the abdominal region, behind the stomach.

 Insulin and glucagons are known to be the important hormones produced by the glands.

Functions



Functions

 The hormones which get secreted into the blood stream by these glands, serve to control proper digestion and blood sugar regulation

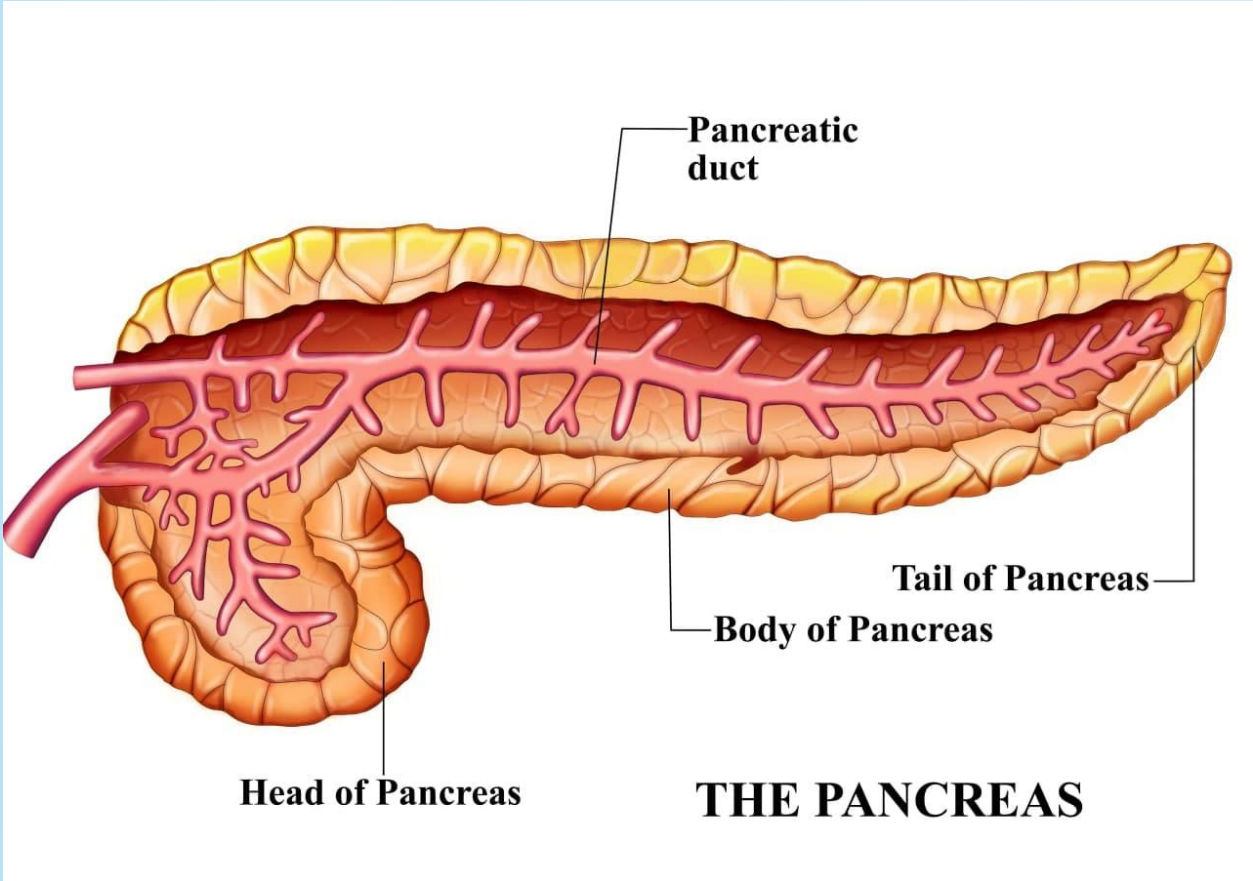
 Maintaining appropriate levels of sugar throughout the body.

 This gland produces insulin crucial to maintain blood sugar levels.

Hormones produced

 Glucagon – The blood sugar level raises with its help.

 Insulin – It helps in lowering the blood sugar level. Apart from this, metabolism of sugar, protein, and fat are also carried out with its help.



Disorders

 Acute pancreatitis is a sudden attack causing inflammation of the pancreas and is usually associated with severe upper abdominal pain

 Chronic pancreatitis is the progressive disorder associated with the destruction of the pancreas.

 Hereditary pancreatitis

 Pancreatic cancer

Adrenal Glands

The adrenal glands are paired glands. They are located directly above the upper poles of the kidneys. The glands are surrounded by a dense connective tissue capsule and immersed in adipose tissue. The bundles of the connective tissue capsule penetrate into the gland, pass into the septa that divide the adrenal glands into two layers - cortical and cerebral... The cortical layer is of mesodermal origin, the cerebral layer develops from the rudiment of the sympathetic ganglion.

The adrenal cortex consists of three zones - glomerular, fascicular and reticular.

The cells of the glomerular zone lie directly under the capsule, collected in glomeruli. In the bundle zone, the cells are arranged in the form of longitudinal columns or bundles. The reticular zone received its name due to the reticular nature of the arrangement of its cells. All three zones of the adrenal cortex are not onlymorphologically separate structural formations, but also perform different physiological functions.

The adrenal medulla is made up of chromaffin tissue, which contains two types of chromaffin cells - those that produce adrenaline and norepinephrine. It is currently believed that the adrenal medulla is a modified sympathetic ganglion.

The adrenal glands are abundantly supplied with blood and are innervated by sympathetic and parasympathetic nerves. Sympathetic innervation is carried out by the celiac nerves, as well as nerve fibers coming from the solar plexus. The parasympathetic innervation of the adrenal glands is represented by the branches of the vagus nerve. There is evidence that phrenic nerves are involved in the innervation of the adrenal glands.

The adrenal glands are an endocrine organ that is vital. Removal of the adrenal glands leads to death. It has been shown that the adrenal cortex is vital.

Adrenal cortex hormones divided into three groups: 1) glucocorticoids - hydrocortisone, cortisone and corticosterone, 2) mineralocorticoids - aldosterone, deoxycorticosterone; 3) sex hormones - androgens, estrogens, progesterone.

The formation of hormones occurs mainly in one area of the adrenal cortex. So, mineralocorticoids are formed in the cells of the glomerular zone, glucocorticoids - bundle, sex hormones - reticular.

By chemical structure, adrenal hormones are steroids. Their formation comes from cholesterol. For the synthesis of hormones of the adrenal cortex, ascorbic acid is also required.

Physiological significance of glucocorticoids... These hormones affect the metabolism of carbohydrates, proteins and fats. They enhance the formation of glucose from proteins, increase the deposition of glycogen in the liver. Glucocorticoids are insulin antagonists in the regulation of carbohydrate metabolism: they delay the utilization of glucose in tissues, and in case of an overdose, they can lead to an increase in the concentration of sugar in the blood and its appearance in the urine.

Glucocorticoids have a catabolic effect on protein metabolism, causing the breakdown of tissue protein and delaying the incorporation of amino acids into proteins. Since the reproduction and growth of body cells cannot occur without protein synthesis, glucocorticoids delay the formation of granulations and the subsequent formation of a scar, which negatively affects wound healing.

Glucocorticoids are anti-inflammatory hormones, as they have the ability to inhibit the development of inflammatory processes, in particular by reducing the permeability of vascular membranes and reducing the activity of the enzyme hyaluronidase.

Glucocorticoids suppress the synthesis of antibodies and inhibit the reaction of interaction of a foreign protein (antigen) with an antibody.

Glucocorticoids have a pronounced effect on the hematopoietic organs. The introduction of glucocorticoids into the body leads to the reverse development of the thymus gland and lymphoid tissue, which is accompanied by a decrease in the number of lymphocytes in the peripheral blood, as well as a decrease in the content of eosinophils.

