POLTAVA STATE MEDICAL UNIVERSITY

ANATOMICAL AND PHYSIOLOGICAL FEATURES OF THE ENDOCRINE SYSTEM IN CHILDREN. SEMIOTICS OF THE DISEASES OF THE ENDOCRINE SYSTEM IN CHILDREN.

ASSOC. PROFESSOR SOLOVIOVA HALYNA

PLAN OF THE LECTURE

- 1. Definition of the endocrine system in children.
- 2. The main function of the endocrine system.
- 3. Embriology of the endocrine system.
- 4. Anatomical and physiological features of the hypophysis.
- 5. Anatomical and physiological features of the thyroid gland.
- 6. Anatomical and physiological features and diseases of the adrenal glands.
 - 7. Methods of investigation of the endocrine system.
- 8. Methods of clinical examination of endocrine system.

THE ENDOCRINE GLANDS CONSIST OF

1.HYPOTALAMUS

2.HYPOPHYSIS

3.THE EPIPHYSIS

4.THE THYROID GLAND

5.THE PARATHYROID GLANDS

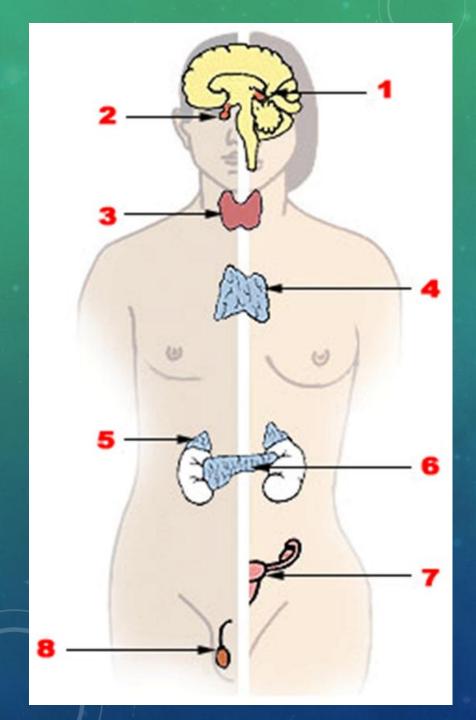
6.THE THYMUS

7.THE ISLANDS OF LANGERHANS IN THE PANCREAS

8.PANCREAS

9.THE ADRENAL GLANDS

10.THE GONADS (TESTIS AND OVARIES)



MAJOR ENDOCRINE GLANDS. (MALE LEFT, FEMALE ON THE RIGHT.)

- 1. Pineal gland (epiphysis)
- 2. Pituitary gland (hypophysis)
- 3. Thyroid gland
- 4. Thymus
- 5. Adrenal gland
- 6. Pancreas
- 7. Ovary
- 8. Testis

THE MAIN FUNCTION OF THE ENDOCRINE SYSTEM

- 1. TO TAKE AN ACTIVE PART IN METABOLISM
- 2. INFLUENCE ON WATER-MINERAL METABOLISM
- 3. INFLUENCE ON GROWTH AND DEVELOPMENT OF A CHILD
- 4. REGULATION OF DIFFERENTIATION OF TISSUES
- 5. ENSURATION OF ADAPTATION OF THE ORGANISM TO ITS ENVIROMENT

EMBRIOLOGY

❖ PITUITARY, THYROID, ADRENAL-BEGIN TO FUNCTION DURING THE INTRAUTERINE PERIOD

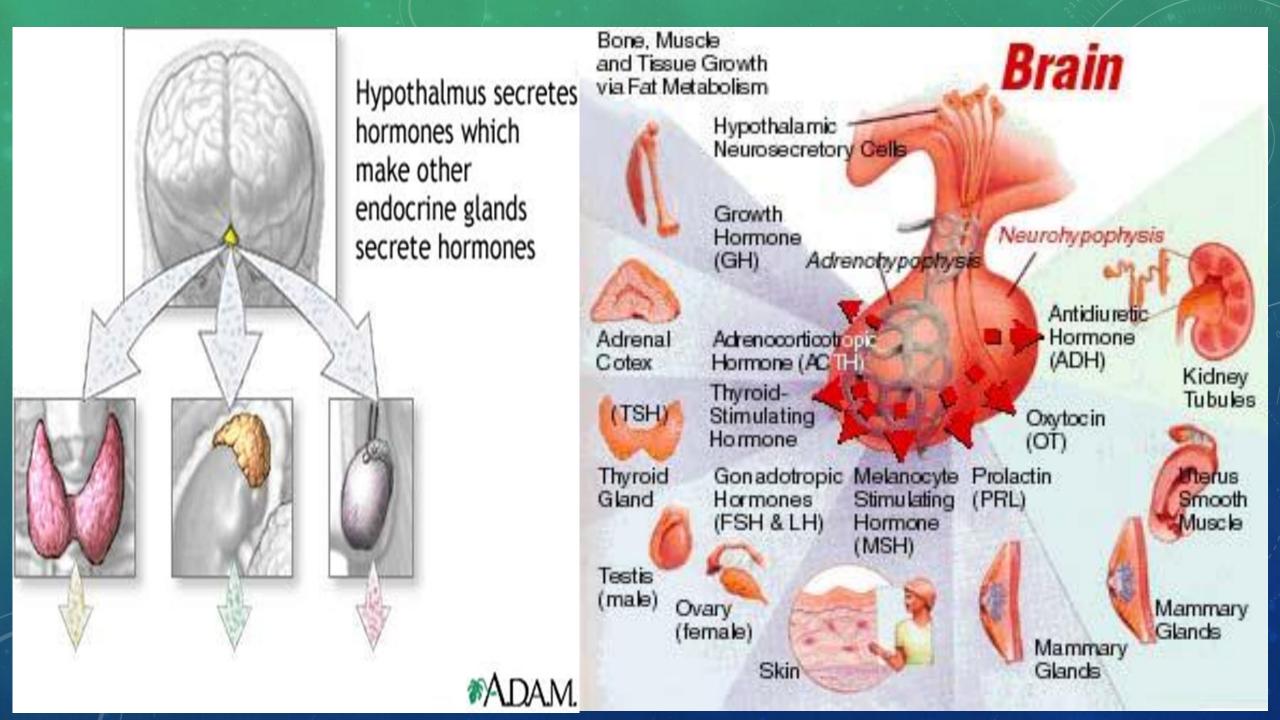
THE HYPOPHYSIS IS ORGANIZED AT FIRST AT 4 WEEKS OF GESTATION AND STARTS TO SECRETE AT 9-10 WEEKS

