MINISTRY OF HEALTH PROTECTION OF UKRAINE
ODESSA NATIONAL MEDICAL UNIVERSITY

Faculty of **medicine**

Department **of general and clinical pathophysiology**

I APPROVE

Vice-rector for scientific and pedagogical work

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MANUAL
FOR SELF-EDUCATION
FROM EDUCATIONAL DISCIPLINE

Faculty of Medicine, course 3

Educational discipline - " **pathophysiology"**

Approved:
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Plan

1. Topic #1. The doctrine of disease. General doctrine of etiology and pathogenesis.
2. Topic #2. Pathogenic effect of physical factors.
3. Topic No. 3. The role of heredity, constitution, age-related changes in pathology.
4. Topic No. 4. Typical disorders of peripheral blood circulation and microcirculation.
5. Topic #5. Inflammation.
6. Topic #6. Pathology of reactivity. Violation of immunological reactivity.
7. Topic #7. Allergy.
8. Topic #8. Violation of water-electrolyte exchange.
9. Topic No. 9. Violation of acid-base balance.
10. Topic #10. Starvation.
11. Topic No. 11. Violation of protein and fat metabolism.
12. Topic No. 12. Insufficiency of blood circulation. Pathophysiology of the heart.
13. Topic No. 13. Coronary insufficiency. Arrhythmias.
14. Topic No. 14. Pathophysiology of blood vessels.
15. Topic No. 15. Pathophysiology of external breathing.
16. Topic No. 16. Pathophysiology of the digestive system. Insufficiency of digestion.
17. Topic No. 17. Kidney pathophysiology. Kidney failure.
18. Topic No. 18. Pathophysiology of the endocrine system. General violations.
19. Topic No. 19. Dysfunction of the thyroid, parathyroid , adrenal , and gonads.
20. Topic No. 20. Pathophysiology of the nervous system.

Topic: Doctrine of the disease.
Types of tasks: General concepts of etiology and pathogenesis.
Number of hours: 4

A disease is a violation of the normal vital activity of an organism when it is affected by harmful agents, as a result of which its adaptive capabilities are reduced (M.M. Zaiko).

Classification of diseases is a certain system of distribution of diseases and pathological conditions into classes, groups and other headings according to established criteria.

1. Etiological principle - hereditary and acquired, infectious and non-infectious, etc.
2. Anatomical and topographic principle - cardiovascular diseases, respiratory diseases, kidney diseases, etc.
3. By age and gender - children's diseases, women's diseases, diseases of old age.
4. Pathogenetic principle - allergic diseases, inflammatory diseases, metabolic diseases, etc.
5. Depending on the state of structural and functional disorders - organic and functional diseases.
6. According to the clinical course - acute and chronic, subacute.
7. Depending on the methods that are mainly used to treat the disease - therapeutic and surgical.

A pathological reaction is an inadequate and biologically inappropriate response of the body to the action of ordinary or excessive stimuli. Examples: various types of pathological reflexes, allergies, a short-term increase in blood pressure after nervous tension or a decrease in blood sugar due to the introduction of large doses of insulin, etc.

A pathological process is a sequence of reactions that naturally occur in the body to the harmful effect of a pathogenetic factor. Examples of pathological processes are inflammation of lung tissue in pneumonia, hypoxia in obliterating endarteritis, inflammation of the heart muscle in myocardial infarction, fever in typhoid fever, etc.

A pathological condition is a set of pathological changes in the body that arise as a result of the development of a pathological process. In the narrow sense of the word, it is a persistent deviation from the norm that has a negative biological meaning. Examples of pathological conditions are a stump after amputation of a limb, cicatricial tissue changes after a thermal burn, atrophy of the alveolar processes of the jaw in connection with the removal or loss of teeth, an acquired defect of the valve apparatus hearts

Typical pathological processes are such processes that have the same laws of development regardless of the cause, localization, species of animals and individual characteristics of the organism. Examples: inflammation, tumor growth, local circulatory disorders, hypoxia, starvation, fever.

In the development of the disease, 4 periods (stages) are distinguished:

- latent (regarding infectious diseases - incubation) lasts from the moment of exposure to the cause until the appearance of the first clinical manifestations of the disease;
- prodromal is the period of time from the first non-specific signs of the disease to the full manifestation of its symptoms;
- the period of exacerbation of the disease is characterized by the full development of the clinical picture: convulsions in parathyroid insufficiency, leukopenia in radiation sickness, hyperglycemia and glucosuria in diabetes;
- the period of the end of the disease: complete and incomplete recovery, relapse, transition to a chronic form, remission, complications, death.

Complete recovery is a state in which all manifestations of the disease disappear and the body fully restores its functions.

In case of incomplete recovery, the consequences of the disease are pronounced. They remain for a long time or forever.

Remission is a temporary improvement of the patient's condition, which manifests itself in slowing down or stopping the disease process, partially reversing the development or disappearance of clinical manifestations or the pathological process.

Exacerbation is a stage of the course of a chronic disease characterized by an increase in existing symptoms or the appearance of new ones.

A complication is a pathological process secondary to the existing diseases, which arises in connection with the peculiarity of the pathogenesis of the primary (main) disease or as an unforeseen consequence of medical measures.

Relapse - restoration or strengthening of the manifestations of the disease after their temporary disappearance, weakening or termination of the pathological process.

Death is the most unfavorable outcome of the disease. It can be natural (physiological from aging) and premature, which can be violent (murder) and from disease. In addition, there is brain death (sudden death of the brain against the background of all healthy organs supported by artificial ventilation) and somatic death, which occurs as a result of irreversible, incompatible with life damage to any organ, organs or systems. It occurs more often in chronic diseases, when the cerebral cortex and internal organs die simultaneously, but slowly.

The terminal state is a reversible fading of the body's functions, which precedes biological death, when the complex of protective and compensatory mechanisms is insufficient to eliminate the effects of the pathogenic factor on the body. Cessation of vital functions occurs gradually, and the dynamism of this process allows us to distinguish several phases that are observed during the death of an organism: preagony, agony, clinical and biological death.

Clinical death is a terminal state that occurs after cessation of cardiac activity and breathing and continues until the onset of irreversible changes in the higher departments of the central nervous system. During clinical death, external signs of life (consciousness, reflexes, breathing, heart rate) are absent, but the body as a whole has not yet died, energy substrates are stored in its tissues and metabolic processes continue, therefore, with timely resuscitation measures, it is possible to

restore all body functions.

Biological death is an irreversible state, when reviving the organism as a whole is no longer possible, and the restoration of its individual functions (for example, cardiovascular activity) with the help of resuscitation measures loses its meaning.

General etiology (Greek: Aitia - cause, logos - science, teaching) - teaching about the causes and conditions of disease occurrence and the principles of etiotropic prevention and therapy.

The cause of the disease should be considered the pathogenic factor without which it cannot occur under any conditions. Conditions for the occurrence of the disease are factors that reliably increase the probability of the occurrence of the disease. Example: the cause of ARVI is a virus, the conditions are hypothermia, fatigue, reduced immunity.

A risk factor is a general name for factors that are not the direct cause of a certain disease, but increase the likelihood of its occurrence.

Classification of etiological factors.

- physical - mechanical action, ionizing radiation, high and low temperature, electric current, etc.;
- chemical - inorganic and organic compounds of natural and artificial origin;
- biological - viruses, rickettsia, bacteria, protozoa, etc.
- psychogenic - negative emotions, etc.

General pathogenesis (pathos - disease, suffering; genesis - origin , birth) - the doctrine of the general mechanisms of development, course and consequences of the disease and the principles of pathogenetic prevention and therapy.

The relationship between the cause of the disease and its pathogenesis.

1. The etiological factor plays the role of a trigger and includes the process of disease development. For the further course of pathogenesis, the continued existence of the cause is not mandatory (for example, radiation sickness, mechanical trauma, thermal injuries).

2. Parallel existence of the cause and pathogenesis. The mechanism of disease development functions as long as the causative factor operates. Most infectious diseases can serve as an example of this type of interaction between the cause and the mechanism of the disease.

3. Persistence of the etiological factor . Disease-causing agents stay in the body longer than the pathogenesis itself. At the same time, the properties of the etiological factor may change under the influence of the organism. An example is bacteremia after infectious diseases.

Adaptation - this is the adaptation of the organism and its structures to the changing conditions of the external environment. Adaptation ensures preservation of homeostasis and prevents damage under the influence of normal environmental factors.

Compensation is a condition that develops as a result of the implementation of compensatory reactions and processes aimed at restoring disturbed homeostasis due to the influence of pathogenic factors.

The second section of general pathological physiology is the study of typical pathological processes. The section contains data on the processes underlying many

diseases, namely: inflammation, tumor growth, fever, hypoxia, typical metabolic disorders, starvation.

The second section of pathological physiology - private pathophysiology - examines disorders in individual organs or systems: blood circulation, breathing, endocrine, nervous systems , etc.

Research methods, significance of the experiment in pathophysiology

Pathophysiology is an experimental science. Therefore, its main method is an experiment on living objects. A pathophysiological experiment differs from a physiological one by modeling a human disease on laboratory animals. Currently, it is possible to reproduce such pathological processes on animals as traumatic shock, diabetes, atherosclerosis, myocardial infarction, kidney inflammation, arterial hypertension , etc. Meanwhile, we must not forget that the human body is much more complex than even the most highly organized animals and is under the constant influence of social factors, which is why it is almost impossible to get the full extent of human diseases on animals. It is possible to reproduce only some pathogenetically important links, symptoms and syndromes of a human disease. Physiological, electrophysiological, biophysical, biochemical, hematological, morphological, immunological, mathematical research methods are used in the experiment. Pathophysiological experiment, in contrast to clinical observation, has a number of beneficial advantages. These benefits include the ability to:

1. Clarification of the causal factors of the disease;

2. Observations from the pre-disease period and the earliest stage of the disease to the result;

3. Research of incurable forms of the disease;

4. Conducting experimental therapy.

All these possibilities are sharply limited in clinical conditions. All experiments can be acute and chronic. An acute experiment is needed to study the effects of blood loss. Tumor development is studied in a chronic experiment. Conducting the experiment involves humane treatment of animals (using anesthesia). It is unacceptable to conduct an experiment that will cause suffering to the animal.

Test tasks

1. Which of the Ukrainian scientists first wrote a textbook on pathological physiology (general and experimental pathology)?

A. O.O. Bogomolets

B. V.V. Pashugin

V. V.V. Podvysotskyi.

H. O.V. Rev

D. N.A. Khrjonshchevskiy.

2. Which of the Ukrainian pathophysiologists was the president of the Academy of Sciences of Ukraine?

A. O.O. Bogomolets
B. RE. Kravetskyi V. V.V. Komisarenko G. V.V. Podvysotskyi D. M.M. Sirotinin

3. What does pathological physiology study?

A. Etiology and pathogenesis of typical pathological processes.
B. Specific features of the course of diseases. V. Life activity of the sick body G. The most general patterns of occurrence, development and end of diseases.

4. What is the main method of pathological physiology?

A. Experiment
B. Clinical observation. Randomization method G. The method of introducing indifferent substances (placebo) D. Methods of static processing of received data

5. Health is a state characterized by:

A. Full physical, mental and social well-being of
B. Absence of diseases and physical disabilities. Due to the absence of symptoms of the disease G. The ability to maintain homeostasis D. A slight deviation of reactions to numerous stimuli from the general population level

6. What features are characteristic of the disease?

A. Violation of vital activity of the body
B. Reduction of adaptive capabilities of the body. Dominance of protective and adaptive processes at all stages of development G. Complete lack of protection against the pathogenic factor D. Mandatory increase in the risk of fatal outcome

7. What is characteristic of a typical pathological process?

A. The nature of development, which is determined by the type of tissue
B. Dependence of the course on the degree of evolutionary development of the organism. Independence of process development from localizationG. Independence of the dynamics of the process from the type of organism D. Dependence of the development of the process on the reasons that prompted its emergence

Topic: Pathogenic effect of physical factors on the body

Types of tasks: General concepts about the pathogenic effect of physical factors on the body :
Number of hours: 4

Action of ultraviolet radiation.

Pathogenic action excess ultraviolet exposure :

- damage skin causes her photochemical burn , with development erythema and blisters on the skin , increase temperature bodies , mainly pain , general a painful condition; pathogenic effect associated with the activation of peroxidation lipids that

_ leads to membrane damage , disintegration protein molecules, death cells as a whole ;

- damage conjunctiva of the eyes (photoophthalmia), manifests itself her redness and swelling , feeling burning and " sand " in the eyes, lacrimation ;

- may provoke aggravation some chronic diseases (rheumatism, ulcer stomach , tuberculosis , etc.) ;

- due to elevated formation melanin and destruction proteins the body's need for irreplaceable substances increases amino acids , vitamins , calcium salts , etc .;

- excessive UV exposure in the range waves region C can lead to inactivation of cholecalciferol - to transformation it in indifferent (suprasterins) and even harmful (toxysterols) substances ;

- long excessive UV exposure may promote formation peroxide compounds and epoxy substances which _ have mutagenic effect , and induce occurrence basal cell and squamous cell skin cancer , especially in people with light skin ;

- the effect on the nervous system is mediated through irradiated capillaries skin squirrels blood and cholesterol. occurs excitation vegetative centers hypothalamus and subcortical nodes , increase temperature body , increase and then decrease bloody pressure , drowsiness , collapse and death from paralysis respiratory center.

Photosensitization - increase sensitivity to UV radiation . _ Photosensitizers they can strengthen effect of UV radiation . They include paint (methylene blue), cholesterol and porphyrins , as well as contact photosensitizers (perfume , lipstick , creams , etc.) . In persons with high content porphyrins in the blood because of violation transformation hemoglobin (for example , with hematoporphyria) even after short-term staying in the sun they can arise burns and serious condition intoxication irradiated by toxic products porphyrins - photoallergy .

Harmful action thermal energy _

Action high temperature may cause burns , burn disease and overheating body _

Burn (thermal) - local tissue damage as a result actions flames , hot liquids

, steam, heated solid bodies _ By depth 4 degrees of tissue damage are distinguished burns :

I degree - redness skin (erythema);

II degree - formation blisters ;

IIIA degree - partial or complete necrosis of the germ layer of the skin ;

IIIB degree - complete necrosis of the skin over its entire surface thickness ;

And V degree - necrosis of skin , tendons , muscles .

Mechanism occurrence burns related to development inflammatory reactions in place actions thermal agent and coagulation proteins , which leads to death cells and tissue necrosis.

Burn disease - functional violation internal organs and systems caused by large (more than 10-15% of the surface bodies) and deep burns _

There are 4 periods development burn diseases :

1. *Burn shock* - in the first 12-36 hours in the zone care sharply increases permeability capillaries , this leads to a significant exit liquid from vessels in tissues . In place damage a large amount evaporates swollen liquid , falls volume circulating blood _ Conductive pathogenetic factors : hypovolemia , pain and elevation permeability vessels _

2. *Opikova toxemia* - develops because of autointoxication by products of tissue decay on the spot burn (denatured protein , biologically are active amines , polypeptides , etc.) and production specific burns autoantibodies (in the skin are found burns autoantigens specific for this type of damage);

3. *Opikova infection* ;

4. *Burning exhaustion* ;

5. *Restoration* .

Overheating (hyperthermia) - increase temperature bodies because of accumulation excess heat during operation high temperature surrounding environment .

Increase temperature bodies accompanied by :

- sharp frequency respiratory movements (irritation respiratory center hot

blood), develops thermal shortness of breath ;

- increase frequency cardiac contractions and blood pressure ;

- at the expense of water loss due to strengthening sweating happens thickening of blood is disturbed electrolyte exchange , increases hemolysis erythrocytes ;

- damage various tissues leads to accumulation toxic products their decay ;

- in connection with the destruction of VII, VIII, X and others plasma factors is violated folding blood _

Overstrain mechanisms thermoregulation leads to them exhaustion , with further braking functions central nervous system , oppression breathing , functions heart , decrease arterial pressure and, as a consequence - to deep hypoxia .

Heatstroke is acute _ overheating body with fast increase temperature bodies or long influence high temperature surrounding environment . Death by heatstroke occurs from paralysis respiratory center

Action low temperature may cause hypothermia and frostbite .

Hypothermia (hypothermia). In pathogenesis allocate the following phases :

1. Compensation . Reactions aimed at restrictions heat transfer : reflex vasospasm , decrease sweating , slowing down breathing _ Magnification heat production : muscular shivering (chills), increased processes glycogenolysis in the liver and muscles , increase equal glucose in the blood , strengthening of the basic metabolism .

2. Decompensation (with prolonged actions low temperatures). Body temperature decreases , stops muscular tremors are decreasing consumption oxygen and intensity exchangeable processes are expanding peripheral bloody vessels _ As a result braking functions of the cerebral cortex and depression subcortical and bulbar centers decreases arterial pressure , heart rate slows down contractions , progressively the respiratory rate weakens and decreases movements _ Gradual fade out all vital functions . Death is coming from paralysis respiratory center.