The excretion of glucocorticoids from the body is carried out in two ways: 75-90% of the hormones that enter the blood are removed with urine, 10-25% - with feces and bile.

Physiological significance of mineralocorticoids... These hormones are involved in the regulation of mineral metabolism. In particular, aldosterone enhances the reabsorption of sodium ions in the renal tubules and reduces the reabsorption of potassium ions. As a result, the excretion of sodium in the urine decreases and the excretion of potassium increases, which leads to an increase in the concentration of ionssodium in blood and interstitial fluid and an increase in osmotic pressure in them. An increase in osmotic pressure in the internal environment of the body is accompanied by water retention and increases blood pressure.

Mineralocorticoids contribute to the development of inflammatory reactions. The pro-inflammatory effect of these hormones is associated with their ability to increase the permeability of capillaries and serous membranes.

Mineralocorticoids are involved in the regulation of the tone of the blood vessels. Aldosterone has the ability to increase vascular smooth muscle tone, thereby increasing blood pressure. With a lack of mineralocorticoids, due to a decrease in the function of the adrenal cortex, hypotension is observed.

The daily secretion of mineralocorticoids is approximately 0.14 mg. Hormones are excreted from the body in the urine (daily 12-14 mcg).

Physiological significance of sex hormones of the adrenal cortex... These hormones are of great importance in the development of the genital organs in childhood, that is, when the intrasecretory function of the sex glands is still poorly developed. Sex hormones of the adrenal cortex cause the development of secondary sexual characteristics. They also have an anabolic effect on protein metabolism: protein synthesis in the body is enhanced due to the increased inclusion of amino acids in its molecule.

With insufficient function of the adrenal cortex, a disease develops, called "bronze disease", or Addison's disease. Early signs of the disease are bronze discoloration of the skin, especially on the hands, neck, face, increased fatigue during physical and mental work, loss of appetite, nausea, vomiting. The patient becomes very sensitive to cold and painful irritations, more susceptible to infections.

With increased function of the adrenal cortex, which is most often associated with the presence of a tumor in it, not only the formation of hormones increases, but also the predominance of the synthesis of sex hormones over the production of glucocorticoids and mineralocorticoids is noted. As a result, in such patients, secondary sexual characteristics begin to change sharply. For example, women may have secondary sexual characteristics of men: a beard, a rough male voice, and cessation of menstruation.

Regulation of glucocorticoid formation... An important role in the regulation of glucocorticoid formation in the adrenal cortex is played by adrenocorticotropic hormone (ACTH) of the anterior pituitary gland. The effect of ACTH on the formation of glucocorticoids in the adrenal cortex is carried out according to the principle of direct and feedback: corticotropin stimulates the production of glucocorticoids, and the excess content of these hormones in the blood leads to inhibition of ACTH synthesis in the anterior pituitary gland.

In addition to the pituitary gland, the hypothalamus is involved in the regulation of glucocorticoid formation. It has been shown that in the nuclei of the anterior part of the hypothalamus a neurosecret is produced, which contains a protein factor that stimulates the formation and release of corticotropin. This factor, through the general circulatory system of the hypothalamus and pituitary gland, enters its anterior lobe and contributes to the formation of ACTH. Thus, in functional terms, the hypothalamus, the anterior lobe of the pituitary gland and the adrenal cortex are in close connection, therefore they speak of a single hypothalamic-pituitary-adrenal system.

It has been established that under the influence of adrenaline - a hormone of the medulla - there is an increased formation of glucocorticoids in the adrenal cortex.

Regulation of mineralocorticoid formation... The formation of mineralocorticoids is influenced by the concentration of sodium and potassium ions in the body. The increased amount of sodium ions in the blood and tissue fluid leads to inhibition of the secretion of aldosterone in the adrenal cortex, which leads to an increasedexcretion of sodium in the urine. The blockade of the formation of

mineralocorticoids also occurs with an insufficient content of potassium ions in the blood. With a lack of sodium ions in the internal environment of the body, the production of aldosterone increases and, as a consequence, the reabsorption of these ions in the renal tubules increases. An excessive concentration of potassium ions in the blood also stimulates the formation of aldosterone in the adrenal cortex. Thus, sodium and potassium ions have an opposite effect on the mineralocorticoid function of the adrenal cortex.

The formation of mineralocorticoids is also influenced by the amount of tissue fluid and blood plasma. An increase in their volume leads to inhibition of the secretion of aldosterone, which is accompanied by an increased release of sodium ions and associated water.

Adrenal medulla hormones... The adrenal medulla produces catecholamines. The main hormone of the medulla is adrenaline. The second hormone is the precursor of adrenaline in the process of its biosynthesis - norepinephrine. In venous blood flowing from the adrenal gland, adrenaline makes up 80-90% of the total amount of catecholamines.

The production of adrenaline and norepinephrine is carried out by chromaffin cells. Chromaffin cells are found not only in the adrenal medulla, but also in other organs: the aorta, at the site of the carotid artery separation, among the cells of the sympathetic ganglia of the small pelvis, and also in individual ganglia of the sympathetic chain. All these cells form the so-called adrenal system, in which adrenaline and the physiologically active substances close adrenalin it are produced.

Physiological significance of adrenaline and norepinephrine... Adrenaline acts as a hormone; it flows from the adrenal glands into the blood constantly. In some emergency conditions of the body (an acute decrease in blood pressure, blood loss, cooling of the body, hypoglycemia, increased muscle activity, emotions - pain, fear, rage) increases the formation and release of the hormone into the vascular bed.

Excitation of the sympathetic nervous system is accompanied by an increased flow of adrenaline and norepinephrine into the bloodstream. These catecholamines enhance and lengthen the effects of the sympathetic nervous system. On organ functions and the activity of physiological systems, adrenaline has the same effect as the sympathetic nervous system. Adrenaline has a pronounced effect on carbohydrate metabolism, increasing glycogenolysis in the liver and muscles, resulting in an increase in blood glucose. With the introduction of adrenaline and an increase in its production, hyperglycemia and glucosuria occur. Adrenaline relaxes the bronchial muscles, thereby expanding the lumen of the bronchi and bronchioles. It increases the excitability and contractility of the heart muscle, and also increases the heart rate. The hormone increases vascular tone, which increases blood pressure. However, on the coronary vessels of the heart, lungs, brain and working muscles, adrenaline

Adrenaline increases skeletal muscle performance. This is the manifestation of its adaptive and trophic influence on the functions of the body. Adrenaline inhibits the motor function of the gastrointestinal tract and increases the tone of its sphincters.

Adrenaline is referred to as a short-acting hormone. This is due to the fact that in the blood and tissues, the hormone is rapidly destroyed under the influence of the enzyme monoamine oxidase to products that do not have hormonal activity.

Norepinephrine, unlike adrenaline, performs the function of a mediator - a transmitter of excitation from nerve endings to the effector. Norepinephrine is also involved in the transmission of excitation in the neurons of the central nervous system.

Regulation of the formation of hormones of the medulla... The production of hormones in the adrenal medulla by chromaffin cells is regulated by the nervous system. MN Cheboksarov (1910) was the first to show that stimulation of the celiac nerves, which are sympathetic in their function, are intensified, and when they are cut, the release of adrenaline from the adrenal glands decreases. At the

same time, when the celiac nerve is irritated, norepinephrine enters the blood from the adrenal glands.

The secretory function of the adrenal medulla is controlled by the hypothalamic region of the brain, since the higher autonomic centers of the sympathetic nervous system are located in the posterior group of its nuclei. When the neurons of the hypothalamus are stimulated, adrenaline is released from the adrenal glands and its content in the blood increases.

The cerebral cortex affects the flow of adrenaline into the vascular bed, which is proved by the method of conditioned reflexes.