THE HYPOTALAMUS REGULATES ACTIVITY

 The hypotalamus regulates activity of the hypophysis by producing neurohormones (releasing hormones).

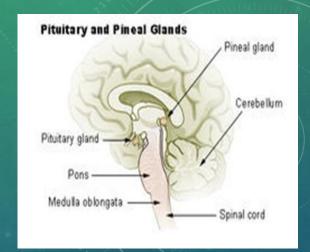
 Some of them activate and others inhibit secretion of trophic hormones of the hypophysis.

CLOSE RELATIONSHIP BETWEEN FUNCTIONS OF THE ENDOCRINE SYSTEM AND THOSE OF THE HYPOTALAMUS



PITUITARY GLAND (OR HYPOPHYSIS)

- Located in the pituitary fossa of the Turkish saddle of the
- sphenoid bone, it consists of two lobes: the anterior (adenohypophysis), in which another intermediate part is isolated, and the posterior (neurohypophysis).
- The pituitary gland through the hypothalamus is closely connected with the nervous system. It integrates the entire endocrine system into functional integrity. This ensures the constancy of the internal environment of the body.
- The concentration of hormones in a child varies depending on age, season and month of the year, time of day. The secretion of hormones by the pituitary gland begins already in utero.



HORMONES OF THE ANTERIOR PITUITARY GLAND

- ACTH adrenocorticotropic hormone (contributes to the function of the adrenal cortex)
- growth hormone STG
- thyroid stimulating hormone TSH (stimulates the growth and function of the thyroid gland)
- lactotropic (prolactin), follicle-stimulating FSH and luteinizing LH hormones (gonadotropic hormones - regulate sex hormones)

HORMONES OF THE INTERMEDIATE AND POSTERIOR PITUITARY GLAND

Intermediate share:

 melanocytostimulating hormone (affects the metabolism in melanocytes, causes darkening of the skin)

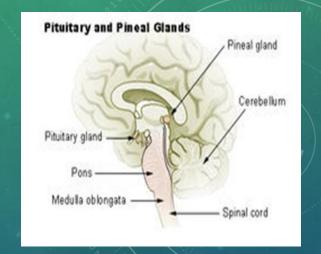
The posterior lobe (hormones enter the pituitary gland from the nuclei of the hypothalamus):

- vasopressin antidiuretic hormone ADH (antidiuretic and vasopressive effect)
- oxytocin (takes part in the process of lactation of the mammary glands and stimulates the contraction of the uterus).

PINEAL GLAND

It is an endocrine gland located deep beneath the cerebral hemispheres. The main functions of the gland:

- synthesis of the hormone melatonin, which:
- inhibits the secretion of gonadotropic hormones by the anterior pituitary gland
- inhibits sexual development
- normalizes pigment metabolism
- regulates the circadian rhythm and body adaptation to changes in lighting conditions.



METHODS OF EXAMINATION OF THE HYPOTHALAMUS, PITUITARY AND PINEAL GLAND

- X-ray of the skull (Turkish saddle)
- Blood hormone levels
- CT, MRI



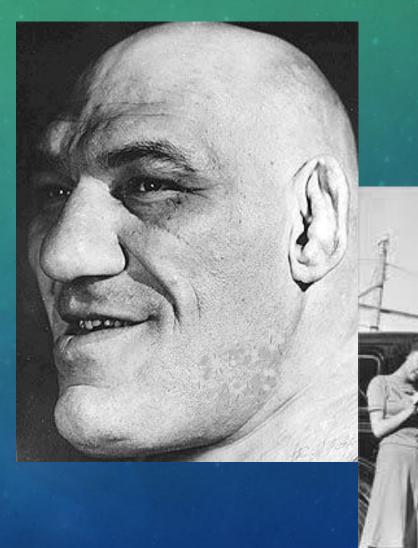
HYPOFUNCTION OF THE GROWTH HORMONE

 Causes pituitary nanism (dwarfism)



HYPERFUNCTION NOF GROWTH HORMONE

Pituitarygigantism and acromegaly





HYPOFUNCTION OF THE ADRENOHYPOPHYSIS

 Hypophyseal cachexia, Simmonds disease



LUTEINIZING HORWONE



- 1. Premature menopause
- 2. Gonadal dysgenesis
- 3. Castration
- 4. Testicular failure

Decreased levels of LH can lead to infertility and impaired sexual development

Follicle-stimulating (FSH)

This condition with FSH low secretion is typically manifest in males as failure in production of normal numbers of sperm and In females, amenorrhea.