Hibernation - artificial decrease temperature bodies in medical practice that _

is achieved under anesthesia with help physical effects , is used to reduce the body's need for oxygen and prevention temporary ischemia brain _

Defrosting . Action is the direct cause of frostbite low body temperature _ a person

By depth tissue injury from frostbite can be:

• First degree frostbite . The first signs - feelings burning , tingling with further numbness affected areas _ Then appear itch skin and pain different degree expressiveness . Impressed area skin pale , after warming reddened , sometimes with purple- red shade ; swelling develops . After a few days may to observe insignificant shelling skin _ Complete recovery occurs up to 5 - 7 days after frostbite .

• II degree frostbite . After warming pain becomes more intense and longer than with frostbite of the 1st degree , disturbing skin itching , burning . In the initial period, there is pallor , cooling , loss sensitivities , education blisters , filled transparent content _ Complete restoration integrity skin cover happens within 1-2 weeks , granulations and scars do not form .

• III degree frostbite . Lasting intense painful feeling _ Formed in the initial period blisters which _ are filled bloody content , the bottom of them blue-red , insensitive to irritation . Happens death everyone elements skin with development granulations and scars . Rejection dead tissue ends in 2-3 weeks , after what is coming scarring that lasts up to 1 month .

• IV degree frostbite . Are damaged all layers soft tissues, often are impressed bones and joints . Damaged area limbs sharply bluish, sometimes with marbling color _ Absence blisters with developed significant edema , loss sensitivity indicate IV degree frostbite . _ Skin temperature much lower than on others _ areas of tissues.

Effect on the body changed barometric pressure _

Influence reduced barometric pressure (hypobaria). With hypobaria man occurs during ascent in the mountains , when climbing to a height in leaky ones flying devices , in case of accidents cosmic devices , in pressure chambers.

At an altitude of 3-4 thousand meters (which responds barometric pressure 530-460 mm Hg) occurs expansion gases and increase their pressure in closed and

semi-closed cavities bodies that _ leads to irritation receptors walls , causing painful sensations (especially tympanic membranes and mucous membranes shell middle and inner ears , maxillary and frontal sinuses).

At an altitude of 9 thousand meters and more (which corresponds to 225 mm Hg . and below) occur symptoms decompression . It associated with the transition to the gaseous state of dissolved in liquids body oxygen and, especially, nitrogen. Bubbles free gas (gas emboli), that formed , spread through the vessels in different areas organism , causing embolism . This in turn leads to development tissue ischemia . Especially dangerous embolism crown vessels and vessels of the brain .

Mountain sickness. On a large height man falls under under influence of the 4 main ones pathogenic factors :

- reduced partial pressure of oxygen in inhaled air air (main pathological factor);

- elevated sunny irradiation ;

- cold;

- dryness inhaled air _

Pathogenesis: deficiency oxygen causes a number of adaptive reactions aimed at maintaining normal oxygen _ supply organs and tissues, and, at the same time, on more economical expenditure energy and vitality in the conditions oxygen starvation _

Compensatory level reactions _ body :

- strengthening pulmonary ventilation ;

- promotion oxygen containers of blood (emission erythrocytes from blood depots - spleen , liver ; with prolonged stay in the conditions hypoxia strengthening erythropoiesis);

- increase minute volume circulating of blood , acceleration of blood flow.

Compensatory reactions on tissue levels :

- is growing capillarity ;

- increases myoglobin ;

- improving systems regulations redox processes , etc. _

Excess carbon dioxide in the blood excites respiratory center As a result hyperventilation in the blood decreases CO_2 content , as a result is developing respiratory alkalosis is disturbed regulation breathing _ In a person most brain tissues are sensitive and vulnerable to hypoxia . _

Vybukhova decompression occurs , as a rule, with fast depressurization flying device on a large height (more than 16 km above sea level).

Pathogenesis: sharp decreases partial pressure of oxygen in inhaled air air , joins multiple gas embolism of tissues and organs (quick formation gas bubbles , mainly nitrogen, due to sharp decrease him solubility in tissue and intertissue liquids). occurs the effect of " boiling " of blood , intercellular and even intracellular liquids , which leads to rupture vessels , lungs and others organs .

On the background excess afferentation from a huge receptor field and mechanical limitation excursions lungs , heart and blood vessels quickly becomes complicated and oppressive breathing , cardiac activity , return of blood to the heart decreases arterial and rises venous pressure and pressure spinal cord liquid _

The main ones symptoms explosive decompression : expansion chest cages ; subcutaneous emphysema ; bloating and all bodies ; fast output in the form of jerk air from the nose, mouth and anus ; involuntary vomiting , defecation , urination ; quick cooling body _ Within 1-2 minutes _ from the beginning of development explosive decompression stops the heart is developing collaptoid state, is lost consciousness , arise convulsions , and death occurs .

Influence elevated barometric pressure (hyperbaric) .

There are two main ones species hyperbaria : *natural and artificial* .

Artificial hyperbarium , which is carried out with different goals occurs when being a person or experimental animals in a pressure chamber (for example , hyperbaric oxygenation).

Natural hyperbaria - compression body during immersion under water (when diving in large depth , diving and caisson works, in the fleet , especially underwater).

Periods (stages) of development hyperbaria :

1. *Period immersion* (period of transition from normal to elevated pressure). When diving they are compressed under water to a depth of 20-40 m superficial vessels , chest cage , lungs , increases blood filling internal bodies (including lungs , heart , brain), that is accompanied overstretching walls their vessels , up to rupture , depression (up to rupture) of the tympanic membrane membrane _ Maybe displacement and compression internal organs , as well as gaps pulmonary tissues and even death.

2. *Period saturation* (period permanent elevated saturation liquids and tissues by gases as a result magnification their solubility). Intensifies development barotrauma lungs _ Dissolved in plasma , tissues (especially nerve and fat , where it dissolves 5 times more than in the blood) nitrogen, causes first euphoria , then - narcosis and finally - toxic action _ Toxic effect of nitrogen and oxygen appear development of headache, dizziness , disorders cardiovascular system (in the form bradycardia , decrease voluminous blood flow rate), damage epithelium respiratory ways , alveoli, them surfactant layer (up to swelling lungs), mucosa lining of the digestive tract, suppression erythropoiesis , development and progression metabolic acidosis, convulsions, necrobiosis , necrosis and even of death

3. *Period desaturation* (period rise , or decompression that _ characterized by formation and increase gas , especially nitrogen , bubbles in extracellular and intracellular liquids). It develops during transition organism from the region elevated pressure to normal atmospheric pressure . In case of violation of the lifting rules is developing bends . The faster the diver rises from the depths of the permissible time , the faster , in large quantities and larger are formed gas bubbles (especially nitrogen and helium), because it changes from a dissolved state to a gaseous state . The gas accumulates in the form of bubbles in the blood , extracellular fluids , fatty and nervous tissues. Urgent assistance : placement of the patient in a pressure chamber (sub strict medical control), creation in it hyperbaria (with the necessary amount and composition of gas mixtures), and then strictly controlled slow , long , gradual decrease barometric pressure and quantity inert gases in the respiratory tract mixtures .

Action on the body electric current.

Features harmful current actions :

- damages tissues along the entire path of passage ;

- irritates huge number receptors ;

- causes biological effect , chemical , mechanical , thermal damage _

Mechanism current actions :

1. Mechanical action conditioned significant thermal and mechanical energy currents high voltage _ Joint action thermal and mechanical energy provides explosive effect _ Manifestations:

• delamination of tissues;

• detachment parts bodies ;

• education cut wounds;

• bone fractures , skull injuries .

2. Electrochemical current action includes : electrolysis ; polarization cell membranes; accumulation in some areas of positively charged ions , occurrence sour reactions and coagulation proteins coagulation necrosis; on others negatively charged accumulate ions , occurs alkaline reaction occurs _ swelling colloids , occurs colliquation necrosis; movement protein molecules; accumulation toxic products electrolysis ; gases pass from the dissolved state to the gaseous state.

3. Thermal action conditioned transformation electric energy into heat with allocation big the amount of heat in the tissues. Manifestations of the thermal action of the current:

• « pearly necklace » occurs during melting bone substances with the release of calcium phosphate ;

• "current signs" - sections coagulated epidermis that _ have round or oval shape, gray-white color , solid consistencies , bordered roller-like elevations and depressions in the center ;

• leafy picture red color conditioned paralysis blood vessels vessels _

Mechanisms of fatal outcome:

- stop hearts because of fibrillation ventricles ; coronary spasm blood vessels

; damage vascular center; increase in tone n. v agus _

- stop breath because of damage respiratory center; spasm a. vertebralis , that are supplied by blood respiratory center; respiratory spasm muscles , laryngospasm, which means a violation passability respiratory ways _

Harmful action ionizing radiation _

All by nature _ ionizing radiation are divided into electromagnetic (X-ray radiation and γ- rays , which accompany ra-radioactive decay) and corpuscular (charged particles : helium nuclei - α- rays , electrons - β- rays , protons , π- mesons , as well as neutrons that do not carry electric charge).

Pathogenesis of radiation damage includes primary action ionizing radiation (IR) at the level atoms and molecules, action at the level cells and the whole body _

Primary IP action at the level atoms and molecules:

- direct action of IP - absorption energy , excitation and ionization atoms and molecules, formation radicals (especially dangerous products radiolysis of water). free radicals cause chain chemical reactions , interact with the most _ reactive protein structures of enzyme systems (SH- groups) and translated them in inactive disulfide groups (S = S).

- indirect action - interaction radicals with nucleic acids, proteins , lipids , carbohydrates , active centers of enzymes . As a result are formed primary radiotoxins , which inhibit the synthesis of nucleic acids. This , in turn , depresses activity different enzymes that _ increase permeability biological membranes and changes diffusive processes in the cell . As a result this arise violation processes exchange , functional and structural damage cells , organs and body systems .

IP action at the level cells conditioned influence primary radiotoxins includes violation of the synthesis of macroergs , increase membrane permeability , violations integrity lysosomes , inhibition of DNA and RNA synthesis, rupture chains nucleic acids, genes mutations . This leads to synthesis changed proteins , formation secondary radiotoxins , initiation reparations , violations biochemical processes , change ultrastructure organoids , inhibition mitoses , radial death cells

Radiosensitivity cells _ To *radiosensitive* carry cells that are actively dividing

and poorly differentiated cells : hematopoietic cells bone brain , embryonic cells testes , intestinal and skin epithelium _ Despite the differentiation , high radiosensitivity have lymphocytes .

Radioresistant tissues include *the* brain , muscles , liver , kidneys , cartilage , and ligaments .

IP action at the level cells : increase membrane permeability , activation and release lysosomal enzymes (DNAase , RNAse , cathepsins , phosphatases) , suppression fabric breathing , degenerative changes in the core . Mitotic (reproductive) death cells - emergence chromosomal aberrations leads to disruption of DNA synthesis and death cells at the time of mitotic division _

IP action at the level body :

- Sharp radiation sickness
- Chronic radiation sickness
- Local action of IR (radial burn , cataract, necrosis)

Distant consequences IP actions : can to develop in 10-20 years or more , after general or local exposure body _

Allocate *somatic* consequences (appear in the irradiated body):

- non-neoplastic forms - abbreviations duration life , hypoplastic conditions in hematopoiesis tissue , mucous membranes shells bodies digestive , respiratory ways , in the skin ; sclerotic processes (cirrhosis liver , nephrosclerosis, atherosclerosis, radiation cataracts), as well as dyshormonal conditions (obesity , pituitary cachexia , non-diabetic diabetes).
- development tumors , radiation leukemias .

Genetic consequences (as a result damage sexual cells) can appear death zygotes or embryo , birth individuals with hereditary anomalies or those who carry mutant genes _ " Genetic cargo » can be passed down from generation to generation .

sharp radiation sickness (RPC) occurs with total, one-time, uniform , external irradiated body in a dose more than 0.5 Gy.

There are 4 forms of GPC:

1. Bone-brain form of GPC occurs when exposed to doses of 0.5-10 Gy. Depending from doses distinguish 4 degrees severity bone marrow forms of GPC: I- mild degree (1-2 Gy); II - medium degree (2-4 Gy); III- severe degree (4-6 Gy); IV- extremely heavy degree (more than 6 Gy).

In his I will run the bone-marrow form passes through 4 periods :

- *period primary reactions* - occurs in the first minutes or hours after irradiation . Duration phase 1-3 days . Manifestations: excitement , main pain , general weakness ; dyspeptic disorders (nausea , vomiting , loss appetite); lability vegetative functions - fluctuations arterial pressure , heart rate ; activation pituitary-adrenal system , strengthened secretion adrenal cortex hormones glands ; at doses of 8-10 Gy is observed development shock-like state with decrease arterial pressure , short-term loss consciousness , increase temperature body , development of diarrhea. Peripheral blood: neutrophilic leukocytosis with landslide on the left , absolute lymphopenia .

- *period imaginary well-being* - inclusion in the pathological process protective mechanisms body _ Duration depends from doses exposure and fluctuates from 10-15 days to 4-5 weeks . At very severe forms of damage this phase is absent . Manifestations: well-being patients becomes satisfactory , visible clinical signs pass by ; in the gonads is possible atrophy , suppression early stages of spermatogenesis; in the small intestine and skin atrophic changes ; neurological symptoms disappear . Peripheral blood: progresses lymphopenia on the background leukopenia , decreases number reticulocytes and platelets . In bone brain is developing devastation (aplasia).

- *period in the heat of the moment illness* - sharp deterioration well- being Duration phases from several days to 2-3 weeks . When exposed above 2.5 Gy death is possible . Manifestations: weakness , body temperature rises ; appear bleeding and hemorrhages in the skin , mucous membranes shells , gastrointestinal tract, brain , heart and lungs ; decreases mass bodies , hypoproteinemia , hypoalbuminemia , increase content residual nitrogen and decrease chlorides . Peripheral blood: leukopenia , thrombocytopenia , anemia , increased ESR. In bone brain - a picture

of devastation with initial signs regeneration . Joining infection as a result decrease immunity _

- *the recovery phase* is gradual normalization violated functions . Duration 3-6 months , in severe cases in cases of 1-3 years, it can turn into a chronic form. Manifestations: the general condition is significant improves , the temperature normalizes , disappear hemorrhagic and dyspeptic manifestations, after 2-5 months normalizes function sweaty and greasy glands , is restored growth hair _ Peripheral blood: are restored Indexes blood and metabolism substances _

2. Intestinal form of GPH occurs when exposed to 10-20 Gy. Manifestations: nausea , vomiting , bloody diarrhea, increased t^0 bodies , can to observe full paralytic intestinal obstruction and bloating . They are developing hemorrhages and deep leukopenia with complete absence lymphocytes , picture of sepsis. Death as a result dehydration , which is accompanied loss electrolytes and protein , shock.

3. Cerebral form of GPH occurs when exposed to doses of 20-50 Gy, death after 1-3 days . Manifestations: convulsive- paralytic syndrome, disorder blood circulation , lymphatic circulation in the central nervous system, vascular tone and thermoregulation , digestive and urinary systems; progressive decrease arterial pressure _ The cause of death is death cells of the cerebral cortex , neurons , nuclei of the hypothalamus .

Chronic radiation sickness (CPC) occurs with prolonged irradiated body in small , but which ones exceed permissible doses. Disease differs gradual development and lasting wave-like flow , terms occurrence and nature of changes at the same time are determined intensity and total radiation dose . Initial period disease characterized by development unstable leukopenia , signs astenization , vegetative-vascular instability , etc. _ Expanded period disease inherent insufficiency physiological regeneration most radiosensitive tissues in combination with functional ones changes in activity nervous and cardiovascular systems. Period restoration characterized by smoothing destructive and expressive predominance reparative processes in the most radiodamaged tissues.

Topic: The role of heredity, constitution, age-related changes in pathology.
Types of tasks: The role of heredity, constitution, age-related changes in pathology.
Number of hours: 4

Hereditary diseases are _ diseases which _ conditioned violation hereditary information as a result mutational process and obtained body a person with sexual cells parents _

Congenital diseases reveal themselves from birth child _ They can be due to both hereditary and external , teratogenic influences .

Classification hereditary diseases. Depending from volume violations quantity genetic information hereditary diseases divided into 3 large groups : *monogenic , polygenic and chromosomal* .

Mutation is _ stable DNA damage . Classification : *spontaneous* (occur spontaneously, without influence external factors) and *induced* (caused artificially, by action external factors which _ are called mutagens); *somatic* (occur in somatic cells) and *sex cells* (occur in sex cells cells); useful , harmful , neutral ; *genomic* , *chromosomal* and *gene* .

The causes of mutations are ***mutagens*** . Classification :

- physical mutagens : all species ionizing radiation , ultraviolet rays and high temperature.

- chemical mutagens : a) agents that deaminated (nitrous and nitric acid, as well as others nitro compounds); b) substances which able transfer alkyl (methyl , ethyl , etc.) to DNA molecules ; c) connection nitrogenous bases (5-bromurocil, 2-aminopurine, etc.) ; d) connections which are embedded in the DNA molecule and cause violation her configurations (acredine and his derivatives).

- biological mutagens - viruses .

Chromosomal diseases - hereditary diseases which _ conditioned genomic (change in the number of chromosomes) and chromosomal (change chromosome structures) by mutations .

Chromosomal mutations :

1. deletion - loss individual regions of chromosomes;

2. duplication - doubling individual regions of chromosomes;

3. translocation - transfer plots from one chromosomes to another ;

4. inversion - rotation of a part chromosomes at 180 ^{0} .