The release of adrenaline from the adrenal medulla can occur reflexively, for example, during muscular work, emotional arousal, cooling of the body and with other effects on the body. The release of adrenaline from the adrenal glands is regulated by blood sugar levels. In a hypoglycemic state of the body, a reflex release of adrenaline occurs from the chromaffin cells of the adrenal system.

The participation of the adrenal glands in the general adaptation syndrome of the body... Adrenal cortex hormones increase the body's resistance to the effects of various factors (cooling, starvation, trauma, hypoxia, chemical or bacterial intoxication, etc.). In this case, the same type: nonspecific changes in the body occur, manifested primarily by the rapid release of corticosteroids, especially glucocorticoids, under the influence of corticotropin.

Changes in the body in response to extreme (stress) stimuli received the name of the general adaptation syndrome. This term belongs to the Canadian pathologist and endocrinologist Selye, who for many years studied the essence of the general adaptation syndrome and the mechanisms underlying it.

Later it was shown that the adrenal medulla is also involved in the development of the general adaptation syndrome.

It has been established that the sympathetic-adrenal system begins a reaction that develops in the body under conditions of extreme stress, the hormones of the adrenal cortex maintain and continue this reaction, as a result of which the level of efficiency of the effector cells increases.

Selye describes the phases of the general adaptation syndrome, the essence and significance of which is highlighted in the study of pathological physiology.

 On the upper side of the kidneys, are located these endocrine glands.

 In hormone production, there are two parts of these adrenal glands which comes into play.

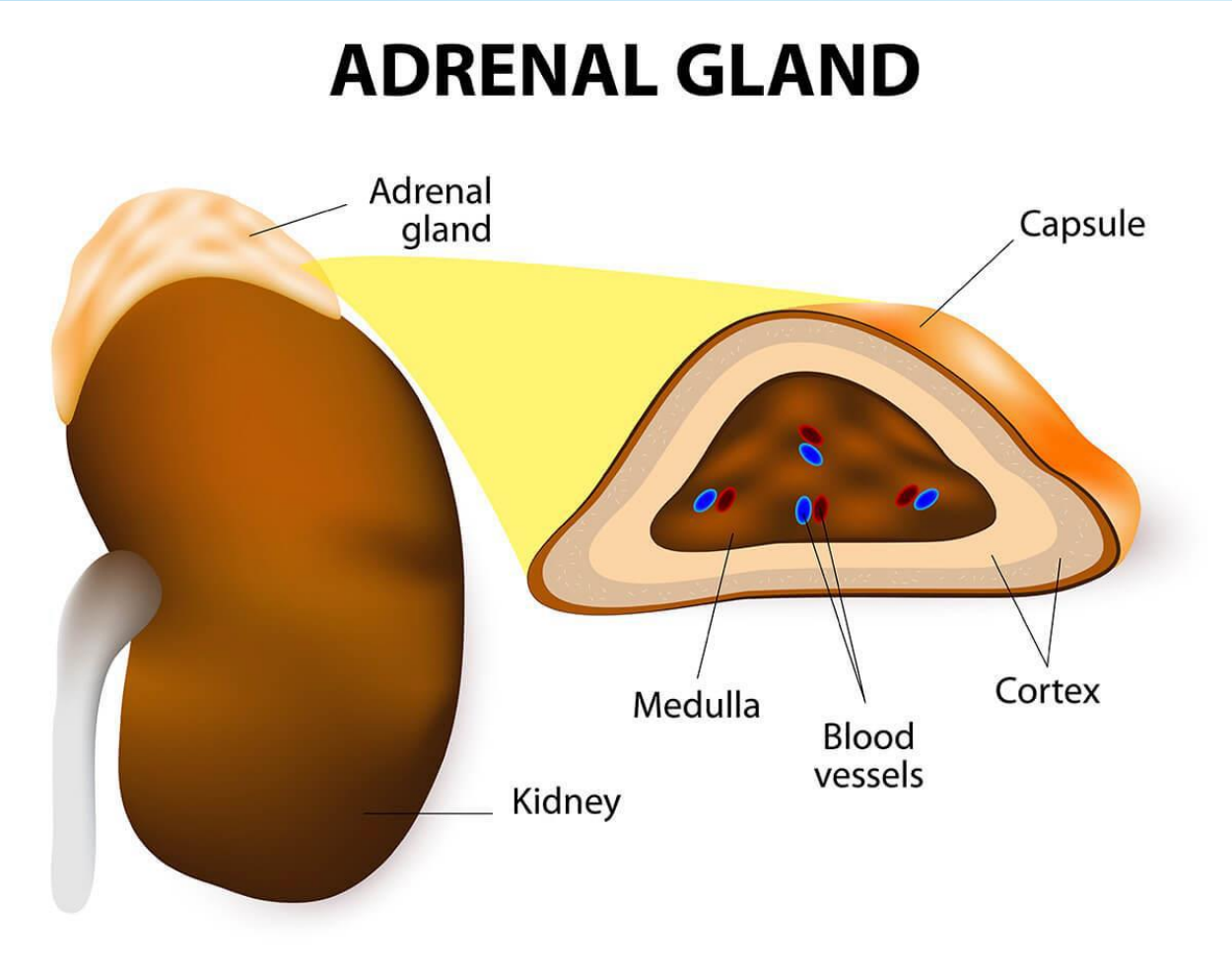
 One is known as the adrenal cortex. It is known to steroid hormones, which are essential for digestion and sexual maturity.

The other is what is known as the adrenal medulla. Now the hormones that this part secretes, are although not essential to sustain life, but help the body to manage stress and improve the quality oflife.

Functions

 Essential for digestion and sexual maturity

 This gland produces the hormones that control the sex drive, cortisol and stress hormone.



Hormones produced

 Aldosterone – Responsible for maintaining the salt and water balance in the body.

 Cortisol – The functions which regulate the blood sugar level, blood pressure, and muscle strength in the body is controlled by the cortisol.

 Dehydroepiandrosterone (DHEA) – It is related to the immune system, bones growth, and also to the mood of an individual.

 Epinephrine and norepinephrine – The nervous system is associated with it.

Disorders

 Cushing's syndrome is a condition caused by having too much of a hormone called cortisol in your body. It can be serious if it's not treated. Cushing's syndrome is uncommon. It mostly affects people who have been taking steroid medicine,

especially steroid tablets, for a long time. Steroids contain a man-made version of cortisol. Very rarely, it can be caused by the body producing too much cortisol.

This is usually the result of:

a growth (tumour) in the pituitary gland in the brain

a tumour in 1 of the adrenal glands above the kidneys

The tumours are usually non-cancerous (benign). They're most common in young women.

Symptoms of Cushing's syndrome

Symptoms of Cushing's syndrome can start suddenly or gradually. They tend to get slowly worse if not treated.

One of the main signs is weight gain and more body fat, such as:

increased fat on your chest and tummy, but slim arms and legs

a build-up of fat on the back of your neck and shoulders, known as a "buffalo hump"

a red, puffy, rounded face

Other symptoms include:

skin that bruises easily

large purple stretch marks

weakness in your upper arms and thighs

a low libido and fertility problems

depression and mood swings

Cushing's syndrome can also cause high blood pressure, which can be serious if not treated.

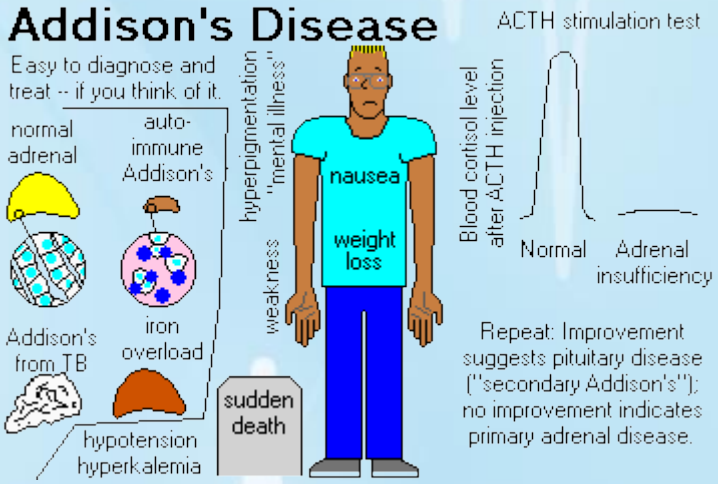
 Addison's disease. Addison's disease, also known as primary adrenal insufficiency or hypoadrenalism, is a rare disorder of the adrenal glands.