Conditions with very low FSH secretions are:

- 1. Kallmann syndrome
- 2. Hypothalamic suppression
- 3. Hypopituitarism
- 4. Eating disorder
- 5. Hyperprolactinemia
- 6. Gonadotropin deficiency

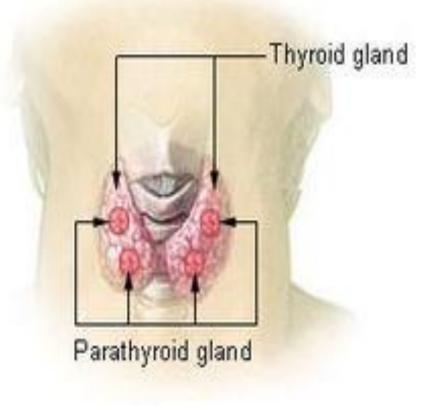
ABNORMAL FUNCTION OF THE PINEAL GLAND



 With a violation of the functions of the pineal gland, the risk of disorders of the nervous system increases (depression). It is assumed that there is a relationship between the disruption of the pineal gland and the risk of cancer.

THYROID

Thyroid and Parathyroid Glands



 This is an unpaired gland located in the front of the neck (in front and on the sides of the trachea) and consists of two (right and left) lobes, most often connected by an unpaired isthmus.

ANATOMICAL AND PHYSIOLOGICAL FEATURES OF THE THYROID GLAND

- The newborn has a relatively large thyroid gland, but its histological structure is not complete.
- The first significant growth of the gland occurs before primary school age.
- The second growth is observed at 12-15 years, after which the histological development of the gland is completed.

THYROID HORMONES

- A-cells (follicular) make up the bulk of the thyroid gland. They absorb and accumulate iodine, synthesize thyroid hormones: thyroxine (T4) and triiodothyronine (T3).
- The functioning of A-cells begins at 11-12 weeks of fetal development, exceeding at the end of this stage of life the indices of an adult.
- A large number of hormones are stored in the first days of a child's life, after which they decrease.
- B-cells first appear in children of high school age.
- The main function is the secretion of serotonin.

THYROID HORMONES

- C-cells not able to absorb iodine. They produce the hormone calcitonin, whose main function is the regulation of calcium in the body, namely, a decrease in its amount in the bloodstream. This contributes to the deposition of calcium in the bone tissue, which ensures its growth.
- The functioning of C cells begins at 14 weeks of fetal development. In the chest period, the amount of calcitonin decreases. The maximum activity of calcitonin occurs after the full histological development of the thyroid gland (at the end of senior school age).
- Calcitonin is antagonistic to parathyroid hormone.

THE FUNCTIONS OF THYROID HORMONES

- Enhances motility and secretory function of the gastrointestinal tract
- They have a positive effect on the heart muscle, increase the work of the heart and the power of its contractions
- Affect the sympathetic nervous system (excite it)
- Contribute to brain maturation
- Strengthen the process of heat generation
- Promote linear bone growth
- Stimulate blood formation
- Participate in the exchange of protein and carbohydrates
- Regulate the amount of cholesterol in the blood

THYROID EXAMINATION METHODS





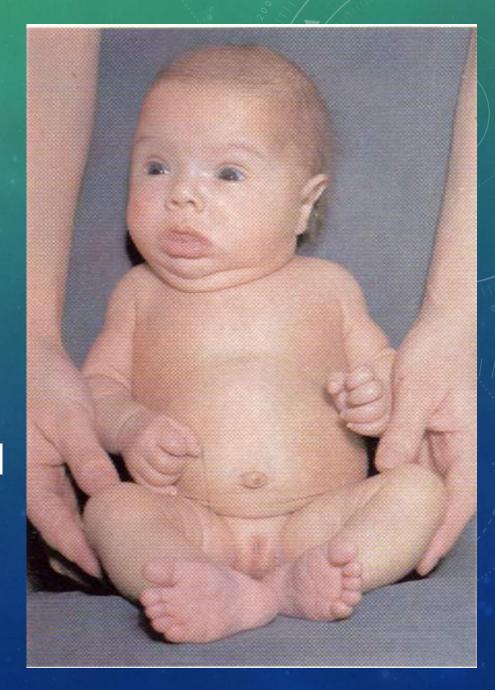
- Examination of the neck: visibility of the gland when swallowing, deformation of the neck (Normally, the thyroid gland is not visible)
- Palpation of the thyroid gland
- Blood hormone levels
- Urinalysis for ioduria
- Thyroid ultrasound

THYROID GLAND DISEASES

ENDEMIC CRETINIZ - endocrine disease caused by a decrease in thyroid hormones, delayed physical and the company of the company

HYPOTHYROIDISM CONGENITAL

complex of clinical and laboratory manifestations arising in a child from birth with thyroid hormone insufficiency or insensitivity of the tropic organs, symptoms include lag in psychophysical development, myxedema, trophic disorders of the skin, depression of the heart, a decrease in basal metabolism.