Distinguish chromosomal diseases caused by :

1) change quantity and structure autosome ;

2) change quantity sex chromosomes.

Chromosomal diseases caused by change quantity and structure autosome _ It is a consequence non-divergence chromosomes in gametogenesis .

Down syndrome - trisomy on the 21st chromosome , karyotype 47 XX (XУ) + 21. Clinical diagnostic signs : low height , different degree mental retardation , craniofacial anomalies : " Mongoloid " cut of the eyes, short neck, epicant , flat face , small short nose , big tongue , small deformed ears . Muscles are also characteristic hypotonia , laziness joints , transverse fold on the palms , clinodactyly little finger Internal birth defects organs (heart), reduced immunity is often the cause of death these children _

Patau syndrome - trisomy on the 13th chromosome , karyotype 47 XX (XУ) + 13. Clinical diagnostic signs: cleft upper lip and palate ("hare lip" and "wolf mouth"), reduced skull volume, low forehead, microphthalmia , anophthalmia (absence of one or both eyeballs), deformed auricles, polydactyly; congenital defects of the heart, other internal organs. Most children die in the first weeks or months.

Edwards syndrome - trisomy on the 18th chromosome, karyotype 47 XX (XУ) + 18. Clinical diagnostic signs: anomalies of the cerebral and facial skull, the cerebral skull has a dolichocephalic shape; defects of the heart and large vessels; hypoplasia of the cerebellum and corpus callosum, changes in olive structures, pronounced mental retardation, decreased muscle tone.

Chromosomal diseases caused by changes in the number of sex chromosomes.

Shereshevsky -Turner syndrome (karyotype 45XO). Clinical diagnostic signs : female phenotype; low height , short neck with lateral skin folds (sphinx neck), primary amenorrhea, infertility . Rozumova backwardness there is no

Klinefelter's syndrome (karyotype 47XXU). Microscopic examination reveals 1 Barr body , male. Clinical signs: tall stature, long limbs, eunuchoidism ,

gynecomastia (enlargement of mammary glands), lack of spermatogenesis , underdevelopment of gonads, mental retardation.

Trisomy on the X chromosome (karyotype - 47XXX, superwoman). At microscopic examinations 2 Barr bodies are detected . In such patients is noted insignificant mental backwardness and underdevelopment ovaries and, therefore , disorder sexual development _

Henny diseases conditioned by genes mutations . Types of inheritance genes diseases : autosomal dominant , autosomal recessive , X- linked (dominant and recessive), Y- linked .

Autosomal dominant type of inheritance . The effect of the mutant gene is manifested both in the homozygous and heterozygous state . sick people girls and boys are born with the same frequency. For example : brachydactyly , syndactyly , Huntington's disease, Marfan syndrome , neurofibromatosis.

Autosomal recessive type of inheritance . The effect of the mutant gene is manifested in the homozygous state . According to this type of inheritance are transmitted diseases caused by enzyme defects proteins - enzymopathies (phenylketonuria , alkaptonuria , albinism , etc.) .

Recessive type of inheritance linked to the X-chromosome. The effect of the mutant gene is manifested only with ХУ set , that is only in boys , women are carriers pathological gene. For example : hemophilia , color blindness and some types of muscular dystrophy dystrophy .

Dominant type of inheritance , linked to the X-chromosome. A pathological gene manifests itself in any variants of the set of sex chromosomes: XX, XU, XO. Manifestations do not depend from gender , but more difficult occur in boys . All sons of a sick father are healthy , all of them daughters are sick . From mother the pathological gene is transmitted half daughters and sons . For example : phosphate- diabetes , vitamin D- resistant rickets _

Multifactorial disease - diseases with hereditary due to inclination combination genetic and non-genetic factors (external environment). To such diseases include : atherosclerosis, gout, rheumatism, coronary heart disease ,

hypertension , epilepsy , peptic ulcer disease of the stomach and duodenum, cirrhosis liver , sugar diabetes , bronchial asthma, tuberculosis , psoriasis , schizophrenia .

Methods study hereditary diseases:

1. Genealogical - study pedigrees families in a row generations ;

2. Twin ;

3. Population-statistical ;

4. The cytological method allows conduct research karyotype in the nuclei of cells that share , learn sex chromatin in cells mucous shells oral cavity , to investigate the phenomenon of " tympanic rod » in the nuclei of neutrophils ;

5. The biochemical method is used as a method of express diagnostics hereditary metabolic diseases substances ;

6. Molecular genetic - DNA diagnostics .

The constitution is a complex of morphological , functional and mental features organism that _ formed on a hereditary basis basis under influence factors external environment and determines him reactivity and resistance .

Classification constitutional types :

- according to Hippocrates : sanguine , choleric, phlegmatic, melancholic ;

- by type of GNI (I. P. Pavlov): strong balanced mobile , strong unbalanced exciting , strong balanced calm , weak ;

- according to Chernorutskyi : hyposthenic , hypersthenic , normosthenic ;

- according to Kretchmer : athletic , picnic , asthenic ;

- according to Shigo : respiratory , digestive , muscular , cerebral ;

- according to Bogomolets: asthenic , fibrotic , lipomatous .

Diathesis is _ anomaly constitution , which is characterized by an abnormal reaction organism on physiological and pathological irritants .

There are 4 types diathesis _

Exudative-catarrhal diathesis _ External appearance child normal or pasty _ It is observed significant tendency to occur inflammatory processes with formation exudates and true allergic reactions . Clinically it manifests itself in the form of urticaria , bronchial asthma , edema Quincke .

Lymphatic-hypoplastic diathesis _ External appearance characterized by pasty and paleness skin covers , muscle tissue is poorly developed , it is noted availability increased lymph nodes . Often observed sore throat and pharyngitis , in the blood is noted lymphocytosis . Characteristic predisposition to autoimmune diseases _

Nervous and arthritic diathesis _ External appearance normal or pasty _ Often found obesity _ Excitability nervous systems increased _ Characteristic tendency to deforming diseases joints non-infectious origin , skin diseases such as eczema , disorders psyche , gout , obesity , rheumatism.

Asthenic diathesis _ Characterized by lability of vascular tone reactions .

Kinds violations intrauterine development in dependence from their time occurrence :

1. Gametopathies occur before fertilization , during the period gametogenesis process .

2. Blastopathies - pathologies which _ are formed in the first 15 days development embryo _

3. Embryopathies are disorders that _ cover a complex of pathologies that occurs after differentiation embryoblast before the end of organ laying (16 days to 12 weeks).

4. Fetopathies - disorders fetal development . Neonatologists distinguish pathology early fetogenesis , when it occurs the formation of fine structures of tissues and organs is achieved viability of the fetus (12 weeks - 7 months), as well as violations late fetogenesis , when it occurs process becoming functions of the fetus at the same time aging placenta (7th month - before childbirth).

Aging is _ biologically destructive process which _ develops with age and leads to limitation adaptive opportunities organism , appearance age pathology and increase probabilities of death

Theories aging _ Currently, they are allocated the following groups theories which _ explain the causes of aging .

1. Theories genetically programmed aging _

2. Theories accumulation damage _

3. Synthetic theories aging (in general combine the first and second types).

Topic: Typical disorders of peripheral blood circulation and microcirculation.
Types of tasks: Typical disorders of peripheral blood circulation and microcirculation.
Number of hours: 4

Arterial hyperemia - an increase in the blood filling of an organ or tissue area due to an increase in arterial blood flow.

Reasons:

- physical (temperature, UV radiation);

- chemical (turpentine , mustard powder);

- biological (toxins);

- psychogenic (emotions).

Species :

- ***physiological*** (develops in connection with the increased need of tissues for oxygen and nutrients substances): *working* (functional) - conditioned metabolic needs of the body or tissues in communication with increase their functioning . For example , hyperemia in the muscle during exercise work , hyperemia pancreatic gland and intestinal walls at the time of digestion , hyperemia endocrine glands during secretion , hyperemia _ drooling glands _ Magnification contractile activity myocardium leads to an increase in coronary blood flow, activation of the brain is accompanied strengthening him blood supply *Reactive* (postischemic) arterial hyperemia observed after temporary cessation of blood flow (temporary ischemia) and has a protective and adaptive nature (removal harness).

- ***pathological*** - develops with pathological processes such as allergy , fever , inflammation .

The leading link of pathogenesis: expansion arteriole and enlargement tide arterial blood _

Mechanism expansion artery :

- **neurogenic :** decrease in the tone of vasoconstrictors (neuroparalytic), increase in the tone of vasodilators due to acetylcholine (neurotonic);

- **humoral** (myoparalytic) - expansion blood vessels with BAV : histamine , bradykinin , lactic acid, excess carbon dioxide , nitric oxide, adenosine, hypoxia ,

some prostaglandins , etc. _

Manifestations arterial Hyperemia :

- redness areas fabrics at the expense of magnification quantity functioning capillaries and arterialization venous blood ;

- local increase temperature (increase tide arterial of blood and strengthening redox processes in the fabric ;

- increase in tissue turgor (expansion vessels , increase blood filling);

- expansion arteriole , increase blood flow rate , increase intracapillary pressure , increase quantity functioning capillaries .

Consequences : - *positive* : improved delivery of oxygen and nutrients to the body substances , strengthening exchangeable body processes and functions ; - *negative* : gap vessels with hemorrhage if present pathologies , generalization infections , progression tumor growth and metastasis .

Venous hyperemia - increase blood filling of the organ or areas fabrics because of difficulty outflow venous blood _

Reasons:

- vein thrombosis;

- compression of veins from the outside tumor , enlarged uterus during pregnancy , scar , exudate , tourniquet ;

- violation general hemodynamics in right ventricular failure cardiac deficiencies ;

- constitutional insufficiency of the valve apparatus of the veins.

The leading link of pathogenesis: difficulty outflow venous blood _

Mechanism development : circulatory hypoxia → damage cells → death cells → sclerosis; local intoxication due to accumulation dairy acid , carbon dioxide → metabolic acidosis

Manifestations of venous Hyperemia :

- cyanosis areas fabrics at the expense of increase in blood reconstituted hemoglobin ;

- local decrease temperature (decrease restorative processes in the tissue ,

increase heat transfer);

- increase in the size of the organ (increase blood filling , edema);

- expansion of veins and capillaries , slowing down blood flow rate ;

- increase filtering liquid , decrease her reabsorption , difficulty lymph drainage .

Consequences : - *positive* : deceleration development local infectious process , relief migration leukocytes in the focus inflammation ; *negative* - atrophy parenchymatous elements , growth connecting tissues and the development of sclerosis.

Ischemia - reduction blood filling of the organ or areas fabrics because of reduction tide arterial blood _

Reasons:

- compression arteries from outside

- thrombosis and embolism arteries ,

- angiospasm arteries ,

- atherosclerotic damage internal shells arteries _

The leading link of pathogenesis: reduction of arterial inflow blood _

Mechanism development : disorders _ energy metabolism : $\downarrow O_2 \rightarrow$ violation of oxidative phosphorylation in mitochondria $\rightarrow \downarrow$ ATP $\rightarrow$ violation contractile and secretory functions cells , violation of active transport of substances $\rightarrow$ necrosis, strengthening biosynthesis components connecting tissues $\rightarrow$ sclerosis.

Manifestations of ischemia :

- pallor of a tissue area due to reduction blood filling and number of functioning capillaries ;

- local decrease temperature (decrease inflow of heat arterial of blood , reduction of redox processes in the fabric);

- pain or paresthesias (irritation nervous endings with products of metabolism (H^+, K^+);

- decrease in the size of the body (decrease blood filling);

- reduction intravascular pressure , deceleration speed of blood flow, decrease

in the number of functioning capillaries , decrease filtering liquid , decrease lymph drainage .

Consequences ischemia : restoration blood circulation on collaterals vessels , disorders nutrition and death tissues (necrosis).

Stasis - stoppage of blood flow in vessels microcirculatory channel.

Species :

- ischemic due to termination _ tide arterial blood ;
- venous in connection with termination outflow venous blood ;
- capillary (real) - intracapillary aggregation erythrocytes .

Pathogenesis of aggregation erythrocytes in capillary seniority : etiological factors → damage walls capillaries → increase their permeability → filtration fluid and albumin in the surroundings tissue → increase in blood equal high molecular weight proteins (globulins and fibrinogen) → adsorption proteins on erythrocyte membranes → changes in the surface potential of erythrocyte membranes → aggregation erythrocytes . Etiological factors → damage to erythrocyte membranes → changes physical and chemical membrane properties (decrease ability to deform) → changes superficial potential membrane erythrocytes → aggregation .

Consequences stasis: restoration blood circulation (reversible stasis), necrosis (irreversible stasis).

Thrombosis is lifelong postponement _ _ clot stabilized fibrin and formed elements blood on the internal surface blood vessels vessels with partial or full obturation their enlightenment _

Mechanisms formation and structures a blood clots depend from features of blood flow in a vessel . Basically _ *arterial thrombosis* - thrombus formation in the arterial system with high by the speed of blood flow, - lies activation vascular - platelet (primary) hemostasis, and at the base *venous thrombosis* - formation blood clots in the venous system , which is characterized by low speed of blood flow, - activation coagulation (plasma) hemostasis.

Triad Virkhova :

1. Damage endothelium : death endotheliocytes ; violation their functions - endothelial dysfunction ; death of endotheliocytes → exposure of the basement membrane → unmasking of collagen → ↑ adhesion of platelets;_endotheliocytes release Willebrand factor , which forms "bridges" between collagen and platelets.

2. Violation current of blood - when changing current of blood from laminar to turbulent formative elements of blood are acquired possible about art _ to contact the endothelium .

3. Increase viscosity blood _

Embolism - displacement of blood (lymph) and blockage of blood vessels foreign bodies (embolism and).

Embolism endogenous origin :

a) thromboembolism ;

b) fabric - pieces tissues in case of injuries or tumors with them decay ;

c) fatty - droplets of fat in tubular fractures bones or damage fatty fibers during liposuction ;

d) embolism amniotic fluid - hit amniotic fluid during childbirth is damaged _ vessels of the uterus.

Embolism exogenous origin :

a) air - bubbles air that _ fall from the environment medium into large veins (upper hollow , jugular , subclavian), in which bloody pressure may be below atmospheric;

b) gas - gas bubbles that are formed in the blood during rapid decrease barometric of pressure , for example , at a fast rising divers from the region high pressure to normal; during depressurization cabins aircraft at high altitudes (transition from normal to low atmospheric pressure);

c) foreign bodies - in case of gunshot wounds

Topic: Inflammation.
Types of tasks: Ignition.

Number of hours: 5

Inflammation is a typical pathological process that occurs under the action of phlogogenic factors, characterized by alteration phenomena, microcirculation disorders (with exudation and emigration) and proliferation aimed at localization, destruction and removal of the damaging agent , as well as for the restoration (or replacement) of tissues damaged by it.

The causes of inflammation are phlogogens . Classification of phlogogenic factors:

Exogenous:

- Physical (mechanical trauma, exposure to high and low temperatures, ionizing radiation);
- Chemical (acids, alkalis, salts of heavy metals);
- Biological (bacteria, viruses, fungi).

Endogenous:

- Products of tissue decay during tumor growth;
- Toxic metabolites formed in the event of impaired kidney and liver function;
- Products of tissue decay during heart attack, burns ;
- Immune complexes.

Components of inflammation:

1. Alteration
2. Exudation and emigration leukocytes
3. Proliferation

Alteration is a violation structures and functions cells , intercellular substances , nervous endings , vessels . Alteration can be primary or secondary . ***Primary alteration*** is developing at once after impact harmful factor and is formed at the level functional organ element . ***Secondary alteration*** is the consequence primary and related with change exchange substances , physical and chemical changes , action mediators inflammation _

Mediators inflammation is biological are active substance , appearance which are in the hearth inflammation determines further him ran over

Name	Characteristic
Cellular mediators G and hundred and n	Expands _ arterioles and increases _ _ penetrating _ _ _ vascular walls , irritates nerves and _ end , cause spasm of the smooth muscles bronchi , uterus, intestines
Seroton and n	Increases the permeability of the vascular wall, expands an intact vessel, narrows a damaged one
Lysosomal enzymes	They cause secondary tissue alteration, chemotaxis, increase the permeability of the vessel wall, activate the systems of complement, blood coagulation and fibrinolysis, facilitate the migration of leukocytes
K at i onn i non-enzyme no b and lki	Increase the permeability of the vessel wall, stimulate the emigration of leukocytes, cause a bactericidal effect on microbes
Leukotrienes	They stimulate chemotaxis of neutrophils , narrowing of arterioles, increased permeability of the vascular wall, bronchospasm
Prostaglandins	They cause dilation of arterioles, increased permeability of blood vessels, chemotaxis of leukocytes, decreased sensitivity of nerve endings to stimuli
Thromboxanes	Activate adhesion and aggregation of platelets, vasoconstriction , increase blood coagulation
Prostacyclins	Cause disaggregation of platelets, dilation of blood vessels
Cytokines: - Interleukins - Interferons - Colony-stimulating factors - Chemokines - Apoptosis factors	Stimulate increased adhesion and emigration of leukocytes, increased vascular permeability, stimulation of neutrophils and monocytes. Stimulate phagocytosis, antibody formation , cell proliferation and differentiation
Active O_2 metabolites : O_2-, HO-, H_2O_2 Nitric oxide (NO)	They increase vascular permeability, bactericidal effect of phagocytosis, dilation of blood vessels, bactericidal effect
Humorous mediators Squirrels complement system C3a, C5a, C3c, complex	They cause chemotaxis, increase permeability postcapillary venules, release cellular mediators , cytolysis

C5c-C9	
Kinins (bradyki - nin , kalidin)	Expanding arterioles , increase permeability of venules, stimulation of T- lymphocytes , proliferation fibroblasts , release cellular mediators , pain , itching
Factors of coagulation and fibrinolysis systems	Regulate by flipping blood , chemotaxis

Vascular reactions during inflammation :

1) short-term vasospasm (reflex spasm , action endothelin , catecholamines , thromboxane A_2);

2) arterial hyperemia (paralysis vasoconstrictors , influence vasodilator mediators _ activity - histamine , bradykinin , nitric oxide);

3) venous hyperemia (*intravascular factors* : thickening blood ; formation microthrombi ; marginalization leukocytes ; swelling uniformed elements blood and walls vessels in an acidic environment ; *extravascular factors :* squeeze walls venous and lymphatic vessels exudate and cellular infiltrate ; destruction connective tissue fibers that surround walls capillaries and venules).