The adrenal glands are 2 small glands that sit on top of the kidneys. They produce 2 essential hormones: cortisol and aldosterone.

The adrenal gland is damaged in Addison's disease, so it does not produce enough cortisol or aldosterone. It's also more common in women than men.

Symptoms of Addison's disease

Early-stage symptoms of Addison's disease are similar to other more common health conditions, such as depression or flu.



You may experience:

- lack of energy or motivation (fatigue)
- muscle weakness
- low mood
- loss of appetite and unintentional weight loss
- increased thirst

Over time, these problems may become more severe and you may experience further symptoms, such as dizziness, fainting, cramps and exhaustion.

You may also develop small areas of darkened skin, or darkened lips or gums.

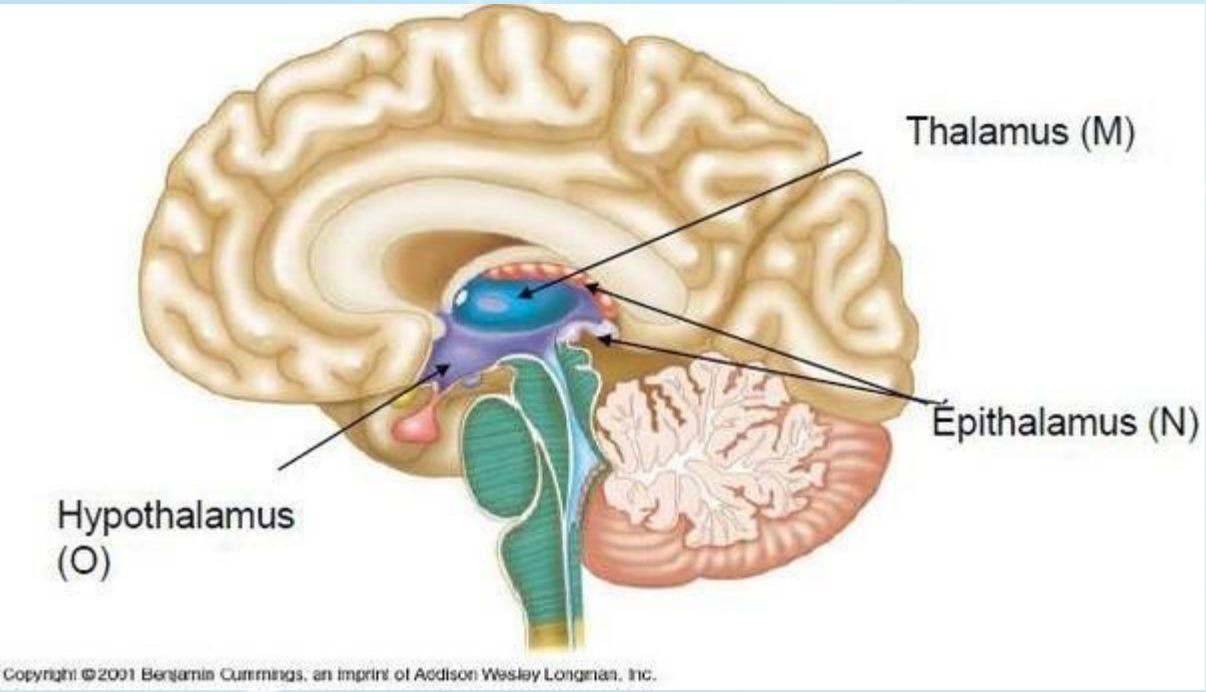
Although these symptoms are not always caused by Addison's disease, you should see a GP so they can be investigated.

Hypothalamus

 The hypothalamus gland is actually a part of the pituitary gland.

 The hormones that it secretes do the work of inducing the master gland, so that it can go on with its normal function.

 Growth-hormone-releasing hormone (GHRH), somatostatin, and dopamine, are the hormones which are released by this gland, which we discussed.



Functions:

 Controls blood pressure

 Regulates body temperature, energy metabolism, and reproduction

 Directs responses to stress

 The hypothalamus also plays a role in the awareness of pleasure and pain, the expression of emotions, and sexual behaviors.

Hormones produced

 Hormone-releasing hormone (GHRH) – It is known as the growth hormone.

 Somatostatin – It works by regulating the endocrine system.

 Dopamine – It inhibits the release of prolactin from the anterior lobe of the pituitary gland.

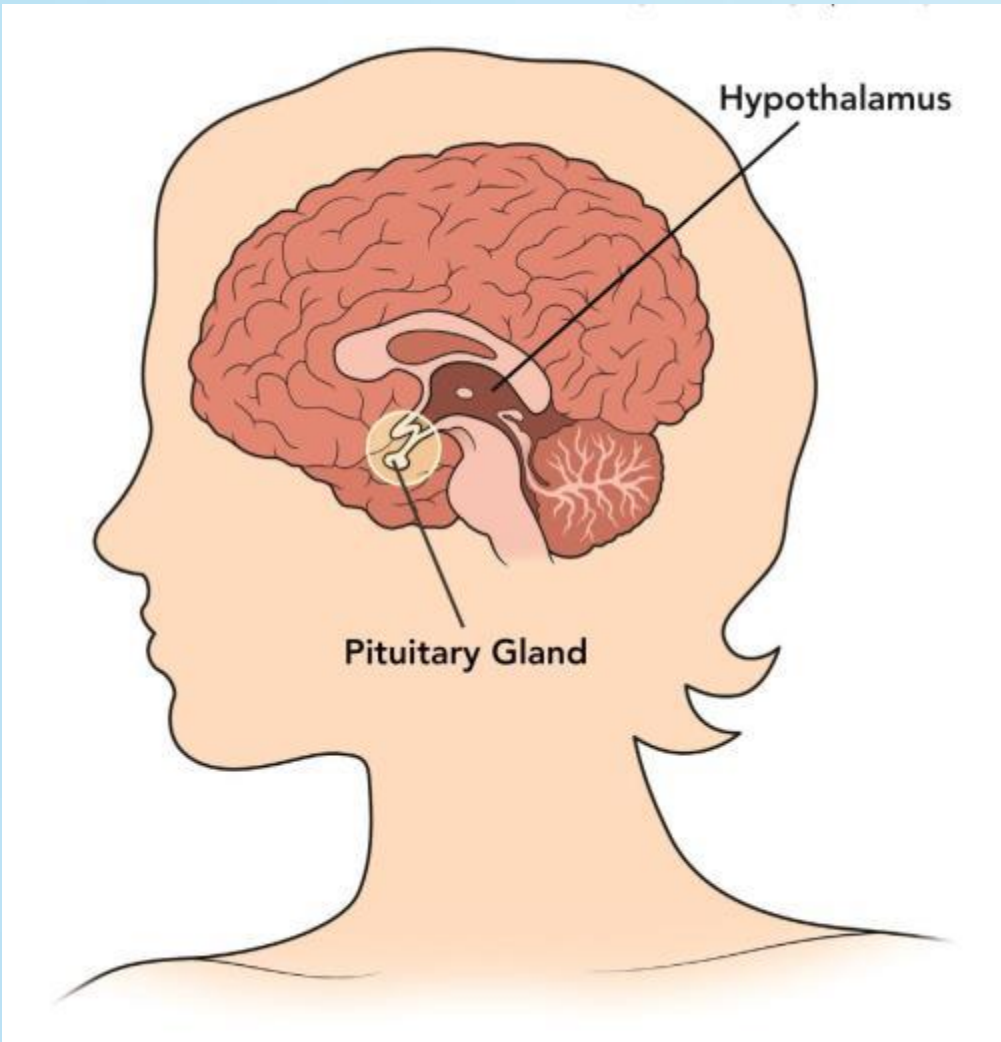
Disorders

 Hypopituitarism (also called pituitary insufficiency) is a rare condition in which your pituitary gland doesn't make enough of certain hormones. Hormones coming from the pituitary gland control the function of other glands in your body: thyroid gland, adrenal glands, ovaries, and testes. Your body can't work properly when important glands, such as your thyroid gland and adrenal gland, don't get the hormones they need from your pituitary gland. Also the pituitary gland makes growth hormone that helps children grow but can also affect the well-being of adults, and anti-diuretic hormone (ADH); lack of ADH causes thirst and increased urination. Hypopituitarism can develop suddenly after surgery, injury or bleeding, or very slowly, over several months or even over several years.