LABORATORY INVESTIGATION OF HYPOTHYROIDISM CONGENITAL

- Newborns screening for T4
- TSH (thyroid-stimulating hormone)
- X-ray delayed bone development
- ECG depressed P and T waves and QRS complex, low voltage

HYPERTHYROIDISM

Mostly appear in the school period

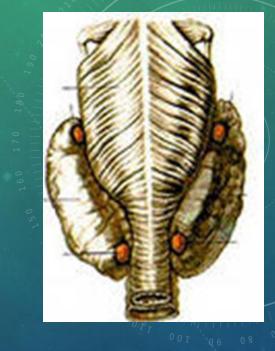
- 1.Emotional lability
- 2.tremor
- 3.increased appetite
- 4.loss of body weight
- 5.exophthalmos
- 6.eyelid leg
- 7.sweating and tachycardia

LABORATORY INVESTIGATION OF HYPERTHYROIDISM

- T4 and T3 elevated
- X-ray of bones: osteoporosis and bones resorption

PARATHYROID GLANDS

• 2 pairs of parathyroid glands are located in loose fiber near the thyroid gland. They begin to function at the end of 3 months of gestational age. After the birth of a child, active secretion persists until preschool age, inclusive.



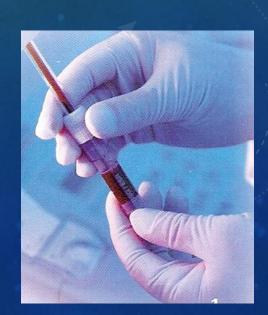
• The main function of the parathyroid glands is the release of parathyroid hormone. The actions of parathyroid hormone and calcitonin are opposite and interrelated. If calcitonin reduces the amount of calcium in the blood, then parathyroid hormone, on the contrary, increases it.

- Calcitonin and parathyroid hormone with vitamin D provide support for the optimal amount of calcium and phosphorus in the body.
- Parathyroid hormone increases the amount of calcium and reduces the amount of phosphorus in the body of the child, and this is all the necessary conditions for the development, growth and functioning of the bone system in the first place.



METHODS OF EXAMINATION OF THE PARATHYROID GLANDS

- CT, MRI
- Ultrasound of the parathyroid glands
- Blood hormone levels
- Biochemical blood test: calcium and phosphorus levels



HYPOPARATHYROID

- Muscle pains,
- Cramps,
- Numbness, tingling and convulsions
- The teeth are soft and erupt late
- Dry and scaly skin
- Cataracts may occurs



LABORATORY FINDINGS OF HYPOPARATHYROIDISM

- 1. low calcium
- 2. elevated phosphorus,
- 3. low vitamin D,
- 4. Low PTH (parathyroid hormone)
- 5. X-ray; increased metaphyseal thickening
- 6. ECG: prolonged QT interval

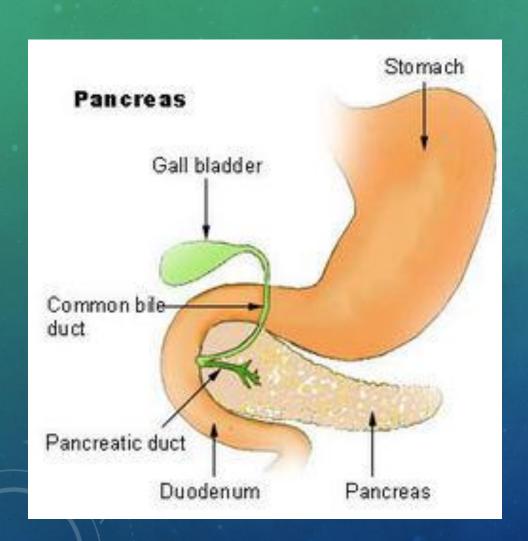
HYPERPARATHYROIDISM

- The increased release of parathyroid hormone contributes to increased osteolysis and the release of calcium from bone tissue, increased absorption of calcium from the intestine, leading to hypercalcemia, as well as increased calciuria and phosphaturia.
- Symptoms: general weakness, depression, bone and joint pain

Laboratory findings of hyperparathyroidism

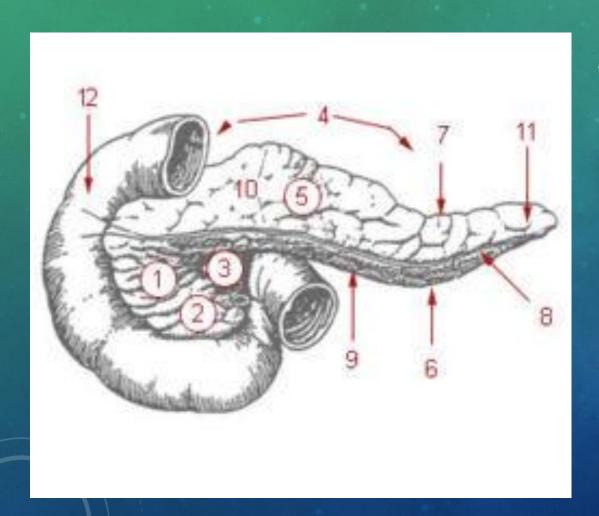
- Blood tests: hypercalcemia
- Urinalysis: increased excretion of calcium (> 5 mmol / day [200 mg / day]) and phosphate in the urine, low specific gravity
- ECG: signs of hypercalcemia may be visible Visualizing research methods: imaging of the parathyroid glands - ultrasound (allows you to detect only significantly enlarged parathyroid glands)
- CT
- X-rays of bones

PANCREAS



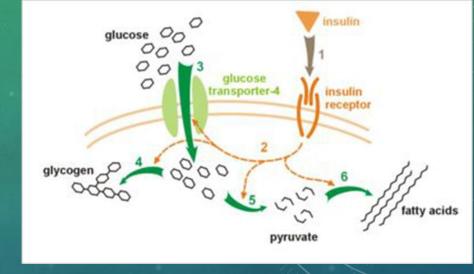
 The pancreas is an organ in the digestive and endocrine system that serves two major functions: exocrine (producing pancreatic juice containing digestive enzymes) and endocrine (producing several important hormones, including insulin).