4) stasis.

Exudation is the way out liquid parts blood , which contains proteins and uniforms elements in a cell inflammation _

Pathogenesis of exudation :

1. Increase permeability vessels : reduction endothelial cells under action histamine , bradykinin , leukotrienes ; directly damage arteriole , capillaries , venules;

2. Increase hydrostatic pressure in capillaries and venules ;

3. Increase osmotic and oncotic pressure in the cell inflammation - at the expense of electrolytes and protein in tissues.

Kinds exudates :

- ***serous*** **-** contains 2-3% protein (albumin), transparent , observed in viral , allergic inflammation , burns ;

- ***hemorrhagic*** - contains significant number erythrocytes , formed in severe cases injuries vessels with destruction basal membrane , develops with influenza pneumonia , Siberian ulcers ;

- ***purulent*** **-** yellow -green in color , contains destroyed cells , leukocytes , bacteria , caused bacterial microflora ;

- ***rotting*** **-** gray color with an unpleasant smell, develops upon exposure anaerobic infections ;

- ***catarrhal*** **–** transparent , contains mucus , lysozyme , immunoglobulin A, develops in viral infections ;

- ***fibrinous*** **- in** is created with significant damage endothelium , contains fibrinogen , which upon contact with tissues turns into fibrin (in diphtheria , dysentery).

Value exudations :

- *positive:* dilution of the concentration of bacterial and other toxins and their destruction by proteolytic enzymes that come from the blood plasma; arrival of serum antibodies in the center of inflammation; emigration of blood leukocytes, which promotes phagocytosis; localization of the pathological process;

- *negative:* microcirculation disorders and ischemic tissue damage; excessive growth of connective tissue; organ dysfunction.

Emigration of leukocytes - release of leukocytes into the focus of inflammation.

Stages of emigration:

1. Marginal standing of leukocytes near the inner wall of blood vessels and rolling :

- slowing of blood flow;
- activation and expression of E and P - selectins on the surface of the endothelium;

- receptor interaction of L- selectins of leukocytes with E- and P -selectins of the endothelium → rolling → reversible adhesion;

- expression of integrins on the surface of leukocytes and their interaction with adhesive molecules on the endothelium (ICAM, VCAM) → irreversible adhesion to the endothelium.

2. Egress of leukocytes through the vessel wall:

- formation of pseudopodia and passage between endothelial cells

- lysis of the basal membrane by proteases;

- thixotropy effect.

3. Movement of leukocytes to the center of inflammation:

- chemotaxis - chemoattractants → interaction with receptors on the surface of leukocytes → increase of Ca^{2+} in the cytoplasm → activation of the microtubular system of the leukocyte, formation of pseudopodia, activation of intracellular enzymes → active movement of the leukocyte (energy due to anaerobic glycolysis).

Proliferation - reproduction of cellular elements of connective tissue. Stimulators of proliferation: epidermal and endothelial growth factor, platelet growth factor, cytokines (IL-1). Proliferation inhibitors: keylons , tumor necrosis factors.

Local signs of inflammation (pentad Celsus Galena):

- redness (development of arterial hyperemia);

- local fever (inflow of warm arterial blood and increased metabolic rate);

- swelling (exudation and inflammatory infiltrate);

- pain (irritation of nerve endings BAR, K^+, H^+; mechanical squeeze exudate);

- violation functions .

general signs inflammation :

- fever - due to IL-1;

- synthesis in the liver proteins sharp phases : C – reactive protein , fibrinogen , ceruloplasmin , haptoglobin ;

- neutrophilic leukocytosis with landslide on the left - leukopoietins stimulate

leukopoiesis ;

- accelerated ESR at the expense magnification quantity globulins and fibrinogen .

Topic: Pathology of reactivity. Violation of immunological reactivity.
Types of tasks: Pathology of reactivity. Violation of immunological reactivity.
Number of hours: 5

Reactivity is _ property body react to action factors external environment .

Classification species reactivity :

A) Species, group , individual .

Species reactivity is a set features reactivity characteristic of this living species _ creatures _ For example , animals indifferent to pathogens that _ cause whooping cough, scarlet fever, and humans - to pathogens that cause plague in pigs.

Group reactivity is formed on the basis of species and is divided into age , gender and constitutional . *age* reactivity determines specificity reactions to stimuli , characteristic for this age _ In particular , newborns compared to adults have bigger ability support bioenergy at the expense of anaerobic glycolysis ; adults do not get whooping cough . In the summer age has its peculiarities corresponding reactions to infectious diseases agents that _ may be related with decrease functions barrier formations , reduced ability produce antibodies and decrease phagocytic activity _ *Gender* reactivity is defined reactive inherent features _ given articles : for example , women more resistant to blood loss and pain, and men - to physical ones loads . *Constitutional* reactivity is defined heredity and lasting influence factors surrounding environments which _ form stable morpho- functional features body _ In particular , normosthenics and hypersthenics more resistant to prolonged and elevated physical and psychoemotional loads in comparison with asthenics .

Individual reactivity conditioned hereditary information , individual variability and constitutional features of each organism that determine the nature of his course as physiological reactions , as well as pathological ones processes . A typical example of manifestation individual reactivity serve allergic individual reactions _ individuals _

B) Non-specific and specific reactivity .

Specific reactivity (immunological reactivity) is manifested development antigenic immunity _ stimulation . Specific reactions form a characteristic in the patient the clinical picture of each nosological forms (for example , lesions hematopoietic organs during radiation disease ; spasm of arterioles in hypertension disease).

Non-specific reactivity manifests general programmed standard reactions characteristic of many _ diseases (development fever , hypoxia , activation of phagocytosis and the complement system , etc.).

C) Physiological and pathological reactivity .

Physiological reactivity is _ reactivity of physiological stimuli in adequate conditions existence body _ It has a protective and adaptive nature and is aimed at preservation dynamic constancy internal environment organism and on a full-fledged interaction organism with the environment the environment

Pathological (painful changed) ***reactivity*** - reactivity that _ occurs as a result effects on the body of a pathogenic stimulus and is characterized reduced adaptability organism to the environment environment (for example , allergic reactions).

D) By degree expressiveness process , where they are allocated hyperergic reactivity , hypoergic and dysergic (increased , decreased , perverted).

Normergic reactivity are characterized a reaction adequate to the character and strength impact of this factor.

Hyperergic reactivity is increased reactivity that _ it turns out excessive reaction to a pathogenic factor (for example , the occurrence anaphylactic shock in response to repeated , most often parenteral introduction specific antigen). With hyperergy dominate processes excitement , and with hypoergy - inhibition , as well as parabiosis .

Hypoergic reactivity is reduced reactivity organism that _ characterized by weak reaction to the influence of any agent (weak immune response to the antigen when present secondary immunodeficiency).

Energy - absence reactions body for any irritants that _ indicates a deep

violation of body systems called form appropriate reaction to the influence of any agent.

Resistance is _ stability organism to action pathogenic factors external and internal environment .

Kinds resistance : passive and active.

passive resistance is _ resistance to the action of the pathogenic factor, insensitivity to it . It occurs when it is impossible or hindered interaction organism with a pathogenic agent. passive resistance is independent and is provided by the following mechanisms : reactivity cells , physical and physico-chemical biological factors _ barriers _

Active resistance is _ stability , which is due to a complex of protective and adaptive reactions aimed at destroying the pathogen and its consequences him actions _ Active resistance is energy-dependent and its basis is phagocytosis and the compliment system .

Biological barriers organism is one of the mechanisms resistance , which serve for protection body or individual him parts , prevent violation constancy internal environment when acting on the body factors capable of destroy this one stability - physical , chemical and biological properties blood , lymph , tissue liquid _

Conditionally distinguish external and internal barriers _

To ***the external ones barriers*** include :

1. Skin that protects organism from physical and chemical changes in the environment environment and what participates in thermoregulation .

2. External mucous membranes shells which _ own powerful antibacterial protection , highlighting lysozyme _ Antimicrobial protein - immunoglobulin A, is secreted mucous shells and organs of immunity (in case of shortage immunoglobulin A - inflammatory disease).

3. Gastrointestinal the barrier is bactericidal action gastric juice + lysozyme and immunoglobulin A, then alkaline duodenal response is the first line protection _

Internal barriers regulate flow from blood to organs and tissues necessary energy resources and timely outflow products cellular exchange substances that _ provides constancy of composition, physico-chemical and biological properties tissue (extracellular) fluid and preservation them at a certain optimal level .

To internal barriers carry barrier organs (liver) and histogematic (separate tissue and blood). *Histohematic barriers* are divided in turn into *non-specialized* (wall capillary) and *specialized* .

Specialized barriers are different from the first because _ of the their are included additional structures which _ are doing notable impact on them permeability . To specialized barriers are related hematoencephalic , hematoophthalmic , hematocochlear , hematothyroid , hematotesticular and hematoovarian .

Hematoencephalic barrier (HEB) - physiological mechanism which _ selectively regulates exchange substances between blood and central nervous system, prevents penetration into the brain foreign substances and intermediates products . He provides relative unchanged composition, physical , chemical and biological properties cerebrospinal fluids and adequacy microenvironments individual nervous elements .

Complement system. This is a system of proteins serum blood , consistent activation which as a result reactions limited proteolysis causes damage cell membranes of bacteria and leads to them to lysis . The complement system consists of 11 proteins , which form 9 factions .

Immunological reactivity - ability body be responsible for implementation antigens education antibodies and cellular complex reactions specific to this antigen . _ _

There are two mechanisms immunological reactivity : cellular and humoral .

Cell type the immune system is represented by T- lymphocytes - killers .

Humorous type immune the response is represented by antibodies (immunoglobulins) - products of B- lymphocyte synthesis .

Antigens are _ substances , mostly protein nature , capable of entering the

body cause immune response and interact with the products of this answers antibodies or activated T- lymphocytes .

Antibodies are _ proteins (immunoglobulins), which are synthesized under influence antigens and specifically interact with them.

Cells that _ participate in the immune system answers : macrophages, B-lymphocytes , T- lymphocytes .

Immunological insufficiency - congenital or acquired immune defect system which _ manifests inability body fully carry out humoral and cellular reactions immunity _

Primary immunological deficiency and its causes. Primary immunological insufficiency occurs because of innate defects immune systems . Depending from equal violations and localization of the defect in the process hematopoiesis allocate the following species ***primary immunodeficiencies*** :

1) combined immunodeficiencies ,

2) cellular or T- cells immunodeficiencies ,

3) humoral or B- cells immunodeficiencies .

Combined primary immunodeficiencies :

a) Louis -Bar syndrome . It has availability a combination immunological deficiencies with ataxia (disruption coordination movements) and telangiectasia (lesion small blood vessels). average duration life patients up to 20-25 years old .

b) Wiskott-Aldrich syndrome . Immunological insufficiency is accompanied development lesions skin and thrombocytopenia . Suffering humoral and cellular mechanisms immune answers _ Duration life does not exceed 10 years .

Primary T cells immunodeficiency . Arise as a result violation processes formation and differentiation of T- lymphocytes . Most common is: Di-Georgi syndrome - congenital thymus aplasia . Disturbed differentiation precursor cells of T- lymphocytes into T- lymphocytes . Immune answer cellular type is absent , but humoral response to thymus-independent antigens is stored

Primary B- cells immunodeficiency . Arise as a result violation formation and differentiation of B lymphocytes . To this one groups diseases refers to

hypogammaglobulinemia Bruton . Hereditary defect is transmitted linked to the X-chromosome, so it manifests itself in boys . Disturbed differentiation precursor cells of B lymphocytes . The T-system of lymphocytes is not disturbed, ie saved cellular immunity _

Secondary immunological deficiency and its causes. Secondary called purchased immunological deficiency (immunosuppressive states). Her reasons occurrence can be ionizing radiation , medicinal drugs - GCS, cytostatics, protein starvation , tumor growth , deficit hello _ At $_{12}$, HIV, aging , nephrotic syndrome.

HIV is amazing cells that are on the membrane have protein - receptor of CD4. This white capable interact with protein - glycoprotein viral shells GR-120. Virus immunodeficiency mainly affects T- helpers (each cell has about 10,000 CD4 receptors).

Immunological tolerance - this state of specific immunological reactivity to this antigen is due previous contact with this antigen. With _ ability body give full immune answer to all others antigens saved _

Topic: Allergy.
Types of tasks: Allergy.
Number of hours: 5

Allergy is immune reaction (qualitatively changed immune answer) that is accompanied damage own tissues of the body .

The causes of allergies are **allergens .**

Classification allergens : exoallergens and endoallergens .

Exoallergens :

1) infectious : a) bacterial , b) viruses , c) fungi,

2) pollen of flowering plants plants , poplar fluff , dandelion , ragweed , cotton ,

3) household - detergents tools , household and library dust, as a product of life home tick , specific for a particular apartments ,

4) food products - especially in children - cow's milk, chicken eggs , chocolate, citrus fruits , strawberries , fish, crabs , lobsters , cereals ,

5) medicinal drugs - especially therapeutic ones serums , antibiotics , vitamins

,

6) products chemical synthesis.

Endoallergens :

a) natural (primary): lens and retina of the eye, tissues nervous system , thyroid glands , male sexual glands ,

b) acquired (secondary), induced from own tissues under influence external effects : infectious , non-infectious (cold , burns , radiation).

Classification allergic reactions :

1. By the time of occurrence reactions after re- entry allergen (according to Cook):

- Allergic reactions immediate type (hypersensitivity immediate type) - I, II, III - develop after 15-20 minutes after re- entry allergen _

- Allergic reactions delayed type (hypersensitivity delayed type) – IV - develop 24-48 hours after re- admission allergen .

2. According to pathogenesis (according to Coombs and Jell):

- I. Anaphylactic ;

- II. Cytotoxic ;

- III. Immunocomplex ;

- And V Hypersensitivity slow type.

General pathogenesis of allergic reactions:

I. Immunological stage

1. Formation antibodies or sensitized T- lymphocytes in primary contact with an allergen (sensitization);

2. Formation complexes allergen + antibody (I, II, III type) or allergen + sensitized T- lymphocyte (IV type) upon repeated contact with the allergen .

II. Pathochemical stage _ Characterized by release , activation , synthesis biologically active substances - mediators allergies _

III. Pathophysiological stage (stage clinical manifestations). Characterized by structural and functional changes in organs and tissues:

- vasomotor reactions (local and systemic) that lead to change arterial pressure , peripheral blood circulation and microcirculation ;
- increase permeability walls vessels that _ leads to development edema ;
- spastic contraction of smooth muscles bronchioles , intestine, which may to manifest asphyxiation , dyspeptic disorders ;
- imbalance between factors of coagulation , anticoagulation and fibrinolytic systems of blood , which may lead to both hemorrhagic syndrome and thrombosis ;
- irritation nervous receptors , which leads to development feeling of pain, itching , burning ;
- inflammatory reactions that _ are accompanied significant cellular tissue infiltration .

Sensitization - formation increased sensitivity organism to this allergen _ Characterized by education specific antibodies or sensitized T- lymphocytes to a certain allergen _ Clinically sensitization is not manifested . Identify the state of sensitization you can allergic tests.

Distinguish ***active*** (develops after 10-14 days after income allergen in the body ; the body's immune system is actively involved in the process formation specific antibodies or sensitized T lymphocytes) and ***passive*** sensitization (develops after introduction serum that _ contains are ready antibodies , or cellular suspensions with sensitized T- lymphocytes ; with _ own the body's immune system does not take participation in the formation antibodies and sensitized T lymphocytes).

ALLERGIC REACTION TYPE I (anaphylactic)

Immunological stage : allergen → recognition _ allergens by dendritic cell (DC) → reading information , her processing , isolation of AG determinants and embedding it into the DC membrane → activation of T- helpers (Th_0) → formation of Th_2 → B lymphocytes → transformation of B lymphocytes into plasma cells cells → synthesis of antibodies - immunoglobulins Ig E, G4 → fixation antibodies on the surface mast cells (antibodies his own at the end Fc (constant fragment) are fixed

on the corresponding receptors of mast cells and basophils ; nerve receptors of blood vessels , smooth muscles intestinal bronchi and cells blood → repeated contact with the allergen → formation complexes allergen-antibody on the surface mast cells (Fab (antigen-binging fragment) antibody fragment binds to AG, and 1 molecule of IgE may bind 2 molecules of AG).