What can cause hypopituitarism?

Hypopituitarism can be caused by:

Tumors in or near the pituitary gland (which are usually benign, meaning not cancer)



Radiation treatment, which can destroy pituitary gland tissue

Pituitary surgery

Bleeding in a pituitary tumor (pituitary apoplexy)

Traumatic brain injury, such as with a head injury from an accident

Severe blood loss during childbirth

Certain infections such as tuberculosis or meningitis

Certain conditions present at birth

Hypophysitis (inflammation of the pituitary gland)

Conditions that can infiltrate the pituitary gland (example, histiocytosis, lymphoma)

Sometimes, the cause is unknown.

What are the symptoms of hypopituitarism?

Symptoms can include one or more of the following:

Stomach pain, decreased appetite, nausea and vomiting, constipation

Excessive thirst and urination

Fatigue and/or weakness

Anemia (not having enough red blood cells)

Headache and dizziness

Sensitivity to cold

Weight loss or weight gain

Muscles aches

In women: loss of armpit or pubic hair, decreased sex drive, infertility, problems with breast feeding, irregular or no menstrual periods

In men: loss of hair (on the face, or in the armpits or pubic area), decreased sex drive, infertility, erectile dysfunction

In children, problems with growth (including height) and sexual development

 Hypothyroidism occurs when your body doesn't produce enough thyroid hormones. The thyroid is a small, butterfly-shaped gland that sits at the front of your neck. It releases hormones to help your body regulate and use energy.

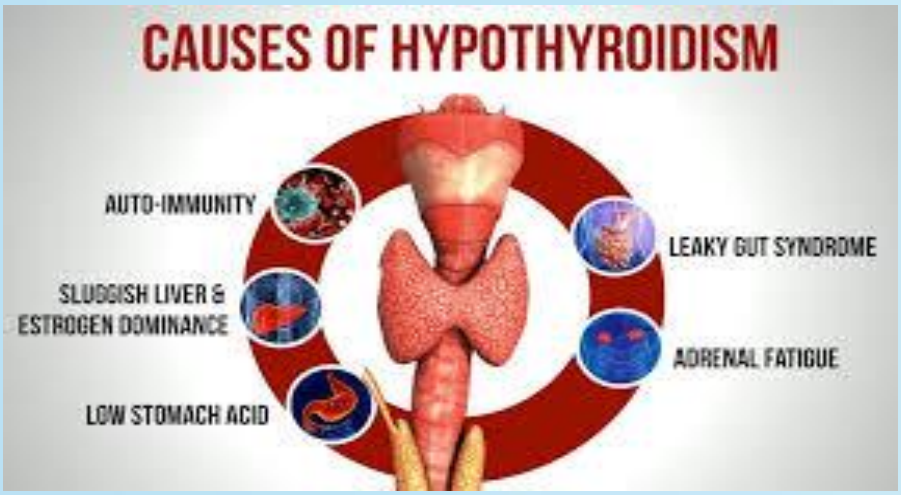
Your thyroid is responsible for providing energy to nearly every organ in your body. It controls functions such as how your heart beats and how your digestive system works. Without the right amount of thyroid hormones, your body's natural functions begin to slow down.

Also called underactive thyroid, hypothyroidism affects women more frequently than men. It commonly affects people over the age of 60 years old, but it can begin at any age. It may be discovered through a routine blood test or after symptoms begin.

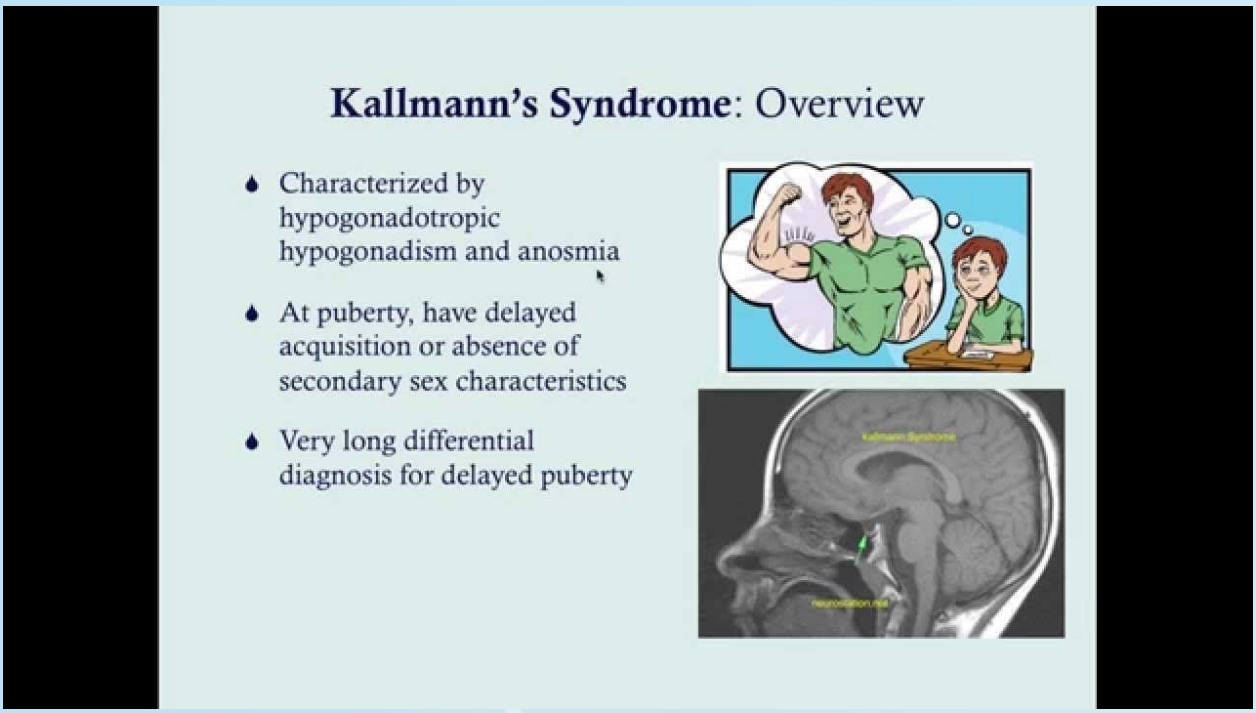
Subclinical hypothyroidism is the name given to an early, mild form of the condition.

If you've recently been diagnosed with hypothyroidism, it's important to know that treatment is considered simple, safe, and effective.