PANCREAS



- 1: Head of pancreas
 - 2: Uncinate process of pancreas
 - 3: Pancreatic notch
 - 4: Body of pancreas
 - 5: Anterior surface of pancreas
 - 6: Inferior surface of pancreas
 - 7: Superior margin of pancreas
 - 8: Anterior margin of pancreas
 - 9: Inferior margin of pancreas
 - 10: Omental tuber
 - 11: Tail of pancreas
 - 12: <u>Duodenum</u>

THERE ARE FOUR MAIN TYPES OF CELLS IN THE ISLETS OF LANGERHANS.



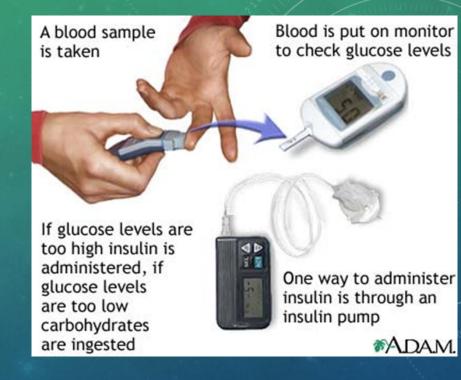
- Glucagon (α -cells) increases the concentration of glucose in the blood, affects the metabolic processes in the body.
- Insulin (β -cells) regulates carbohydrate metabolism, maintaining the necessary level of glucose in the blood by lowering it. The action is the opposite of glucagon. The hormone secretion in the fetus begins at 3 months of gestational age. In a newborn, the number of β -cells is 2.5 times, and at 6 months 3.5 times the number of α -cells.
- Somatostatin and pancreatic polypeptide

DIABETES - CHRONIC PROGRESSIVE DISEASE CHARACTERIZED BY A RELATIVE OR COMPLETE INSULIN DEFICIENCY OR DECREASED INSULIN SENSITIVITY OF TARGET CELLS

- recognizes three main forms of diabetes: type 1,
- *≿type 2* and
- > gestational diabetes (or type 3, occurring during pregnancy)
- Palthough these three "types" of diabetes are more accurately considered patterns of <u>pancreatic</u> failure rather than single diseases.

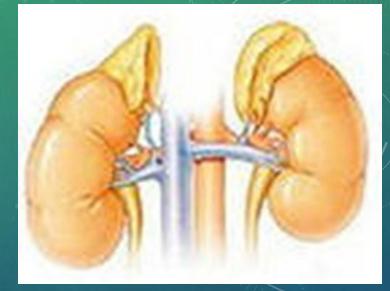
PANCREATIC EXAMINATION METHODS

- Ultrasound of the pancreas
- Blood and urine glucose level
- Indicators of glycosylated hemoglobin (this is the part of hemoglobin in the blood that is associated with glucose; the greater the percentage of hemoglobin is glycated, the higher the blood sugar level). This criterion is used to judge the average level of glycemia (blood glucose) over the past three months.



ADRENAL GLANDS

 Formed in the fetus at 6 weeks gestational age. At week 20, their size is 50 times larger in relation to the



weight of the fetus in comparison with an adult. By birth, the adrenal glands continue to grow (the relative mass at the end of gestational age is 10-15 times greater than that of an adult).

- By birth, the adrenal glands reach a sufficiently large size, and in the neonatal period they gradually decrease.
- The adrenal glands remain insufficiently mature, which is due to the frequent development of gland insufficiency in severe illnesses of the child.

ADRENAL CORTEX HORMONES

- Corticosteroids. Their secretion is characterized by a daily cycle, which develops already on the 15-20th day of a child's life, the maximum amount is allocated in the morning. This is taken into account when prescribing hormonal drugs to the child.
- Male sex hormones are androgens and female sex hormones are estrogens. Affect the development of secondary sexual characteristics.

GLUCOCORTICOIDS FUNCTION (hormones produced in the adrenal cortex)

- Affect tissue metabolism
- Increase protein and glucogen content in the liver
- Influence the immune and nervous systems

ADRENAL MEDULLA HORMONES

- Catecholamines: adrenaline, norepinephrine, dopamine, react to stressful stimuli, they are already in the early neonatal period of the child.
- From pre-school age throughout the day, their secretion is large in the daytime, throughout the year - in the spring.

ADRENAL EXAMINATION METHODS

- CT, MRI
- Ultrasound of the adrenal gland
- The level of hormones in the blood and urine



ADRENAL GLAND DISEASES

CUSHING'S SYNDROME ↑GLUCOCORTICOIDS FUNCTION

Etiology:

- Adrenocortical tumor
- Pituitary adenoma
- Abnormal production of ACTH

Clinical manifestation:

- Moon face, a double chin, a buffalo hump, obesity,
- Masculinization, hypertrichosis on the face and trunk, acne, impaired growth and hypertension.