Happens activation cells and transition process into **a pathochemical one stage** , which includes degranulation mast cells (Fig. 1) and the release of granules from them: histamine , heparin, chemotaxis factors of eosinophils and neutrophils ; formation of leukotrienes and prostaglandins from phospholipids of membranes ; migration to the allergic zone reactions eosinophils , neutrophils and their secondary release mediators : histamines , arylsulfatases , proteases, phospholipases

Pathophysiological stage : smooth spasm muscles bronchi → bronchospasm; expansion vessels → arterial hyperemia ; increase permeability vascular walls → swelling; hypersecretion mucus , irritation nervous endings → itching , pain . *Clinical forms :* urticaria , pollinosis , Quincke's edema , bronchial asthma, anaphylactic shock.

TYPE II ALLERGIC REACTION (cytotoxic)

Immunological stage : allergen (changed components cellular and basal membranes (autoallergens) → recognition allergens by dendritic cell (DC) → reading information , her processing , isolation of AG determinants and embedding it into the DC membrane → activation of T- helpers (Th_0) → formation of Th_2 → B lymphocytes → transformation of B lymphocytes into plasma cells cells → synthesis of Ig $G_{1,2,3;}$ IgM → fixation of antibodies on the surface of target cells → upon repeated contact with an allergen, the formation of an allergen + antibody complex on their surface.

Pathochemical stage: activation of complement components; release of lysosomal enzymes and superoxide radicals (O, OH, H_2O_2) during phagocytosis; granzyme , perforin from NK cells.

Pathophysiological stage. Lysis of target cells, destruction of basement

membranes:

1. Complement-dependent cytolysis (activation of individual fragments of complement components): C3a, C5a - chemotaxis of neutrophils and phagocytosis; C5 b -C9 - formation of channels in the cell membrane and osmotic lysis of cells.

2. The complement is independent cytolysis (the role of opsonins perform antibodies (IgG).

3. Antibody-dependent cellular cytotoxicity (NK cells are activated, which have receptors for the Fc fragment of antibodies on their surface) .

Clinical forms: hemotransfusion shock, hemolytic disease of newborns, autoimmune thrombocytopenic purpura, autoimmune agranulocytosis, Dressler's syndrome (postinfarction myocarditis), acute rheumatic fever, hyperthyroidism, drug allergy.

ALLERGIC REACTION OF II I TYPE (immune complex)

Immunological stage: allergen (soluble proteins, drugs, therapeutic serums) → r recognition of allergens by dendritic cells (DC) → reading information, its processing, isolation of AG determinants and its incorporation into the DC membrane → activation of T- helpers (Th_0) → formation of Th_2 → B-lymphocytes → transformation of B-lymphocytes into plasma cells → synthesis precipitating antibodies - Ig G ; Ig M → upon repeated contact with the allergen, the formation of soluble complexes → fixation of allergen + antibody complexes on the walls of microvessels .

Pathochemical stage: activation of complement components; chemotaxis of granulocytes and macrophages (C3a, C5a); activation of phagocytosis (C3 b) and release of lysosomal enzymes and superoxide radicals by phagocytes; activation of mast cells (C3a, C5a), their degranulation and release of histamine , heparin, chemotactic factors; factor selection Hageman in case of damage to the endothelium of vessels by immune complexes; and activation with its help of the kallikrein-kinin system, coagulation, anticoagulation and fibrinolysis systems .

Pathophysiological stage. Circulating immune complexes are deposited in the vessels of kidney glomeruli and cause various types of glomerulonephritis ,

alveolitis in the lungs , and dermatitis in the skin. In severe cases, inflammation can take on an alterative character with tissue necrosis, partial or complete thrombosis, and hemorrhage . Initially, the focus is dominated by neutrophils , which actively phagocytose immune complexes, releasing lysosomal enzymes and factors that increase permeability and chemotaxis for macrophages. Macrophages accumulate in the focus of inflammation and phagocytose destroyed cells, cleaning the affected area. Inflammation ends with the proliferation of cellular elements.

Clinical forms: serum sickness, nodular periarteritis , Artus phenomenon , poststreptococcal glomerulonephritis , vasculitis , systemic lupus erythematosus, rheumatoid arthritis , etc.

TYPE IV ALLERGIC REACTION (delayed type hypersensitivity)

Immunological stage: allergen → recognition of allergens by a dendritic cell (DC) → reading information, its processing, isolation of AG determinants and its incorporation into the DC membrane → activation of T- helpers (Th_0) → accumulation of clones Th_1 (sensitized T-lymphocytes) , in the cell membrane of which are embedded structures that play the role of AT, able to connect with the relevant allergen → upon repeated application of the allergen, T-lymphocytes diffuse from the bloodstream to the site of application and connect with the allergen, which is located on the target cells.

Pathochemical stage: lymphocytes are thrown out lymphokines , NK cells secrete granzyme and perforin .

Pathophysiological stage: the development of foci of allergic exudative inflammation of a dense consistency.

Clinical forms: contact dermatitis, infectious and allergic diseases (tuberculosis, brucellosis, syphilis, fungal diseases); tuberculin reaction; graft rejection reaction.

Hyposensitization - reduction sensitivity organism to the allergen . Distinguish specific and non-specific hyposensitization .

Specific hyposensitization is achieved introduction of that allergen which caused allergy (introduction serum according to the method of A.M. Bezredka) .

Specific hyposensitization is effective for type I allergic reactions .

Nonspecific hyposensitization is achieved by changes in the body's reactivity (normalization of the function of the neuroendocrine system: working conditions, rest, nutrition, reflexology , physiotherapy ; administration of drugs (antihistamines , GCS, leukotriene receptor blockers).

Pseudoallergic reactions are a group of reactions that are similar in appearance to allergies, but differ in the absence of an immunological stage. They develop under the action of factors that cause degranulation mast cells and the release of biologically active substances.

Mechanisms of development:

- Histamine : degranulation mast cells , violation of histamine inactivation , increased intake of histamine with food, dysbacteriosis .
- Violation of activation of the complement system : excessive activation of the complement system , deficiency of complement inhibitors .

Disruption of the metabolism of the arachidonic system: imbalance between prostaglandins and leukotrienes (aspirin use).

Topic: Violation of water-electrolyte exchange.
Types of tasks: Violation of water-electrolyte exchange.
Number of hours: 5

Violation of water- electrolyte exchange

Water is the main component that provides constancy internal environment body _ In an adult a person about 2/3 of the water is intracellular sector and 1/3 - in the extracellular sector .

Exchange of water and salts between plasma and extracellular environment occurs in capillaries . Osmotic pressure under normal water- salt conditions exchange essential does not matter . Filtration is carried out thanks to differences hydrostatic (32-35 mm Hg) and oncotic (22-25 mm Hg) pressure in the arterial the ends capillary . In the venous end capillary hydrostatic pressure 13-15 mm Hg. Art., therefore liquid moves into the

venous part _ A large part filtered liquid leaves interstitial space through the lymphatics vessels _

Violation of water- electrolyte balance (dyshydria). Dyshydria divided into 2 groups : **dehydration** (dehydration) and **hyperhydration** (water retention). Depending from predominance disturbances in cellular or extracellular spacious allocate **intracellular** and **extracellular** dyshydria . By concentration electrolytes in plasma of blood distinguish dyshydria **hyperosmolar** , **isoosmolar** and **hypoosmolar** .

Hyperosmolar dehydration characterized by predominance loss of water over electrolytes during hypersalivation , overheating , hyperventilation , non-diabetic diabetes _ It is developing dehydration of cells are increasing catabolic processes and cellular exicosis _ They appear neurological disorders , body temperature rises .

Isoosmolar dehydration occurs at the same time loss of water and electrolytes in acute cases blood loss They are developing circulatory violation with decrease pressure of blood up to hypovolemic shock, appear neurological disorders , dryness skin and mucous membranes , soft ocular apples _

Hypoosmolar dehydration develops due to scarcity electrolytes in the plasma - losses during diarrhea and vomiting . _ High osmotic pressure within cells helps movement of water into the cell , causing her hyperhydration . This redistribution of water leads to circulatory ones disorders - tachycardia , hypotension , dryness mucous membranes , decrease in tissue turgor.

Hyperosmolar hyperhydration occurs with increased reabsorption sodium (forced use sea water, use hypertensive solutions , hyperaldosteronism) with the following water retention in tissues. Excess of sodium in the extracellular space spacious is accompanied development swelling and appearance liquid in the cavities .

Isoosmolar hyperhydration occurs during overflow _ plasma and extracellular space isotonic fluid (transfusion of a large amount of isotonic

solutions (0.9% NaCl , 5% glucose); heart failure; oligo- and anuria in renal failure), while the intracellular sector remains normal. Edema at isosmolar hyperhydration appears when the concentration of protein in the blood plasma begins to decrease. Diluted plasma through low oncotic the pressure is not kept in the vascular channels and passes into the interstitial space _

Hypoosmolar hyperhydration occurs during overflow _ of the extracellular space with a liquid with a low osmotic pressure (hyponatremia) - with prolonged diet without salt , hyperproduction antidiuretic hormone. Because of decrease osmolarity plasma water passes into the cells and develops cellular hyperhydration - " hydration poisoning » of the body with pronounced neurological disorders , vomiting , convulsions , disturbance consciousness until coma.

Edema - retention of water in the body , mainly in the intercellular space with an excess of water and delay sodium _ In pathogenesis swelling has value increase hydrostatic pressure in blood vessels , decrease oncotic pressure plasma of blood , increase permeability vascular walls and violations lymph drainage .

The main ones pathogenetic factors development swelling :

1. *Hydrodynamic* . Increase filtering pressure as a result of : a) increased venous pressure (general venous stagnation , connected from cardiac deficiency , violation patency of veins, insufficiency venous valves , etc.) ; b) narrowing of venules.

2. *Osmotic* . Decrease gradient osmotic pressure between blood and interstitial environment because of accumulation osmotically active substances (electrolytes , products metabolism) in the intercellular spacious _

3. *Oncotic* . Decrease oncotic pressure of blood , or increase it in tissues, intercellular liquid _ Hypoonychia of blood most often happens caused by a decrease equal protein and, mainly , albumins due to: a) insufficient income protein in the body ; b) violation of albumin synthesis ; c) excessive losses

proteins plasma blood with urine in some diseases kidney _

4. *Membranogenic* . Increase permeability capillary vessels through: a) actions humoral factors (histamine , serotonin , kinins , prostaglandins , etc.) ; b) violation trophic walls capillary blood vessels (disruption neurotrophic provision , starvation , hypoxia , etc.) .

5. *Lymphatic* . Violation outflow , stagnation lymph in the organ (damage or obturation lymphatic vessels , elephantiasis , etc.).

6. *Violation nervous and humoral* water- electrolyte *regulation* exchange (violation sensitivity volume - and osmoreceptors , secondary aldosteronism , hypothyroidism , etc.) .

Depending from causes and mechanisms development distinguish :

heart or stagnant swelling associated with difficulty outflow blood _ As a result increase in venous pressure (hydrostatic factor) fluid from vessels more actively passes into the interstitial space , why helps increased permeability in connection with development hypoxia . With the same mechanism connected increased permeability tubules glomeruli kidney and limited reabsorption protein in them, increases making renin , angiotensin I and II is stimulated aldosterone production increases reabsorption sodium , enhanced ADH is secreted , increases reabsorption of water in the distal departments renal tubules . As a result these processes are increasing masses circulating of blood , higher becomes filtering pressure in the vessels - and the water again moves into the interstitial sector.

Renal edema is often associated with decrease glomerular filtration (acute glomerulonephritis), increases osmotic pressure plasma _ With nephrotic syndrome rises permeability glomeruli for protein , decreases oncotic pressure plasma and liquid moves into the interstitial space _

Hungry (cachectic) edema develop with deficiency protein , especially in chronic cases diseases stomach and intestines. It is developing hypovolemia and, as compensatory the reaction increases reabsorption sodium and water that worsens swelling _

Incendiary swelling related to promotion permeability vessels , high osmotic and oncotic pressure in tissues.

Violation exchange electrolytes :

I. _ ***Na*** $^{+}$ *(extracellular electrolyte , 130-145 mmol/l).*

1. Primary hypernatremia (absolute magnification ions sodium in the body) can arise or as a result magnification income sodium into the body (intake big amount of sodium chloride , introduction him hypertensive solution), or because of reduction breeding sodium from the body (primary and secondary hyperaldosteronism , renal deficiency).

Secondary (relative) hypernatremia is _ magnification content ions sodium in blood and intercellular liquid because of body water loss . With _ general contents sodium in the body may not change , and sometimes it decreases . This condition occurs with hyperventilation , diarrhea, increased sweating , non-sugar diabetes _

Protective and compensatory reactions : as a result hypernatremia rises osmotic pressure extracellular liquids are disturbed central and peripheral osmoreceptors , increases entry into the blood of antidiuretic hormone. Last strengthens reabsorption of water in the kidneys , as a result what increases amount extracellular liquid and decreases her osmotic pressure _

Consequences : development intracellular dehydration .

2. Primary (absolute) hyponatremia develops as a result reduction income sodium into the body (without salt diet , anorexia) or because of magnification breeding sodium from the body kidneys (hypofunction of the adrenal cortex glands , renal deficiency).

Secondary (relative) hyponatremia is excessive intake of water or _ her delay - hyponatremia because of breeding _

Protective and compensatory reactions : reduction concentration ions of sodium in the extracellular space liquid causes , on the one hand, strengthening secretion of aldosterone through renin-angiotensin the mechanism , on the other hand , - reduction entry into the blood of antidiuretic

hormone, because is decreasing impulse from osmoreceptors . Strengthening reabsorption ions sodium and depression reabsorption of water in the kidneys - osmotic pressure extracellular liquid is restored .

Consequences : generalized swelling of cells .

II . K^+ *(intracellular electrolyte, 3.5-5.5 mmol/l).*

1. Hyperkalemia . Reasons: 1) excess intake of potassium in the body; 2) the transition of potassium ions from the intracellular to the extracellular space with massive damage to cells, with an increase in the intensity of catabolic processes and acidosis; 3) impaired excretion of potassium from the body (oligo- and anuria, insufficiency of the function of the adrenal cortex).

Protective and compensatory reactions: an increase in the concentration of potassium ions in the blood directly activates the cells of the glomerular zone of the adrenal cortex and causes an increase in the secretion of aldosterone. Last increases secretion ions potassium in renal nephrons and thus restores their concentration in the blood .

Consequences: 1) violation of the activity of excitable tissues (nervous and muscular), as a result of which disorders of the central nervous system, cardiovascular system, skeletal muscles, and smooth muscles of the alimentary canal develop; 2) development of non-gaseous acidosis.

2. Hypokalemia . Reasons: 1) insufficient income potassium into the body with food (long-term using a diet that does not contain products vegetable origin); 2) reinforced transition ions potassium from the extracellular space into cells that happens with strengthening anabolic processes and alkalosis ; 3) loss potassium body (polyuria , hyperaldosteronism , long-term using diuretics means).

Protective and compensatory reactions : development hyperpolarization of secretory membranes cells and in connection with this is decreasing secretion of aldosterone by the adrenal cortex . It causes reduction secretions ions potassium cells renal epithelium .

Consequences: a) increases threshold excitability cells and, as a result , appear general weakness , flatulence, hypotension skeletal muscles , decreases skin sensitivity ; 2) is developing hypokalemic alkalosis.

III. $\boldsymbol{Ca^{2+}}$ *(2.25-2.75 mmol/l).*

1. Hypocalcemia . Reasons: - decrease income calcium from the small intestine into the blood: a) decrease content calcium in food products ; b) violation correlation calcium / phosphorus in food products; c) formation of insoluble substances in the intestines calcium compounds ; d) violation absorption calcium in lesions small intestine (enteritis); e) hypovitaminosis D; - loss ionized calcium by the body : a) with urine in case of disorders processes reabsorption ; b) during pregnancy - losses associated with the formation of the fetal skeleton; - violation mobilization calcium from bone tissues : a) hypoparathyroidism ; b) C- cell tumors thyroid glands which _ produce calcitonin ; - mineralization soft tissues: a) hyperphosphatemia ; b) alkalosis; - transition calcium plasma blood from ionized forms in the non-ionized form - in complexes with proteins and organic acids: a) oxalic acid poisoning , transfusion citrate blood ; b) increase concentration serum proteins ; c) alkalosis.

Protective and compensatory reactions : 1) increase secretion of parathyroid hormone; 2) increase formation of 1,25 $(OH)_2$ -vitamin D in the kidneys ; 3) decrease secretions calcitonin . Thanks to hereby reactions increases absorption calcium and phosphorus in the intestines, increases their transition from bones to blood.

Consequences : 1) violation bones of the skeleton - development rickets in children and osteomalacia in adults ; 2) syndrome of elevated neuromuscular excitability - tetany .