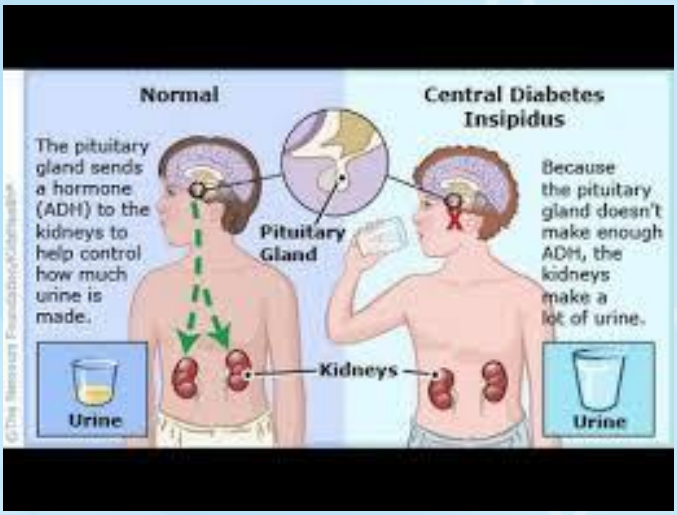
Most treatments rely on supplementing your low hormone levels with artificial hormones. These hormones will replace what your body isn't producing on its own and help return your body's functions to normal.



 Kallmann's Syndrome. Most cases are diagnosed at the time of puberty due to lack of sexual development, but KS may also be suspected in infancy in males with cryptorchidism, micropenis or associated non reproductive signs. The main clinical features consist of the absence of complete spontaneous puberty and a partial or total impairment of the sense of smell (anosmia) in both sexes. Untreated adult males usually have decreased bone density and muscle mass, decreased testicular volume (< 4 mL), erectile dysfunction, diminished libido and infertility. Untreated adult females almost always experience primary amenorrhea with absent, little or normal breast development. Rare presentations include unilateral (occasionally bilateral and lethal at birth) renal agenesis, hearing impairment, cleft lip or palate, dental agenesis or bimanual synkinesis persisting beyond childhood.

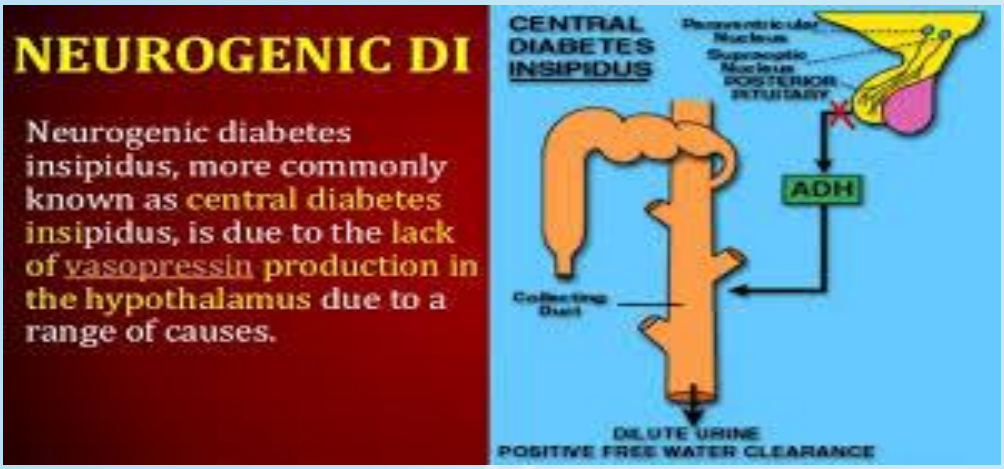


 Neurogenic diabetes may occur in patients with lesions in the vicinity of the hypothalamus after pituitary surgery or traumatic head injury. This syndrome results when the neurons located in the supraoptic nuclei of the hypothalamus fail to release sufficient quantities of vasopressin into the systemic circulation.



Diabetes insipidus is characterized by the production of large volumes of dilute urine and normal or elevated plasma osmolality. In severe cases, urinary output can be as great as a liter per hour. Left untreated or unrecognized, diabetes insipidus can quickly result in severe dehydration, hypovolemia, and hypotension.88 To promptly diagnose diabetes insipidus, one must have a high index of suspicion when dealing with patients who are at risk. Confirmation may be obtained by

documenting elevated serum osmolality and sodium concentration in conjunction with a low urine specific gravity or osmolality. The patient should be vigorously rehydrated with 0.45% saline until euvolemia is established. Because of the preexisting hyperosmolar/hypernatremic state, normal saline should *not* routinely be used for the initial rehydration of these patients. Concomitantly, replacement therapy should be initiated with either aqueous vasopressin (5-10 units by intramuscular or subcutaneous injection) or desmopressin (1-2 µg intravenously or subcutaneously).



Parathyroid Glands

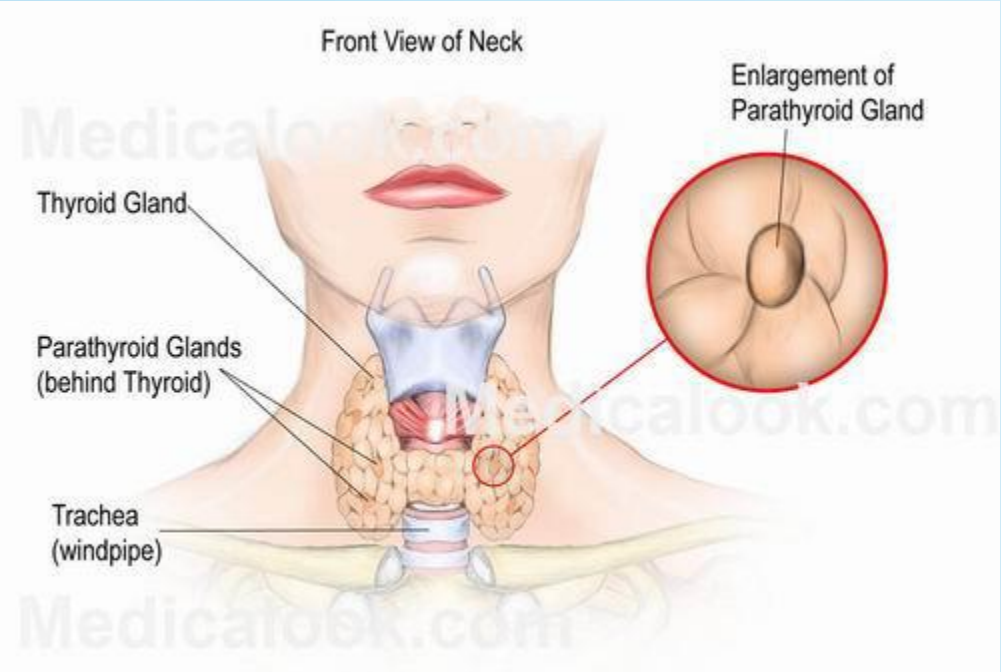
 These are located behind the thyroid gland, and that may be the reason they are known as parathyroid glands.

 They are there with the work of regulating the amount of calcium in the blood stream.

Functions

This gland helps in controlling the amount of calcium present in the body

It helps the nervous and muscular system to function properly



Hormones produced

 Parathyroid hormone – Calcium and phosphorus are eliminated from the body with the help of this hormone, which is also responsible for bone formation.