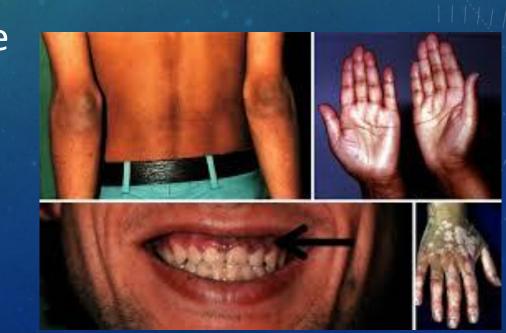


THE ADRENAL CORTEX, OR HYPOCORTICISM) IS A RARE ENDOCRINE DISEASE, AS A RESULT OF WHICH THE ADRENAL GLANDS LOSE THE ABILITY TO PRODUCE ENOUGH HORMONES, ESPECIALLY CORTISOL

Diffuse hyperpigmentation in open areas of the body, skin folds, scars and extensor surfaces of the extremities darken. The

forehead, cheeks, neck and shoulders are usually covered with dark spots

Anorexia, nausea, vomiting, and diarrhea

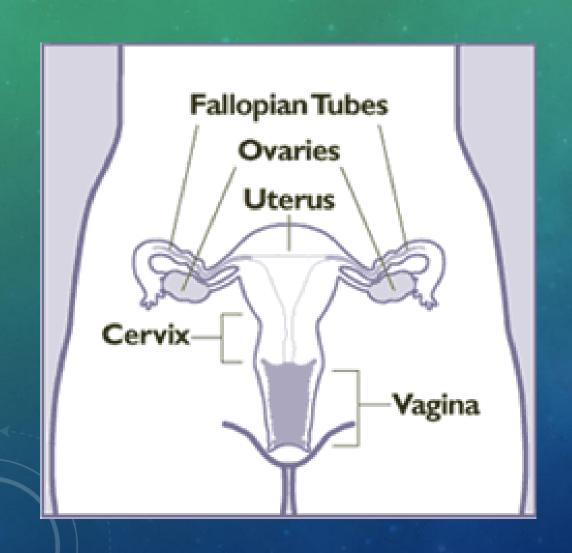


GONADS



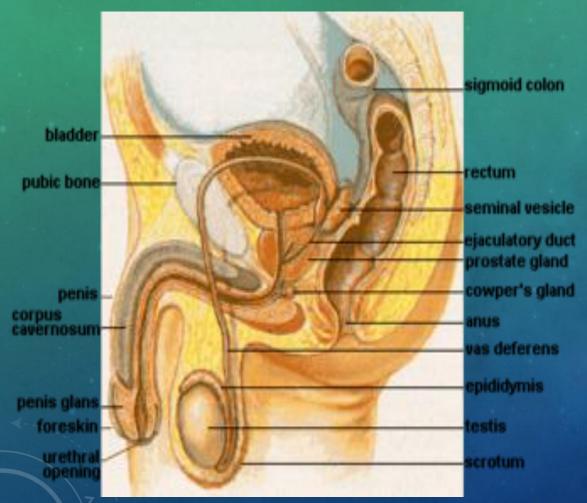
- In boys, they are represented by the testes, in girls by the ovaries. These glands, in addition to the reproductive function, perform an endocrine function, which plays a significant role in the growth and formation of the body. The sex glands produce the largest amount of sex hormones.
- Sex hormones are synthesized already in the early embryonic period. The synthesis of sex hormones is regulated by the pituitary gonadotropin hormones.

OVARY



 Ovaries are egg-producing reproductive organs found in female organisms. They are part of the vertebrate female reproductive system. Ovaries in females are homologous to testes in males. The term gonads refers to the ovaries in females and testes in males.

TESTICLE



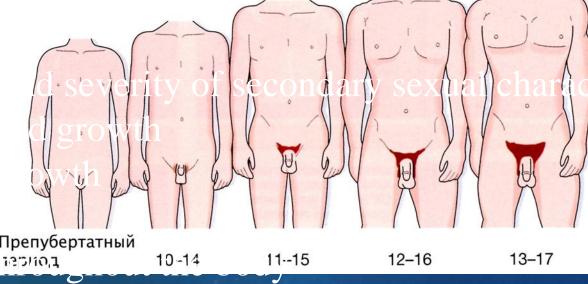
• The testicles, or testes (singular testis), are the male generative glands. Male mammals have two testicles, which are often contained within an extension of the abdomen called the scrotum.

THE APPEARANCE AND SEVERITY OF SECONDARY SEXUAL CHARACTERISTICS

- Inspection: scrotum, penis
- Palpation of

The appearance

- mustache, be
- axillary hair
- pubic hair
- hair growth



teristics:

Препубертатный

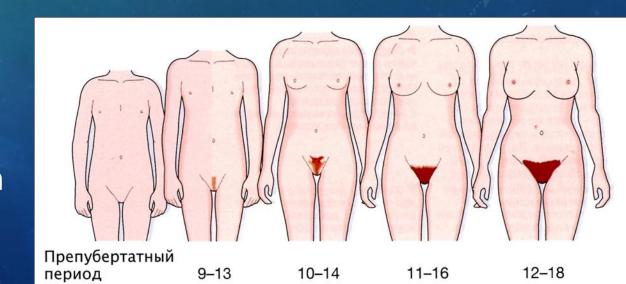
voice mutation

THE STUDY OF THE GONADS IN GIRLS

 Examination of the external genitalia: large and small labia, clitoris, pigmentation.

The appearance and severity of secondary sexual characteristics:

- mammary gland development
- axillary hair growth
- pubic hair
- the formation of menstrual function



ADDITIONAL GONADS EXAMINATION METHODS

- Ultrasound scan
- The level of sex hormones in the blood and urine

SEXUAL DEVELOPMENT DISORDERS

- Premature sexual development
- Delayed sexual development
- Hermaphroditism (the presence of one specimen of sexual characteristics of both sexes)



IMMUNE SYSTEM AND FEATURES OF ITS FUNCTIONING IN CHILDREN.