2. Hypercalcemia . Reasons: - p strengthened income calcium from the small intestine into the blood: a) excessive contents calcium in food products ; b) enhanced

absorption calcium in the intestines that happens most often with hypervitaminosis

D; - reduction breeding calcium from the body : a) acquired violation - chronic renal insufficiency ; b) hereditary violation - family hypocalciuric hypercalcemia ; - reinforced income calcium into the blood from bone tissues : a) hyperparathyroidism ; b) malignant tumors with bone metastases ; c) multiple bone fractures ; - violation postponement calcium in bone tissue, which observed in hypophosphatemia .

Protective and compensatory reactions : 1) decrease secretion of parathyroid hormone; 2) decrease the formation of 1,25 $(OH)_2$-vitamin D in the kidneys and an increase formation of 24.25 * $(OH)_2$-vitamin D; 3) increase secretions calcitonin .

Consequences : 1) damage cells ions calcium ; 2) calcification soft tissues - calcification ; 3) decrease excitability excitable tissues; 4) education calcium kidney stones ; _ 5) strengthening stomach secretions with formation peptic ulcers in the stomach ; 6) development arterial hypertension .

IV . P (0.87-1.45 mmol/l).

1. Hypophosphatemia . Reasons: a) decrease in the intake of inorganic phosphorus in the body (starvation, malabsorption syndrome , hypovitaminosis D); b) increased excretion of phosphates by the kidneys (hyperparathyroidism , phosphate diabetes, Fanconi syndrome).

Consequences: disorders of oxidative phosphorylation in cells, a decrease in the formation of 2,3-diphosphoglycerate in erythrocytes, as a result of which the oxyhemoglobin dissociation curve shifts to the left and hypoxia develops. At the same time, there are disturbances in the digestive system (dyspeptic phenomena, anorexia), blood system (hemolytic anemia, leuko- and thrombocytopenia), nervous system (paresthesia, ataxia, confusion of consciousness, in severe cases - coma), musculoskeletal system (osteomalacia, myopathy, phosphopenic rickets in children).

2. Hyperphosphatemia . Reasons: a) increased influx of phosphates from the cells and tissues of the body into the blood (heavy physical exertion, hemolysis of erythrocytes, leukemia, metastases and primary malignant bone tumors); b) impaired removal of phosphates by the kidneys (

hypoparathyroidism , kidney failure).

Consequences: calcification of soft tissues.

Topic: Violation of acid-base balance.
Types of tasks: Violation of acid-base balance.
Number of hours: 5

Acid-base balance is the relative constancy of the hydrogen indicator of the body's internal environment, due to the joint action of buffer and some physiological systems.

When the reaction of the environment changes, the physicochemical characteristics of cell colloids and intercellular structures change - the degree of their dispersity, hydrophilicity , adsorption capacity , etc. Normally, the pH is in the range of 7.37-7.44, and the level of 6.8-7.8 is incompatible with life.

pH stability is carried out with the help of a complex *of buffer systems:*

1. Carbonate buffer system.

2. Phosphate buffer system.

3. Buffer system of blood proteins, first of all Hb .

Violations of acid-base balance are divided into:

1) **acidosis** - i.e. such a violation of KOR in which either the number of organic and inorganic acids increases, or the number of bases decreases,

2) **alkalosis** - the number of bases increases or the number of acids decreases.

According to the degree of compensation, all violations are divided into **compensated** and **decompensated .**

Acidosis is divided into:

I) **non-gaseous metabolic acidosis** - occurs with the accumulation of intermediate acidic products of metabolism, such as ketone bodies, lactic acid, uric acid. It develops with all types of hypoxia , diabetes, starvation, severe liver damage, and prolonged fever.

Hypoxia and hyperH^+ ionization cause an increase in the permeability

of vessels with a tendency to the development of edema. With a sharp increase in the permeability of the renal tubules, filtration is inhibited, oliguria develops , insufficient excretion of potassium, sodium, chlorine and other electrolytes, and an increase in their concentration in the blood and intercellular fluid. The increase in osmotic pressure caused by potassium and other low molecular weight substances causes dehydration of cells with a deep disturbance of redox processes, progression of acidosis and severe general intoxication.

II) **non-gaseous excretory acidosis** occurs when the release of non-volatile acids is reduced in renal failure; loss of alkalis with damage to kidney tubules - impaired reabsorption of bicarbonate, loss of alkalies with intestinal juice - diarrhea, intestinal fistulas.

III) **non-gaseous exogenous acidosis:** taking drugs, especially ammonium chloride, acetylsalicylic acid, poisoning with salicylates, acetic, boric acids.

Compensation of non-gaseous acidosis:

1. binding of H^+ bicarbonate buffer, proteins;

2. ion exchange with bone tissue;

3. elimination of HSO_3^- due to pulmonary hyperventilation.

III) **gas acidosis** is characterized by the accumulation of carbonic acid in the blood with insufficient function of external respiration or a significant amount of CO_2 in inhaled air, that is, in all cases of hypercapnia . An increase in pCO_2 in the blood, regardless of the reasons, entails hemodynamic disorders in the form of spasm of arterioles. An increase in the tone of renal arterioles leads to a decrease in blood supply in the renal tubules, stimulation of the renin-angiotensin- aldosterone system and an increase in systemic vascular tone. This creates increased resistance to the work of the heart. Unlike peripheral vessels, brain vessels expand under the influence of increased CO_2 , which is accompanied by an increase in the formation of cerebrospinal fluid and an increase in intracranial pressure.

Acidosis increases parasympathetic influence, causing bronchospasm , increased secretion of bronchial glands; vomiting, diarrhea appear. There is a violation of the CNS function - dizziness, drowsiness up to complete loss of consciousness.

Gas acidosis compensation is aimed at neutralizing H^+:

1. ↑ alveolar ventilation
2. ↑ acidogenesis
3. ↑ ammonogenesis ↑ NSO_3^-
4. ↑ reabsorption of Na^+

Alkalosis is divided into:

I) **non-gaseous excretory alkalosis:** *hypochloremic* is an alkalosis associated with the loss of chlorine anions, as a result of which hypochloremia develops . The most common reason for the development of such alkalosis is vomiting; *hypokalemic* is an alkalosis that develops as a result of the body's loss of potassium ions. The most frequent cause of its occurrence is primary and secondary hyperaldosteronism , in which the secretion of potassium ions in the urine increases and hypokalemia develops .

II) **non-gaseous exogenous** (*hypernatremic*) is an alkalosis associated with the entry of exogenous bases into the body. Most often, it happens with the introduction of a large amount of sodium bicarbonate $NaHCO_3$, for example, with incorrect correction of non-gaseous acidosis in diabetes.

The compensatory mechanisms that develop in case of alkalosis consist mainly in a decrease in the excitability of the respiratory center due to an increase in pH , as well as in the mobilization of renal mechanisms. The effectiveness of blood buffer systems in alkalosis is less pronounced than in acidosis. A decrease in the minute volume of breathing leads to a compensatory increase in pCO_2 in the blood, which causes the formation of a large amount of carbonic acid, which is a source of H^+ ions.

Compensation of non-gaseous alkalosis:

1. ion exchange with bone tissue;

2. preservation of HSO_3^- due to pulmonary hypoventilation .

III) **gas alkalosis** occurs as a result of hyperventilation that occurs with altitude sickness, hysteria, brain damage (trauma, tumor), hyperthermia.

Symptoms of alkalosis are manifested in the weakening of respiratory function, increased neuromuscular excitability, which can lead to tetany. This is due to a decrease in the content of Ca^{2+} in the plasma (similar to parathyroid hormone deficiency). At the same time, Cl - in the plasma increases , the amount of ammonia in the urine decreases (inhibition of ammonogenesis), the urine shifts to the alkaline side (the result of increased excretion of bicarbonates). Alkalosis increases the excitability of β- adrenoblockers of the heart, intestinal vessels, and bronchi, simultaneously reducing parasympathetic effects. This leads to tachycardia, constipation, increased blood pressure, etc. The pathological effects of gas alkalosis include an increase in the tone of the vessels of the brain and heart and a decrease in the tone of the peripheral vessels, which leads to hypotension up to collapse.

Gas alkalosis compensation:

↓ alveolar ventilation
↓ acidogenesis ↓ HCO_3^-
↓ ammonogenesis
↑ removal of K^+ during reabsorption of H^+

Thus, acid-base homeostasis can be compensated for a long time, but when protective mechanisms are reduced, pH disturbances most often lead to irreversible changes.

Topic: Starvation.
Types of tasks: Starvation.
Number of hours: 5

Starvation is a typical pathological process that develops as a result of a complete lack of food or insufficient intake of nutrients in the body, as well as in conditions of a sharp violation of the composition of food and its assimilation.

Classification of starvation:

Physiological, pathological and therapeutic fasting are distinguished by

origin. Physiological starvation is characteristic of some animal species during hibernation.

The pathological type of starvation is divided into:

1. Complete fasting: a) with drinking water; b) without drinking water (absolute).

2. Incomplete starvation (malnutrition).

3. Partial starvation (quality).

Complete fasting with water. *Pathogenesis:*

I. The period of uneconomic energy consumption . Lasts 2-4 days. A strong feeling of hunger is characteristic, due to the excitation of the food center. With complete starvation, it lasts up to 5 days, and then disappears. Rapid weight loss occurs. The main source of energy during this period is *carbohydrates* , as evidenced by the value of the respiratory coefficient, equal to 1.0. Hypoglycemia occurs, which increases the secretion of glucocorticoids by the adrenal cortex. This results in increased catabolism of proteins in peripheral tissues, in particular muscle, and activation of gluconeogenesis in the liver. The main exchange first increases slightly, and then gradually decreases and becomes 10-20% less than the original. A negative nitrogen balance develops .

II. The period of maximum adaptation . Its average duration is 40-50 days. The pace of body weight loss slows down to 0.5-1% per day. The feeling of hunger disappears. The main source of energy is *fats*, which is evidenced by the value of the respiratory coefficient, equal to 0.7. Hypoglycemia increases the flow of lipolytic hormones (adrenaline, glucocorticoids , glucagon) into the blood. As a result, fat is mobilized from the depot and hyperlipacidemia develops . It, in turn, is the cause of increased formation of ketone bodies in the liver. The resulting ketonemia can lead to metabolic acidosis. The main exchange during this period is 10-20% below the initial level. The nitrogen balance is negative.

III. Terminal period. Duration - 2-3 days. Intensive decay of tissues occurs, intoxication develops. The main source of energy is *proteins* , as evidenced by the value of the respiratory coefficient, equal to 0.8. Urinary excretion of nitrogen,

potassium, and phosphates increases (signs of destruction of cells and tissue proteins). Death occurs when the body weight decreases to 50% of the original.

Absolute fasting is complete fasting without drinking water. Its duration is 2-3 times less than the duration of complete fasting with water, due to the fact that there is an increased splitting of fats to form endogenous, as a result of which ketonemia and non-gaseous acidosis develop rapidly. The severity of the course of absolute starvation is also due to the accumulation of a large number of end products of metabolism and other toxic products, which require water to be removed from the body.

Incomplete starvation (energy deficiency) develops when the energy value of food does not satisfy the body's energy needs.

Protein-energy deficiency is a condition that occurs as a result of a combination of incomplete and high-quality protein starvation. *Species:*

a) alimentary dystrophy - in its pathogenesis, in addition to protein and energy deficiency, additional factors are also important: cold, physical fatigue, neuropsychological tension;

b) alimentary fever . It develops in children up to one year of age. Energy deficiency comes first;

c) kwashiorkor . It develops in children aged 3-6 years. the main factor in pathogenesis is protein deficiency, the energy deficit is compensated by excessive consumption of carbohydrates.

Clinical manifestations of protein-energy deficiency:

1. Insufficient intake of proteins in the body leads to a violation of the liver's biloxinthetic function. This is the cause of hypoproteinemia , which, in turn, causes the development of oncotic edema.

2. Energy deficiency is the cause of a decrease in basic metabolism. This is manifested by a decrease in body temperature (hypothermia).

3. Atrophic syndromes. Their development is associated with violations of the plastic and energy supply of cells. A manifestation of atrophic changes in the central nervous system is the slowing of mental development, in the digestive system -

malabsorption and diarrhea, in the cardiovascular system - hypotension , in the immune system - a decrease in the synthesis of antibodies and increased sensitivity to infections, in the red bone marrow - the development of anemia, in the skeletal in muscles - hypodynamia and muscle weakness, in bones - retardation of skeletal growth.

Partial (qualitative) starvation is the insufficient intake of one or more nutrients with the normal energy value of food. Types: protein, fat, carbohydrate, vitamin, mineral, water fasting.

Disorders of vitamin metabolism:

Sources of vitamins in the body and signs of hypovitaminosis:

Vitamins	Sources vitamins	Signs hypovitaminosis
A (retinol)	Contained in animal products origin : fish fat , liver , butter , dairy products. Many foods contain beta-carotene , which is transformed in the body human in vitamin A. In products vegetable origin : carrots , apricots , pumpkin , tomatoes , parsley.	Damage epithelium skin and mucous membranes shell , hyperkeratosis , keratinization endometrium (hinders implantation fertilized ova), keratinization cells in the biliary and urinary tracts (promotes formation of stones in them), hemeralopia (chicken blindness), violation of the normal growth of bones in length , a decrease in the synthesis of antibodies and phagocytosis, a decrease immunity _
D (ergocalciferol)	Vitamin D_2 enters the body with food : liver fat tuna , cod , salmon, milk, yolk eggs , butter , porcini mushrooms. Vitamin D_3 is formed in the skin a person under influence sunny rays _	Violation processes mineralization bone and cartilage tissues , development rickets in children and osteomalacia in adults .
E (tocopherol)	Vegetable oils, peas, beans , apples , potatoes , eggs , beef .	Degenerative skeletal changes _ muscles , myocardium , hypotrophy ,

		gait disturbance , oculomotor paresis muscles , increase permeability and fragility capillaries , disorders of spermatogenesis and oogenesis, disorders development placenta , increase in the number of spontaneous abortions _
B_1 (thiamine)	It is synthesized green by plants and microorganisms , contained in yeast , wholemeal bread , pork , milk , yolk eggs _	Raised fatigue , decline strength, paresthesias , polyneuritis , intestinal atony , cardiac heart failure _ arrhythmias . In severe cases cases arise paresis and paralysis skeletal muscles _
B_2 (riboflavin)	Contained in liver , kidneys , beef , yolk eggs , milk , yeast , cereals, potatoes , cabbage .	Cracks in the corners of the mouth, stomatitis, glossitis , peeling skin , turbidity lens , photophobia , decrease sharpness vision , discoloration and loss hair _
B6 (pyridoxine) _	It is synthesized intestinal microflora , contained in the yolk eggs , liver , kidneys , milk , bananas, carrots , wheat , dry yeast .	Raised irritability and inhibition , deterioration appetite , convulsions , seborrheic dermatitis, cheilitis , stomatitis, glossitis , anemia .
B_{12} (cyanocobalamin)	Contained in animal products origin , especially in the liver and kidneys , cheese.	Weakness , lethargy , paresthesias , glossitis , numbness lower ones limbs , anorexia , diarrhea , loss hair , megaloblastic anemia _
C (ascorbic acid)	It is contained in vegetables and fruits: rose hips , berries, cabbage , citrus fruits , apples , licorice peppers _	Raised fatigue , irritability , weakness , increase permeability vascular walls , bleeding gums, loosening and falling out teeth , disorders development of the skeleton, pain in the limbs , weakness immunity _
PP (nicotinic acid)	It is contained in animal organs,	Dermatitis, glossitis , stomatitis,

	milk , fish , yeast , fruits, vegetables .	diarrhea , neuropsychiatric disorder , pellagra .
B 3 (pantothenic acid)	In the yolk eggs , beef liver , meat , fish , milk , beer yeast , potatoes .	Fatigue , malaise , sleep disturbance , paraesthesia , decrease immunity , insufficiency of the adrenal cortex .
Sun (foil acid)	Contains fresh _ vegetables : onions , beets , cabbage , carrots , cucumbers . In products animal origin : liver , meat , milk , eggs .	Weakness , weight loss , slowing down process regeneration , violation structures and functions gastrointestinal tract, glossitis , ulcerative stomatitis, macrocytic anemia , leukopenia .
N (biotin)	Kidneys , liver , chicken egg, meat beef , milk, beer yeast , tomatoes , soy, tea, cocoa.	Baldness , dermatitis, neurotrophic disorders _

Causes of hypovitaminosis:

I. Dietary deficiency of vitamins:

1. Low content of vitamins in the daily diet;

2. Destruction of vitamins as a result of their prolonged and improper storage and irrational culinary processing;

3. Action of anti-vitamin factors contained in products;

4. Violation of the balance of the chemical composition of the diet and violation of optimal ratios between vitamins;

5. Food perversions and religious prohibitions imposed on a number of products by some nationalities .

6. Anorexia.

II. Suppression of normal intestinal microflora, which produces a number of vitamins:

1. Diseases of the gastrointestinal tract;

2. Irrational chemotherapy.

III. Violation of vitamin assimilation:

1. Violation of absorption of vitamins in the gastrointestinal tract:

a) stomach disease ;

b) bowel disease;

c) damage to the hepatobiliary system;

d) competitive relations with the absorption of other vitamins and nutrients ;

e) congenital defects of transport and enzyme mechanisms of absorption of vitamins;

f) abuse of laxatives.

2. Utilization of vitamins that come with food, intestinal parasites and pathogenic intestinal microflora.

3. Violation of normal metabolism of vitamins and formation of their biologically active forms:

a) hereditary anomalies;

b) chronic diseases, action of toxic and infectious agents.