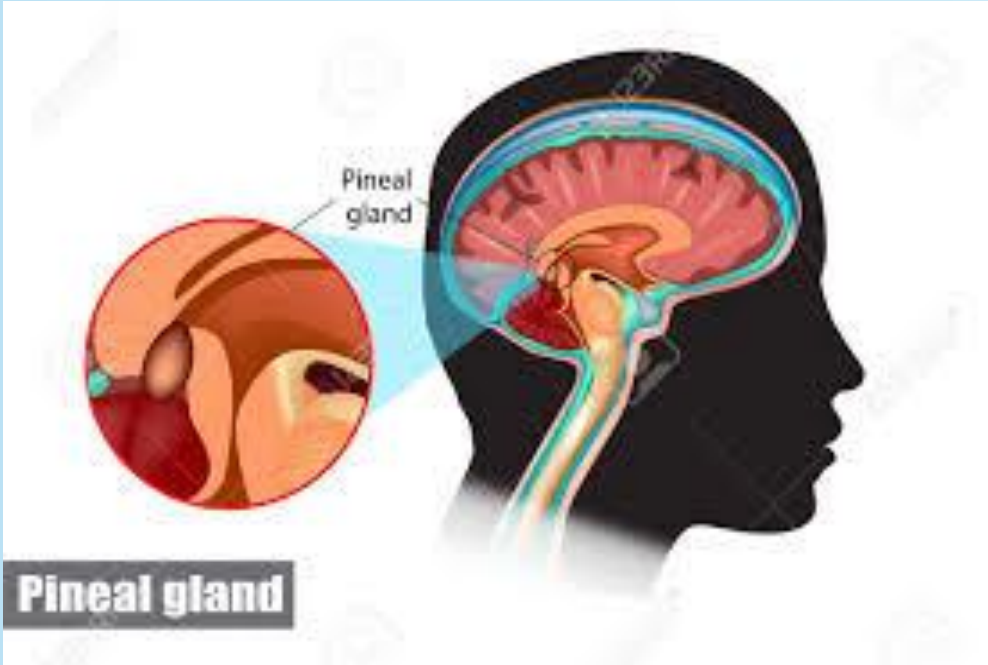
Disorders

 Hyperparathyroidism

Pineal Gland.

 It is at the base of the brain, and is responsible for alertness or consciousness of one's self.

 Pineal is also known as the thalamus, it develops serotonin derivatives of melatonin, which can affect sleep.



Functions

 The function of this endocrine gland is to secrete melatonin

Hormones produced

 Melatonin – Maintains the body's circadian rhythm, apart from what has been mentioned in the earlier segment.

Disorders

 cancer,

 sexual dysfunction,

 hypertension,

 epilepsy,

 Paget's disease.

Gonads The sex glands - the testes in men and the ovaries in women - are glands with mixed function. Due to the exocrine function of these glands, male and female reproductive cells are formed - spermatozoa and eggs. The intrasecretory function is manifested in the production of male and female sex hormones that enter the bloodstream.

The sex glands have a well-defined vascular system, due to which their abundant blood supply is carried out.

Innervation of the gonads is provided by postganglionic sympathetic nerve fibers from the solar plexus and the parasympathetic pelvic nerve…

The development of the gonads and the flow of sex hormones from the sex glnds into the bloodstream determines sexual development and maturation. Human sexual maturity begins. It is characterized by the full development of primary and the appearance of secondary sexual characteristics.

The primary sexual characteristics include the sex glands (testes, ovaries) and genitals (penis, prostate, vagina, uterus, oviducts). They determine the possibility of sexual intercourse and childbirth.

Secondary sexual characteristics are those characteristics of a sexually mature organism by which a man and a woman differ from each other. In men, secondary sexual characteristics are facial hair, body hair, changes in voice, body shape,

psyche and behavior. In women, secondary sexual characteristics include the peculiarities of the location of hair on the body, changes in the shape of the body, the development of the mammary glands.

The importance of sex hormones in the development of sexual characteristics is clearly manifested in experiments with the removal (castration) and transplantation of the sex glands in a rooster and a chicken. If the gonads are removed from these birds, then after castration they begin to approach the middle, asexual type in appearance.

Transplantation of the sex glands of the opposite sex to them leads to the development of external signs and reactions inherent in the opposite sex: the rooster acquires the signs and behaviors characteristic of the hen (feminization), the hen acquires the qualities inherent in the rooster (masculinization).

Male sex hormones... The formation of male sex hormones occurs in special cells of the testes – the interstitial cells. Male sex hormones are called androgens... Currently, the presence of two androgens in the testes has been established - testosterone and androsterone... A person's daily need for androgens is about 5 mg. For a day in men, 3-10 μg of androgens are excreted in the urine.

Hormones stimulate the growth and development of the reproductive apparatus, male secondary sexual characteristics, and the appearance of sexual reflexes. If androgens are administered to immature males, they develop premature genitals and secondary sexual characteristics. The introduction of androgens to castrated males leads to the elimination of the effects of castration in them.

Androgens are necessary for the normal maturation of male germ cells - sperm. In the absence of hormones, motile mature spermatozoa are not formed. In addition, androgens contribute to a longer preservation of the motor activity of male germ cells. Androgens are also necessary for the manifestation of the sexual instinct and the implementation of the behavioral reactions associated with it.

Androgens have a great effect on the body's metabolism. They increase the production of protein in various tissues, especially in muscles, reduce body fat, and increase the basal metabolism.

Androgens affect the functional state of the central nervous system, higher nervous activity. After castration, males experience sharp shifts in higher nervous activity, and the process of inhibition in the cerebral cortex is disrupted.

Female sex hormones... The formation of female sex hormones - estrogen - occurs in the ovarian follicles. The follicle is a vesicle, the wall of which is formed by a three-layer membrane. The synthesis of estrogens is carried out by the follicle membrane. In the yellow body of the ovary, which develops at the site of a bursting follicle, a hormone is produced progesterone... The daily requirement of a woman's body for estrogen is 0.25 mg. Per day, a woman excretes 16-36 mcg of estrogen in the urine.

Estrogens stimulate the growth of the oviducts, uterus, vagina, cause the growth of the inner layer of the uterus - the endometrium, promote the development of secondary female sexual characteristics and the manifestation of sexual reflexes. In addition, estrogens cause increased contractions of the uterine muscle, increase its sensitivity to the hormone of the posterior pituitary gland oxytocin. They also stimulate the development and growth of the mammary glands. Progesterone ensures a normal pregnancy. Under its influence, the mucous membrane of the endometrium of the uterus grows. This creates favorable conditions for the implantation of a fertilized egg into the endometrium of the uterus. Progesterone also contributes to the development of the so-called decidual tissue around the implanted egg. Progesterone inhibits the contraction of the muscles of the pregnant uterus and reduces its sensitivity to oxytocin. Progesterone delays the maturation and ovulation of follicles by inhibiting the formation of the anterior pituitary hormone lutropin.

Regulation of the formation of hormones of the sex glands... The formation of sex hormones in the gonads is under the control of follicle-stimulating, luteinizing and luteotropic hormones of the anterior pituitary gland...

In females follicle-stimulating hormone promotes the growth and development of follicles, in males - the maturation of sex cells - spermatozoa. Luteinizing hormone determines the production of male and female sex hormones, as well as ovulation and the formation of a corpus luteum at the site of a burst graafian vesicle. Under the influence. At the luteotropic hormone the synthesis of the hormone of the corpus luteum occurs. The pineal gland hormone has the opposite effect on the function of the gonads; melatonin, which inhibits the activity of the sex glands.

The function of the gonads is regulated by the nervous system. It has been shown that the nervous system affects the activity of the ovaries and testes in a reflexive way.due to changes in the formation of gonadotropic hormones in the pituitary gland.

The central nervous system is involved in the regulation of the normal reproductive cycle. When the functional state of the central nervous system changes, for example, with strong emotions (fear, grief), a violation of the sexual cycle may occur or even its termination (emotional amenorrhea).

Thus, the regulation of the hormone-forming function of the sex glands is carried out according to the general principle due to nervous and humoral (hormonal) influences.

Understanding tissue hormones... It is now known that specialized cells of various organs and tissues produce biologically active substances. These substances are called tissue hormones. Tissue hormones have a variety of influences on the regulation of the activity of those organs where they are formed.

A large group of tissue hormones is synthesized by the mucous membrane of the gastrointestinal tract. These hormones affect the formation and secretion of digestive juices, as well as the motor function of the gastrointestinal tract.

Tissue hormones are formed in the tissues, which are involved in the regulation of local blood circulation (histamine expands blood vessels, serotonin has a pressor effect).