ASSISTANT OF THE DEPARTMENT OF PEDIATRICS WITH CHILDREN INFECTIOUS, M. D., RAKOVA KATERINA

IMMUNE SYSTEM



is a network of cells, tissues, and organs that work together to defend the body against attacks by "foreign" invaders.

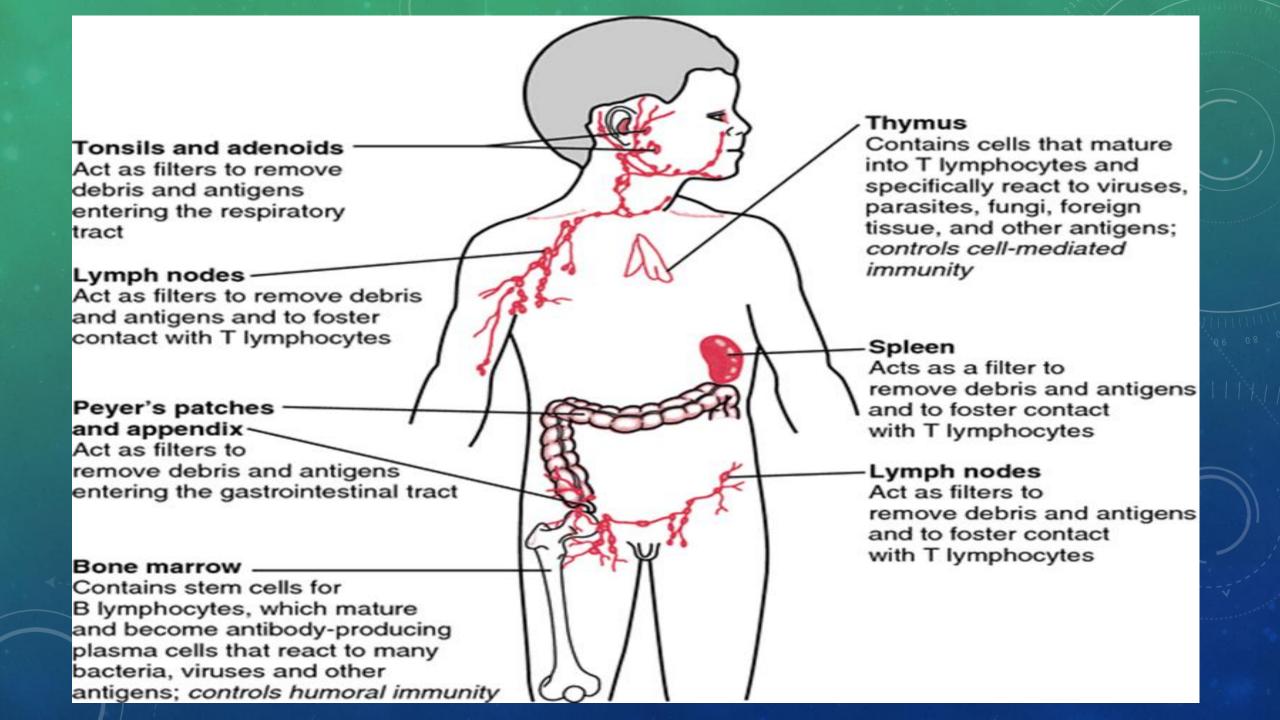
ORGANS OF IMMUNE SYSTEM

Central

- Thymus
- Bone marrow
- Bursa Fabricii

<u>Peripheral</u>

- Lymph nodes
- Peyer's Patches (of GI tract)
- Tonsils
- Adenoids
- Spleen
- MALT (Mucosal-Associated Lymphoid Tissue)



CENTRAL ORGANS OF IMMUNE SYSTEM - THYMUS

- The thymus enlarges from about the 12th week of gestation until puberty, when it begins to shrink.
- Its function is to transform lymphocytes (white blood cells developed in the bone marrow) into T-cells.



Central organs of immune system – bursa
 Fabricius (mammals and humans do not have this bag, but bursa is something like a human appendix).

PERIPHERAL ORGANS OF IMMUNE SYSTEM - LYMPH NODES

Functions:

- Hemopoetic (lymphocytes formation)
- Immunopoetic (plasmocytes formation & antibodies synthesis)
- Barrier-filtration (delay of foreign structures)



PERIPHERAL ORGANS OF IMMUNE SYSTEM — SPLEEN



Functions:

- Immunologic (creation T- & Blymphocytes)
- maintaining of body's resistance (antibodies production)
- maintain homeostasis

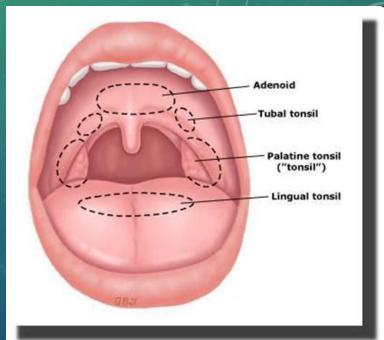
PERIPHERAL ORGANS OF IMMUNE SYSTEM –

Waldeyer's ring

- lingual,
- two (palatine) tonsils
- adenoids (nasopharyngeal tonsil),
- lymphoid tissue on the posterior pharyngeal wall