4. Violation of the formation of transport forms of vitamins.

5. Antivitamin action of medicinal substances.

IV. Increased need for vitamins:

1. Features of the physiological state of the body (intensive growth, pregnancy, lactation);

2. Intense physical activity;

3. Significant neuropsychological stress, stressful conditions;

4. Infectious diseases and intoxications;

5. Diseases of internal organs and endocrine glands (diabetes, thyroid disease);

6. Smoking, drinking alcohol;

7. Special climatic and ecological conditions;

8. Increased excretion of vitamins.

Topic: Disorders of protein and fat metabolism.
Types of tasks: Violation of protein and fat metabolism.
Number of hours: 5

Lipids are chemical compounds insoluble in water, but soluble in chloroform or alcohol. Lipids include unsaturated and saturated fatty acids, mono- , di- , triacylglycerols , cholesterol, phospholipids, glycolipids , sterols and wax. According to their composition, they are divided into simple and complex, lipids and steroids. Fatty acids are the simplest lipids in structure, there are more than 200 of them, more than 20 of which are present in human tissues; polyunsaturated fatty acids (linoleic , linolenic, arachidonic) belong to the irreplaceable and conventionally called vitamin F. Triacylglycerols (TAG) are esters of triatomic alcohol glycerol and fatty acids. Complex lipids are phospholipids (phosphoric acid derivatives) and glycolipids (containing saccharide residues). 8 Steroids - derivatives of cyclopentaneperhydrophenanthrene : CS and its esters, bile acids, steroid hormones - sex, gluco - and mineralocorticoids , active metabolites of vitamin D. CS refers to steroid alcohols. It is a source of formation of bile acids, steroid hormones, vitamin D; are part of cell membranes and are important components of blood plasma LP. Phospholipids are complex esters of polyatomic alcohols with higher FA and phosphoric acid, their composition includes nitrogen-containing compounds: choline, ethanolamine , serine . They are components of cell membranes and cell organelles, regulate their permeability and the activity of membrane ATP, adenylate cyclase , etc. Functions of lipids in the body: plastic, because lipids are the main component of biological membranes, ensure their permeability and fluidity; are part of the glycocalyx of the cell surface; participate in intercellular interactions; serve as receptors for bacterial toxins, for example, cholera toxin; determine the blood group (AB0 system); are the main element of the surfactant (surfactant) of the lungs, which is necessary for straightening the alveoli; energy, since a large amount of energy is generated as a result of the oxidation of FA. For example, the β-oxidation of one molecule of palmitic acid (from 16 C atoms) produces 131 ATP molecules (with the splitting of one glucose molecule in glycolysis, only 2 ATP molecules are produced, and in the tricarboxylic acid cycle and the pentose phosphate shunt, 38 and 36 ATP molecules, respectively); regulatory - as neurotransmitters participate in the transmission of nerve impulses (acetylcholine), are a source of synthesis of hormones, fat-soluble vitamins, biologically active substances (eicosanoids), phospholipids regulate the activity of membrane ion pumps; 9 protective, mechanical - thermal insulation of the body, protection of internal organs from mechanical influences. Fat metabolism includes the following stages: digestion of lipids in the intestines and absorption into the blood; transport of lipids and their transfer from blood to tissues and vice versa; deposition of fats; intermediate exchange of lipids. The pathology of lipid metabolism is associated with a violation of their splitting, absorption, transport, utilization, deposition and metabolism. For the normal digestion and absorption of lipids in the intestine, the interaction of such factors as: 1) production of the political enzyme lipase by the pancreas is of decisive importance; 2) entry of bile acids from the bile , which emulsify fats and their breakdown products, activate pancreatic lipase and participate in the absorption of fatty acids (a complex of fatty and bile acids is

absorbed); 3) uptake of lipid digestion products by the cells of the mucous membrane of the small intestine; 4) transformation of lipid hydrolysis products absorbed into particles (chylomicrons) into intestinal walls for their further transport into lymphatic vessels and further into the bloodstream. Violation of any of these processes leads to steatorrhea - excess fat content in stools. The reasons for impaired digestion and absorption of lipids are: 1. Deficiency or low activity of pancreatic lipase (damage to the pancreas), which leads to impaired fat splitting. 10 2. Insufficient entry of bile acids into the intestines (in case of hepatitis, cirrhosis , cholecystitis , obstructive jaundice, etc.), causes a violation of the emulsification and splitting of fat, as well as the transfer of its hydrolysis products to the surface of the absorbing intestinal epithelium. 3. Deficiency of hormones of the gastrointestinal tract (cholecystokinin , gastrin , etc.), which regulate the contraction of the walls of the gallbladder, the processes of emulsification and splitting of fats, their transport through the intestinal wall. 4. Damage to the epithelium of the small intestine by various poisons (phloridzin , monoiodoacetic acid) and infectious agents that inactivate enzyme systems of resynthesis triacylglycerols of the epithelium of the small intestine, as well as the processes of phosphorylation and dephosphorylation in the intestinal walls. 5. Vitamin deficiency A, B, C (because these vitamins are coenzymes of the corresponding biochemical reactions). 6. Excessive consumption of Ca ++ and Mg ++ salts with food, which leads to the formation of water-insoluble salts of complex substances (soap). 7. Deficiency of choline in food or insufficient formation of it from methionine with a low-protein diet inhibits lipid reabsorption. 8. Changes in the activity of the nervous and endocrine systems: transection of the vagus nerve weakens the absorption of fats from the intestines, and anesthesia works similarly; adrenocorticotropic hormone (ACTH) and thyroxine increase fat absorption. Due to a lack of hormones of the adrenal cortex or an excess of adrenaline, the absorption of fat is inhibited. 9. Increased intestinal peristalsis and diarrhea prevent the reabsorption of most of the fat. 10. Violation of lipid metabolism in enterocytes with the formation of abnormal protein-lipid complexes worsens the absorption of fat and causes the formation of fat accumulations in the walls of the small intestine and in small lymphatic ducts, which blocks the outflow of lymph. Deficiency of lipids in the body can be associated not only with a violation of their absorption in the intestines, but also with an increase in their excretion. The body 11 can lose lipids with urine (lipiduria), which is observed in lipoid nephrosis . Loss of lipids by the sebaceous glands (eczema, acne) and the release of lipids from the depot are possible when large areas of adipose tissue and bone marrow are traumatized. The consequences of a lack of lipids are: 1) the development of hypovitaminosis (fat-soluble vitamins A, D, E, K); 2) the occurrence of a deficiency of essential polyunsaturated fatty acids with the subsequent violation of the synthesis of biologically active substances (leukotrienes , prostaglandins , etc.). This is usually accompanied by hair loss, inflammatory lesions of the skin, the appearance of necrotic foci and eczematous phenomena, kidney damage, loss of the ability to reproduce; 3) the development of exhaustion. Synthesis and destruction of lipids occurs in almost all tissues of the body. Some tissues perform specialized

functions. For example, the absorption of exogenous lipids occurs in the walls of the small intestine; accumulation - in adipose tissue, removal of lipid breakdown products - in the intestines, kidneys, lungs. The central place in lipid metabolism is occupied by the liver, where the pathways of lipid, carbohydrate and protein metabolism intersect. The bulk of lipid transport proteins and lipid degradation products that need to be removed from the body are synthesized here. End products of lipid breakdown are excreted from the body in the form of bile acid salts, neutral steroids and ketone bodies. Absorbed non-polar lipid molecules circulate in the blood and lymph in a complex with polar compounds (proteins). There is a wide range of lipoprotein particles, differing in size, density and composition. Lipoproteins are spherical particles consisting of a hydrophobic core and a hydrophilic shell (in the center - non-polar lipids: TG and CH esters; the shell is built from polar lipids - cholesterol and phospholipids, and their charged ends are turned outward, and the shell is composed of proteins , which are non-covalently bound to PL and CH, apoproteins). 12 Apoproteins support the structure of particles, ensure their interaction with receptors and serve as a "calling card" of LP, since receptors for LP on different cells recognize only certain apoproteins . LPs are divided into classes depending on their density and mobility during electrophoresis. The density of the lipoprotein part is determined by the apoprotein /lipid ratio: the higher the ratio, the higher the density. II. There are 4 main groups of lipoproteins : 1. High-density lipoproteins (HDL, or α-LD). The composition of HDL includes 40-55% protein (percentage of the total particle mass), 27-30% PL, 3-8% TG, 2-3% free CH, 14-20% CH esters. The shell contains apoproteins A, SP, and E. They are synthesized by the parenchyma of the liver, in the wall of the small intestine and are always present in the blood of healthy people. They perform a transport function, transferring excess CH from the surface of blood vessels to the liver and remove the excess from endothelial cells. Highly specific HDL receptors are found on smooth muscle cells and fibroblasts. The number of these receptors increases with an increase in the concentration of CS in the cell. The binding of HDL to receptors causes the release of cholesterol from the cells. At first, CH is incorporated into the HDL shell, but then under the action of lecithin-cholesterol acetyltransferase (LCAT), it is esterified and moved inside to the HDL core. In the liver, HDL binds to receptors and is destroyed. Thus, HDL is an antiatherogenic lipid. 2. Very low density lipoproteins (VLDL, or pre-β-LD) represent a rather heterogeneous class of particles with different content of components: 8-12% - protein, 10-12% - free cholesterol, 18-20% - FL, 3- 6% - cholesterol esters, about 50% - TAG. They are formed mainly in hepatocytes, in smaller quantities - in the intestinal mucosa), are the main transport form of endogenous TAGs. They contain apoproteins C, E and B100. in the blood plasma, VLDL is transformed into β-LP (with the participation of enzymes - lipoprotein lipase and blood LHT). In the course of their catabolism, the size of the 13 fractions decreases, their composition changes (TAGs are lost and the relative percentage of CH increases). 3. Low-density lipoproteins (LDL, or β-LP) have the following composition: 24-31% - free CH, 16-28% - ECH, 7-11% - TG, about 30% - FL, 20-25% - white. They are formed in plasma from LDL and are the most

atherogenic fraction of LP in humans. LDL contains only one apoprotein B100. About 70% of LDL is removed from the blood by hepatocytes with the help of highly specific receptors. The rest of LDL is captured by cells of the reticuloendothelial system with the help of specific neutralizing receptors. The synthesis of highly specific receptors in the liver is suppressed when the concentration of β-LP increases. On the contrary, the number of neutralizing receptors on the cells of the reticuloendothelial system does not depend on the level of LDL. Impaired uptake of LDL in the liver (as a result of a defect in apoprotein B100 or a defect in highly specific receptors) leads to the accumulation of LDL in other tissues and organs. Their atherogenic effect is mediated by neutralizing receptors. It is believed that LDL become atherogenic only after certain transformations, for example, during peroxidation of modified LDL. Oxidized LDL is taken up by macrophages, which then turn into xanthoma cells accumulated by cholesterol esters. Neutralizing receptors are also found in smooth muscle cells of arteries. 4. Chylomicrons are the largest lipoprotein particles that enter the blood from the lymph and are a transport form of dietary fats (exogenous TAGs). They contain: 3-8% PL, 2-4% CH esters, about 2% free CH, 1-2% protein and 86-94% TAG. The shell contains apoproteins B48, A, C, E. Chylomicrons are formed in the intestinal wall during the absorption of exogenous TAG and CH, enter the lymphatic vessels, and through the thoracic lymphatic duct enter the large circle of blood circulation. 14 In the blood, chylomicrons exchange apoproteins with HDL : they give a part of apoproteins A, receive C and E. In the blood capillaries of adipose tissue, myocardium, skeletal muscles, and mammary glands, chylomicrons are cleaved by lipoprotein lipase, which is located on the surface of the endothelium, and lose a significant amount of TAG (free fatty acids (FA) and glycerol are formed). At the same time, the residual component of the chylomicron (core) is released, containing a large amount of CH esters. Chylomicrons themselves do not have atherogenic properties, but the residual components of chylomicrons are obviously atherogenic . For lung tissue, the metabolism of chylomicrons is particularly important, since they play a key role in ensuring the high activity of alveolar macrophages and are necessary for the synthesis of PL surfactant and prevention of atelectasis. In this regard, a fatty diet has a positive effect on lung diseases. It should be noted that the blood plasma of healthy people on an empty stomach (12-14 hours after eating) does not contain chylomicrons . In the blood taken on an empty stomach, only VLDL, LDL, and HDL are present, while other LPs (chylomicrons , residual components of chylomicrons , as well as LPs of intermediate density) are detected only after eating or due to lipid metabolism disorders. III. With a number of diseases, the serum LP spectrum changes and hyper- , hypo- , and lipoproteinemias occur . At the same time, there is an increase or, conversely, a decrease in the content up to the complete absence of one or more classes of LP in the blood, as well as the appearance of their specific forms (DLP). Hyper- and dyslipoproteinemia is one of the main risk factors for many diseases, primarily atherosclerosis. Their clinical manifestations and severity depend on the diet and nutrition regime, on accompanying diseases . DLP occurs or worsens with obesity, diabetes, hypothyroidism, kidney and liver

diseases, their course and prognosis depend on the severity of the underlying disease. There are 5 types of hyperlipoproteinemia : 15 I. Hyperchylomicronemia - characterized by a high content of chylomicrons in fasting plasma. It is manifested by xanthomatosis - the deposition of cholesterol and its esters in the Cooper's cells of the liver, histiocytes , subcutaneous tissue and tendons, followed by the growth of connective tissue in the form of yellowish plaques and nodes. Patients develop hepatosplenomegaly , thrombosis and micronecrosis of the pancreas are detected, followed by the formation of chronic pancreatitis, abdominal colic after eating fatty food. Xanthomas appear on the skin in the form of yellowish papules. The disease can be caused by a hereditary autosomal recessive defect of lipoprotein lipase or autoimmune diseases of the connective tissue (antibodies against glycosaminoglycans are formed in systemic lupus erythematosus , which disrupts the process of heparin activation of lipoprotein lipase). II. Hyper -b- lipoproteinemia is divided into 2 types: IIa – increase in the content of β-LP in the blood at a normal pre-β-LP level ; IIb – increase in the content of β-LP and pre-β-LP. The disease is characterized by pronounced xanthomatosis of the eyelids, skin, cornea, the development of coronary heart disease with myocardial infarction at a very early age, atherosclerotic vascular lesions in children. It is assumed that the basis of the disease lies in an autosomal dominant defect of LDL and LDL receptors (IIb) or changes in the activity of lipoprotein lipase of the blood plasma (IIa). III. " Floating " hyperlipoproteinemia , or dys -β- lipoproteinemia The basis of the disease is a hereditary violation of the synthesis of apoprotein E (a protein that is part of chylomicrons and VLDL). The disease is characterized by the appearance of floating β-LPs in the blood serum , which are called intermediate (intermediate density lipoproteins - LDL). They are enriched with CH, and their TG content should be reduced. These particles are formed due to disruption of the catabolism of VLDL and chylomicrons . There are also acquired forms of the disease in hypothyroidism, some 16 autoimmune gammapathies . This type of hyperlipoproteinemia is accompanied by early atherosclerotic manifestations (after 20 years), the development of coronary heart disease, ischemic encephalopathy up to strokes, xanthomatosis , obesity. IV. Hyper -pre-β- lipoproteinemia . The disease can be hereditary (autosomal dominant) or acquired (in case of alcoholism, acute hepatitis, acromegaly, diabetes, etc.). The pathogenesis has not been fully elucidated. This type of HLP is characterized by an increase in the level of TG and VLDL in the blood. The content of LDL and HDL varies from normal to significantly low. Patients develop obesity and type 2 diabetes, xanthomas appear , possible atherosclerotic lesions of the vessels of the lower extremities, retinal lipidoma and visual impairment, manifestations of coronary heart disease. VI. Hyper -pre-β- lipoproteinemia and chylomicronemia In this disease, the content of chylomicrons and VLDL in the blood increases and the level of LDL and HDL decreases. Patients have hepatomegaly and splenomegaly , obesity, reduced glucose tolerance (with type 2 diabetes), myocardial damage. After eating fatty food, sudden attacks of abdominal colic can be observed , xanthomatosis and atherosclerosis are weakly expressed. In the pathogenesis of the primary disease, the main role is played by the hereditary absence of the cofactor lipoprotein lipase