Tissue hormones also include the components of the body's kinin system - kallikrein, under the influence of which a vasodilating polypeptide - bradykinin is formed.

In recent years, prostaglandins, a large group of substances formed in the microsomes of all body tissues from unsaturated fatty acids, have been assigned a significant role in the local regulation of physiological functions. Various types of prostaglandins are involved in the regulation of the secretion of digestive juices, the process of platelet aggregation, changes in the tone of the smooth muscles of blood vessels and bronchi.

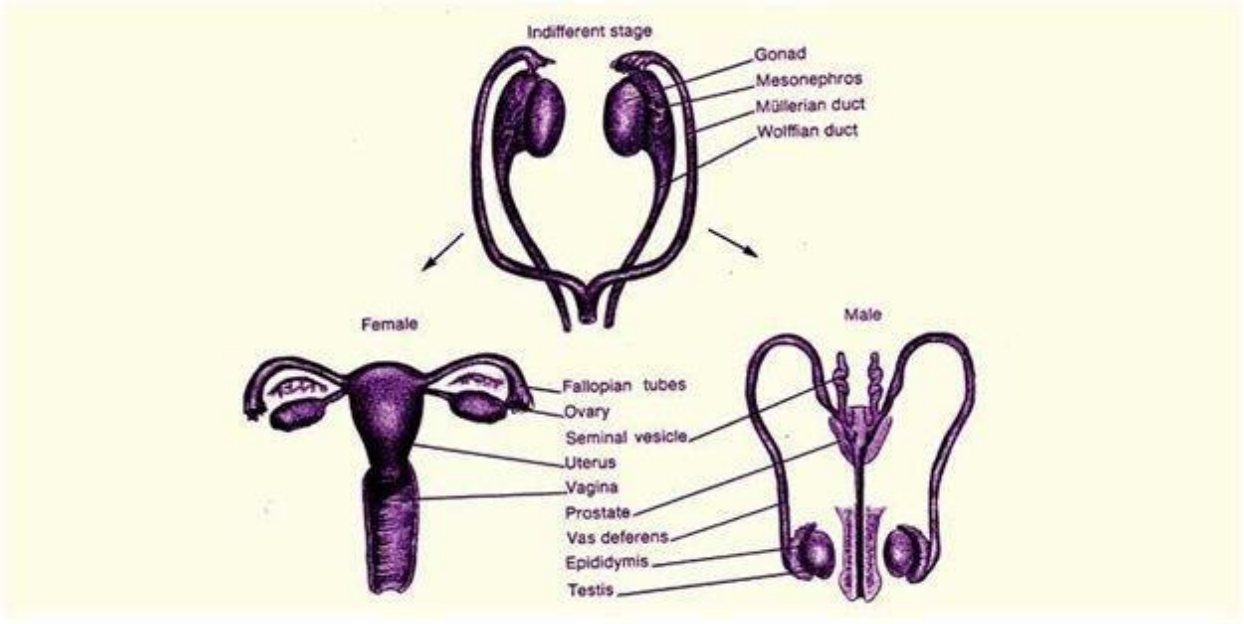
Tissue hormones also include neurotransmitters - acetylcholine and norepinephrine...

Testes:

- In men, the testes secrete the male sex hormone, testosterone.
- It also produces sperm.

Ovaries:

- In women, the ovaries secrete estrogen, progesterone, testosterone, and other female sex hormones



Functions

 These glands produce hormones and cells that are vital to reproduction, in males and females.

Hormones produced

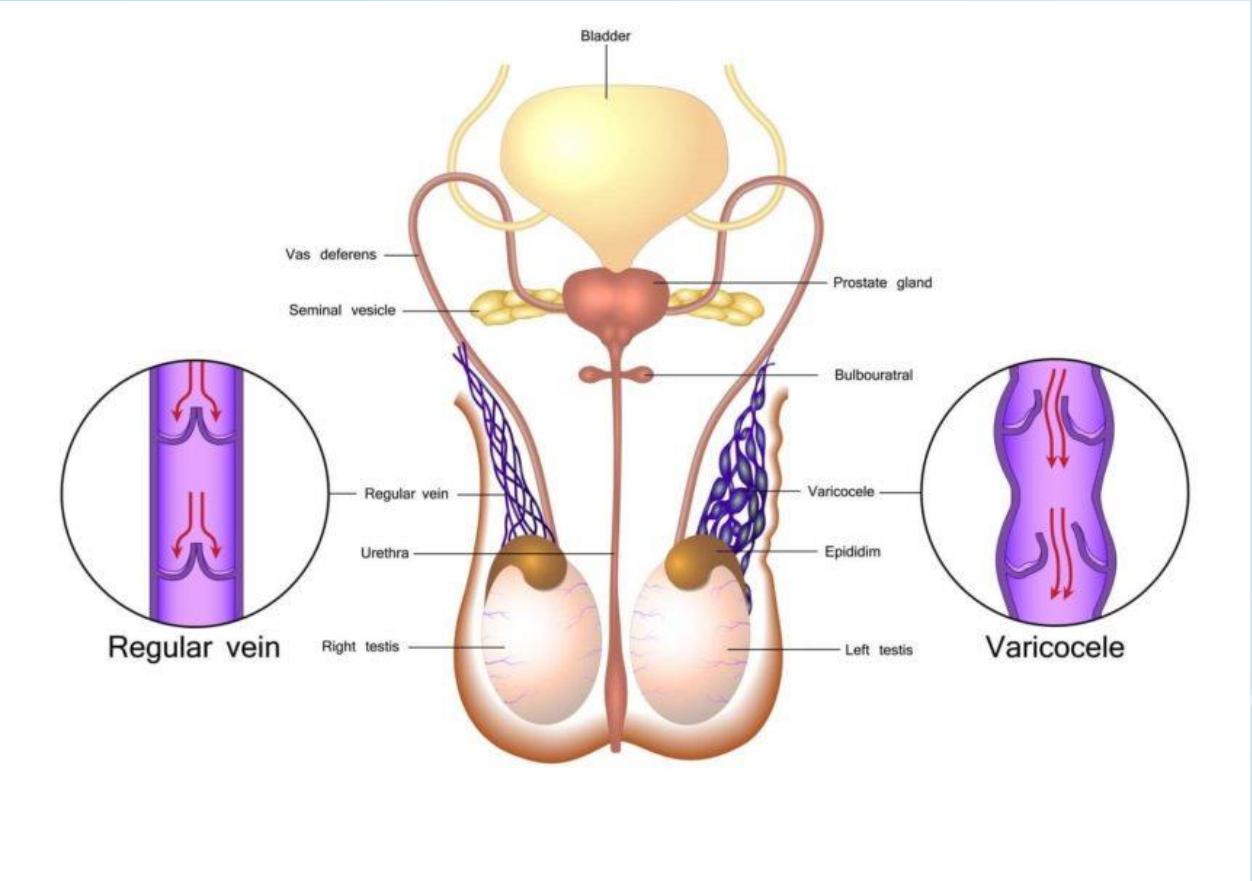
 Estrogen – The female sexual characteristics and the function of the reproductive system are influenced by the secretion of this hormone.

 Progesterone – It plays vital roles in pregnancy. For instance, it helps in preparing the lining of the uterus for the fertilized egg to get implanted.

 Testosterone – Men's sexual characteristics and the nature of the reproductive system, involve the secretion of this hormones

Disorders

 Hypogonadism refers to a condition in which little or no hormone is produced by the testes or ovaries. The condition can be hypergonadotropic (primary, resulting when the gonads fail) or hypogonadotropic. The latter can result from failure of the hypothalamic luteinizing-hormone releasing hormone [LHRH] pulse generator or from the inability of the pituitary to respond with secretion of luteinizing hormone [LH] and follicle-stimulating hormone [FSH]. (See the image below.) Morbidity for men and women with hypogonadism includes infertility and an increased risk of osteoporosis; there is no increase in mortality.



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