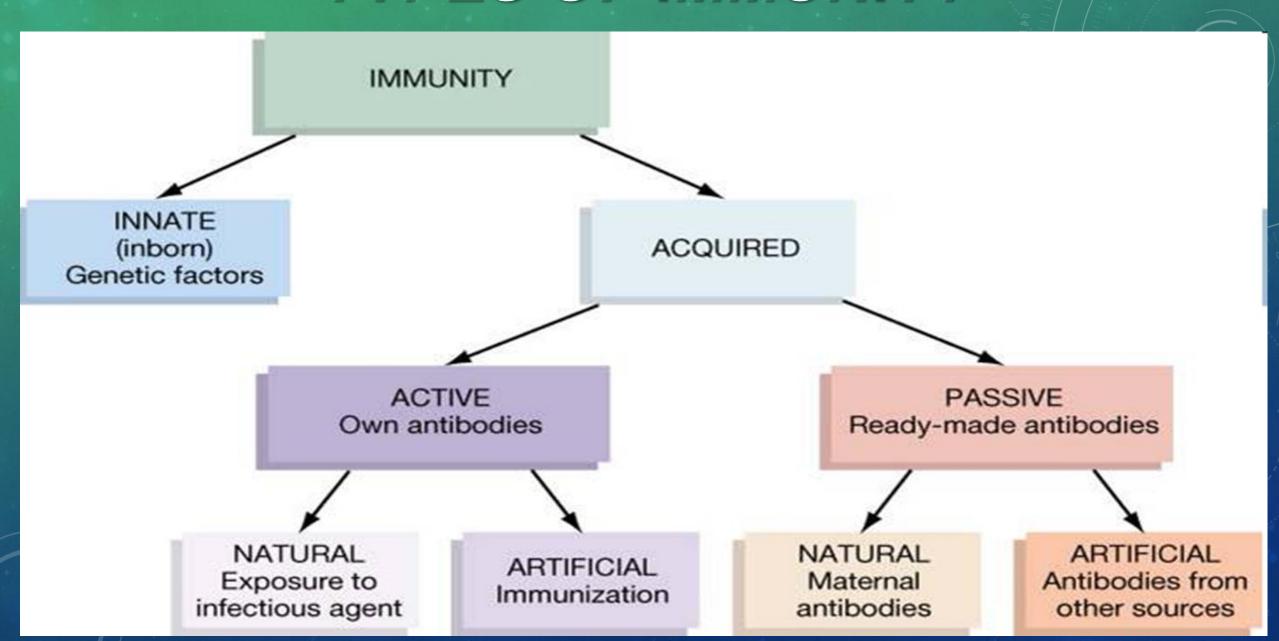
Payer's patches

lymphoid follicles located in the wall of the small intestine





TYPES OF IMMUNITY



IMMUNITY: CONTRASTS BETWEEN INNATE AND ACQUIRED

Innate (non-specific, natural, native)

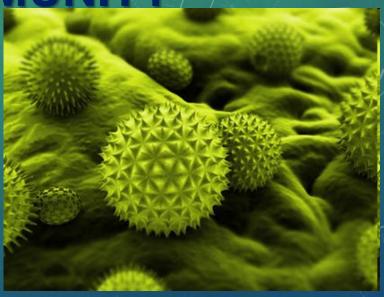
Acquired (specific, adaptive)

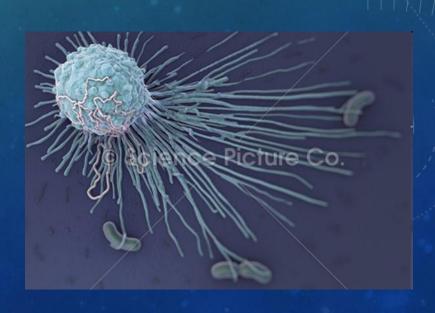
- System in place prior to exposure to antigen
- Lacks discrimination among antigens
- Can be increased after exposure to antigen through effects of cytokines

- Induced by antigen
- Increased by antigen
- Shows fine discrimination

THE ELEMENTS OF THE INNATE IMMUNITY

- Skin = physical barrier
- Mucus
- Cilia
- Lysosyme (in tears)
- Acid (in stomach and urine)
- Phagocytes = scavenge up and engulf cell debris.
- Granulocytes
- Commensal bacteria (normal microflora)
- Fever





TYPES OF ACQUIRED (SPECIFIC) IMMUNITY

Active immunity is protection that is produced by the person's own immune system.

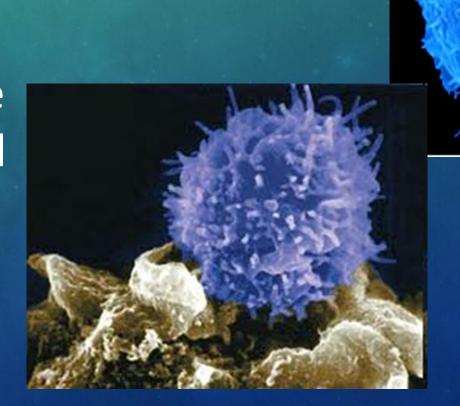
Specific immunity

Passive immunity is protection by products produced by an animal or human, and transferred to another human

THE ELEMENTS OF THE SPECIFIC IMMUNITY

 T-lymphocytes are Cellular Immunity

 B-lymphocytes are the generators of Humoral Immunity



FEATURES OF IMMUNE SYSTEM IN CHILDREN

- The deficient immunity of newborns or "neonates" is a natural state at birth and is medically known as physiologic immunodeficiency in the neonate.
- The immune system actually requires several years before reaching a fully mature state in children.
- The maturation process of the immune system occurs in stages starting in the fetus prior to birth and reaching completion between 10 to 14 years of age.





Thank you for your attention



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