- apoprotein CII (autosomal recessive inheritance), as a result, the two main substrates of this enzyme accumulate in the blood. The phenocopy of the disease develops with alcoholism, Gierke's glycogenosis and some other liver diseases. Hypo -(a) -lipoproteinemia belongs to a group of relatively rare abnormalities of the LP spectrum: 1. A-β- lipoproteinemia The disease is based on an autosomal dominant defect in the synthesis of apoprotein B, which leads to an abnormality in the structure of chylomicrons , a decrease in 17 content or its complete absence in plasma LDL and LDL. Clinical manifestations are associated with impaired intestinal absorption of fats and carbohydrates, hemolytic anemia, degeneration of lateral and posterior cords of the spinal cord, pigmentary retinopathy. Impaired fat absorption is manifested immediately after birth by poor appetite, nausea, vomiting, profuse bowel movements, steatorrhea , and the development of hypotrophy. About a third of patients develop mental retardation. With age, neurological disorders increase, skeletal deformities, cardiac arrhythmias appear, vision deteriorates. In the pathogenesis of the disease, the decrease in the content of cholesterol in cell membranes and the loss of fat-soluble vitamins, especially vitamin E, which leads to the loss of antioxidant protection of the membrane, are of crucial importance. 2. Tangier (or Tangier) disease The disease is based on an autosomal recessive disorder of apoprotein A synthesis, which, in turn, disrupts HDL production. In patients, the transport of CH esters is disturbed, as a result, the esters are captured by macrophages and deposited in the cells of the reticuloendothelial system of the spleen, liver, and lymphoid organs. Lymphadenopathy, hepatosplenomegaly , neurological disorders - weakness, paresthesias, decreased tendon reflexes are revealed. One of the bright signs of the disease is the orange -yellow color and enlargement of the tonsils. There are other forms of hypolipoproteinemia : cerebrospinal xanthomatosis (hereditary defect of synthesis of bile acids with cholestasis), Wallmann's disease (autosomal recessive cholinesterase deficiency), hypo-lipoproteinemia (genetically determined violation of apoprotein A and C production), etc. Most of them are associated with a hereditary pathology of the synthesis of the protein part of LP or with a violation of cholesterol metabolism. Alimentary hyperlipemia is a temporary increase in the level of chylomicrons in the blood, which is caused by eating fatty food or carrying out a test with a lipid load. This condition is easily eliminated with the help of 18 increasing functional activity of hepatocytes that utilize chylomicrons . Increased deposition of lipids in adipose tissue is also possible. Transport hyperlipemia is caused either by increased mobilization from the depot in the form of esterified fatty acids (EFAs) during starvation, stress, type 1 diabetes, or by impaired metabolism of lipids circulating in the blood in various forms of familial hypertriglyceridemia . Somatotropic and corticotropic hormones of the pituitary gland, as well as glucagon , thyroxine and adrenaline, which activate tissue lipase through the adenylate cyclase system , contribute to the mobilization of lipids from adipose tissue and bone marrow . From the liver, lipids (a complex of lipids with proteins) enter the blood. Mobilization of fat from the lungs, leading to hyperlipemia , also occurs with long-term hyperventilation of the lungs, for example, in swimmers and professional singers. Retentive hyperlipemia (from the

Latin retentio - to delay) develops as a result of the delay in the transfer of neutral fats from the blood to the tissues. Occurs with atherosclerosis, ischemic heart disease, nephrosis , type 2 diabetes, with mechanical jaundice, intake of a large amount of NaCl (inhibits blood lipoprotein lipase). The following factors are of great importance in the pathogenesis of this type of hyperlipemia : 1) a decrease in the level of heparin, which activates the lightening factor (lipoprotein lipase) - in nephrosis , mechanical jaundice, atherosclerosis; 2) a decrease in the content of albumins in the blood (carry out the transport of NECs into the cells of various organs) - in case of nephrotic syndrome, liver diseases, etc.; 3) the presence of a lipoprotein lipase inhibitor in the serum - in case of nephrotic syndrome; 4) a decrease in the activity of lipocaine , which activates the entry into the blood of lipoprotein lipase, which is synthesized by the cells of many tissues (fat, muscle, heart, lung tissue, spleen) - in diabetes. 19 Violation of neuroendocrine regulation of fat metabolism Human body weight is under the complex control of neurohumoral influences that determine food motivation and the level of basic metabolism. The centers of regulation of eating behavior and basic metabolism are located in the supraoptic nuclei of the hypothalamus and are controlled by the thalamus, the limbic system, and the cortex. The center of hunger is localized in the contralateral , and the center of satiety is located in the ventromedial nuclei of the subhybrid (connected with the center of hunger by synapses that transmit inhibitory impulses). Neurons of the hunger center produce neuropeptide Y, which activates the corticolimbic structures of the brain and stimulates the feeling of hunger, prompting the search for food. Emotional and behavioral aspects of food intake are regulated by divisions located in the cortical part of the limbic system (lumbar gyrus, hippocampus , infraorbital region) and in the amygdala, the destruction of which causes indifference to the nature of the offered food. Suppression of the hunger center (in pathology up to anorexia) is caused by the action of leptin (inhibits the synthesis of neuropeptide Y in the hunger center and stimulates the formation of glucagon-like peptide (GPP) I in the satiety center, which suppresses appetite); somatostatin , neurotensin , cortico- and thyroliberin , pituitary melanocortins ; serotonin, vasopressin, oxytocin ; cholecystokinin (the signal for its production is mechanical stretching) and other intestinal hormones of the digestive system (glucagon , secretin, vasoactive intestinal peptide, gastrin , enterogastrone); norepinephrine , calcitonin , insulin; TNF-α (tumor necrosis factor, or cachexin), released by visceral adipocytes in a "saturated" state. The listed hormones and neurotransmitters bind to the receptors of neurons of the hunger center, reduce the formation of neuropeptide Y and suppress appetite. Activation of the hunger center and the occurrence of hyperrexia (bulimia) can be mediated by neuropeptide Y (reduces sympathetic and increases parasympathetic tone, as well as suppresses sexual function), endorphins and 20 enkephalins , somatoliberin , dopamine , γ- aminobutyric acid (GABA), excess insulin. Leptin is the main hormone that controls the mass of adipose tissue, discovered in 1994). Mechanisms of action of leptin : strengthening of the basic metabolism, thermogenesis and energy expenditure, stimulation of the sympathetic division of the central nervous system; increase in hepatic glycogenolysis and uptake of

glucose by skeletal muscles; activation of lipolysis in white adipose tissue; increased oxidation of fatty acids in the mitochondria of hepatocytes and skeletal muscles, suppression of the activity of gonads and reproductive function, increased production of glucocorticoids . Leptin is secreted mainly by adipocytes of white adipose tissue. Normally, its content in the blood clearly correlates with body weight. Leptin receptors are found in almost all cells, but the main target organ of leptin is the central nervous system. Acting through specific receptors of the hypothalamus, leptin reduces appetite (participates in the development of cachexia, anorexia nervosa, etc.) and reduces fat reserves in fat depots. Leptin is a pro-inflammatory hormone that contributes to the prevalence of cellular immunity due to increased production of cytokines. Leptin is also produced by osteoblasts and inhibits the formation of osteoclasts . LEP obesity gene (obese gene - ob) is located on chromosome 7q31.3, the leptin receptor gene is on chromosome 1. The human leptin receptor has a homologous region with receptors for interleukin (IL)-6 and other cytokines. The hypothalamic melanocortin system and the MC-4R melanocortin receptor are involved in the transmission of leptin effects . Relationship between the central nervous system and leptin Enhancement of lipolysis takes place when the sympathoadrenal system is activated (maximum effect through β2-adrenoceptors, in brown fat adrenergic terminals form synapses on the adipocytes themselves , which promotes "volley" lipolysis); effects of glucagon , catecholamines (high doses of 21 stimulate lipolysis through β2-adrenoreceptors on adipocytes , low concentration of adrenaline acts through α2-receptors and increases lipogenesis), thyroid-stimulating hormone (TSH), thyroxine, somatotropic hormone (STH), androgens, ACTH (direct action on adipocytes), glucocorticoids (in physiological concentrations increase the use of fatty acids in energy metabolism in all tissues except the liver, TNF-α (reduces the response of muscle and adipose tissue to insulin and inhibits lithogenesis). Increased lipogenesis can be caused by parasympathetic impulses (parasympathetic the nervous system practically does not innervate adipose tissue, therefore it does not have a significant effect on its metabolism, but the vagus impulse reduces the release of norepinephrine from presynaptic endings, which can mediate the predominance of lithogenesis), by the action of insulin, glucocorticoids (in high doses, they increase lipolysis in the limbs, face, and trunk; their effect depends on the action of catecholamines and differs in adipocytes of different localization, since the set of adrenoceptors on fatty cells is not the same and depends on their anatomical location), ACTH, prolactin and estrogens (due to hyperinsulinemia ; in addition, prolactin stimulates the synthesis of FL and TAG in the mammary glands and other tissues. Obesity is the excess deposition of fat in adipose tissue. Obesity significantly increases the risk the development of arterial hypertension, type 2 diabetes, atherosclerosis, therefore it is very important to monitor body weight. A person is considered to be obese if his weight exceeds normal by more than 20% and continues to grow. In 1998, the World Health Organization I (WHO) recognized obesity as a chronic disease. According to statistics, in economically developed countries, about 30% of adults and up to 10% of children have one or another form and degree of obesity. In age groups after 50 years, this disease

occurs more often. Over the last decade, the number of such patients in the world has almost doubled, and according to experts, in 2025, their number will be 300 million people. The situation is all the more complicated because every 22 years the number of young people suffering from obesity increases, the total life expectancy of the world's population decreases due to serious diseases associated with obesity. Obese people over the age of 50 have a 50% higher mortality rate than non-obese people. Cancer of the endometrium , ovaries, cervix, gall bladder and mammary gland is more common in obese women , in men - cancer of the prostate gland and colon, decreased potency. Adipose tissue normally makes up 15 - 20% of body weight in men, and 20 - 29% - in women, being a metabolically active formation. Adipocytes secrete hemopoietins ; secrete cytokines - TNF-α, IL-6, transforming growth factor (TGF) β and their corresponding soluble receptors; synthesize bioactive substances - angiotensinogen , plasminogen activator inhibitor ; a number of enzymes (lipoprotein lipase, induced NO-synthase, apolipoprotein E) and hormones (leptin , resistin, adiponectin , estrogens); emits UVC. An increase in the mass of adipose tissue, which will cause an increase in the content of leptin in the blood, and its production in subcutaneous adipose tissue is higher than in visceral fat depots. The level of leptin reflects not only the amount of accumulated fat, but also a violation of energy metabolism: during starvation, its level significantly decreases, during overeating - it increases. An excess of leptin causes insulin resistance of skeletal muscles and adipose tissue, suppresses the effect of insulin on liver cells (insulin activates adipocytes , increasing the formation of leptin , in turn, leptin acts on its own receptors localized on the surface of β-cells, inhibits insulin secretion) . In women, the presence of sufficiently pronounced adipose tissue is essential for maintaining normal sexual function. Menstruation in girls who have not reached the critical mass (about 48 kg) does not begin, even if the puberty period has passed. If the body weight is reduced by 10 - 15% of the norm, even if the cycle is maintained, ovulation does not occur, complete amenorrhea is also possible. These changes are reversible, with weight normalization, the reproductive function is restored. Probably, the impossibility of childbearing in women who do not have sufficient fat depots for the successful birth and feeding of a child was developed in the process of natural selection. In men, when losing weight, sexual attraction may decrease, and if the body weight is 25% below the norm, sperm production is suppressed. It should be noted that highly developed musculature (for example, in bodybuilders) affects reproductive processes in the same way as weight loss. An excess of estrogens in obese men leads to a decrease in potency, gynecomastia , hypogonadism with a decrease in the level of testosterone. Classification of obesity Obesity can occur as an independent disease, in this case it is primary obesity. Secondary obesity is a syndrome that occurs as a result of hormonal or other disorders in the body. Primary obesity occurs due to a violation of the hormonal connection between adipose tissue and the hypothalamus. This is a genetically mediated neuroendocrine disease with absolute or relative leptin deficiency as the main feature. About 20% of patients have absolute leptin deficiency, but leptin deficiency is not the main reason for the development of obesity. More than 80%

of patients with primary obesity have pronounced hyperleptinemia , which indicates resistance to the hormone. The following mechanisms of resistance are known: violation of leptin transport through the blood-brain barrier (introduction of the hormone even in large doses has no effect); violation of hormone transport by transport proteins; leptin receptor mutations (despite leptin production , the hunger center continues to secrete neuropeptide Y); mutations of genes encoding melanocortin receptors (4% of all obese patients). It should be noted that against the background of leptin administration in mammals 24, only the mass of adipose tissue decreases, while the mass of other tissues also decreases during starvation. Genetically mediated leptin deficiency is manifested by early obesity, reduced metabolism, hypogonadotropic hypogonadism , hyperinsulinemia , violation of hypothalamic-pituitary and thyroid interactions and violation of the number and function of T-lymphocytes, which increases the sensitivity of patients to infections. There are 5 separate mutations in the leptin gene that cause the development of primary obesity. Children with a leptin receptor defect quickly gain excess weight during the first months of life, are characterized by hyperphagia , aggressive behavior during eating. Sometimes the receptor defect has more pronounced manifestations (hypothyroidism) than the absence of the ligand. Melanocortins (adrenocorticotropic and melanocyte-stimulating hormones, as well as their fragments) are formed in the pituitary gland from proopiomelanocortin . Leptin stimulates proopiomelanocortin gene expression , the proopiomelanocortin that is produced is cleaved to a substrate that acts as a suppressor of eating behavior, possibly via MC4R. When hypothalamic decreases of the melanocortinergic signal through MC4R receptors, hyperphagia and an increase in body weight are observed. Secondary obesity is a syndrome that occurs due to a violation of the relationship between the processes of lipolysis and lipogenesis , is symptomatic in nature and is caused by various disorders (endocrinopathies, brain tumors, disorders of cerebral circulation, etc.). According to the degree of increase in body weight, obesity of the first degree is distinguished (body weight increases by 30%); II degree (by 30-50%); III degree (more than 50%). One of the most common indicators for assessing the degree of obesity is the body mass index (BMI), which is calculated by the following formula: BMI = Mass (kg) / [Height (m)]2. 25 Patients with a BMI of 30 kg/m2 or more, as well as patients with a BMI of 27 kg/m2 or more, whose obesity is associated with such risk factors as type 2 diabetes or DLP, are subject to mandatory treatment. The simplest method of determining the tendency to obesity is measuring the circumference of the waist. Ideally, the waist circumference should not exceed 94 cm for men and 80 cm for women. If the waist circumference in men reaches 102 cm, and in women - 88 cm, there is a serious threat of increasing the risk of the disease. According to the features of the morphology of adipose tissue, hypertrophic and hyperplastic obesity are distinguished. Hypertrophic obesity is associated with an increase in the size of adipocytes (this is a labile factor that depends on nutrition), and is more common in adulthood. With this type of obesity, body weight can increase by 3-3.3 times. Hyperplastic obesity is accompanied by an increase in the number of adipocytes . It begins, as a rule, in childhood, because the differentiation of fibroblastic

progenitor cells into new adipocytes in the adult body is a rare phenomenon (it occurs during intrauterine development and in infancy). In the development of hyperplastic obesity, heredity is of great importance, which determines the proliferative capabilities of these cells. Excess body weight in hyperplastic obesity can reach gigantic values (up to 1000%). It should be noted that the proliferative activity of preadipocytes increases in the adolescent and pre-menopausal periods . In addition, their division induces excessive caloric content of food, diabetes or overeating in pregnant women. In these cases, hyperplastic obesity develops in adults. Fat can be localized in subcutaneous adipose tissue (subcutaneous fat) and around internal organs (visceral fat), together subcutaneous adipose tissue in the abdomen and visceral fat in the abdominal cavity make up abdominal fat. Different localization of fat deposits in different forms of primary and secondary obesity depends on the effects of 26 male and female sex hormones on their distribution and catecholamine receptors in different parts of adipose tissue. Adipose tissue, localized in different parts of the body, differs in its hormonal function. In people prone to primary obesity, the expression of β- adrenoceptors on adipocytes is reduced . Depending on the nature of the distribution of adipose tissue, the following are distinguished: android (apple) type of obesity, when excess fat deposits are located on the abdomen and upper body (most characteristic of men); gynoid (pear-shaped) type of obesity, when excess fat deposits are located on the hips, buttocks and in the lower part of the body (mostly characteristic of women); mixed type of obesity combines features of android and gynoid types. Gynoid obesity is often hyperplastic in nature, so it is more resistant to diet therapy. However, android is considered more pathogenic , and gynoid and mixed are more favorable. The deposition of adipose tissue in the abdominal region (apple or upper type of obesity) is more associated with morbidity and mortality than gynoid or lower type of obesity, and even more so than the degree of obesity. A large amount of abdominal fat contributes to the development of dyslipidemia , diabetes, cardiovascular diseases, and in women - the development of tumors. This dependence is not related to the total fat content in the body. For the same BMI, abdominal obesity has a higher risk of developing comorbidities than obesity of the lower type, which increases mortality in humans. By etiology, obesity is classified as exogenous -constitutional, hypothalamic , hormonal (endocrine). Exogenous - constitutional obesity (often, but not always refers to the primary form of obesity). Disordered eating behavior (for example, 27 night eating syndrome, increased eating in response to stress) leads to the deposition of excess fat in the body according to the formula: Fat deposition = Energy intake - Energy expenditure Long-term increase in the activity of the "food center" leads to an increase in appetite (hyperphagia) and obesity. The habit of overeating can be acquired in childhood. It has been established that excessive feeding of a child in the first year of life contributes to the development of hyperplastic obesity, which is characterized by an increase in the volume of fat cells. Hypothalamic obesity is the result of damage to the hypothalamus region. The cause may be brain injuries, persistent intracranial hypertension, brain tumors, meningitis, as well as congenital degenerative changes in the hypothalamic region (for example, Frelich's syndrome

). Hormonal obesity. It is associated with hypo- and hyperfunction of endocrine glands and develops with hypothyroidism, hypofunction of the gonads, as well as with hyperinsulinism and hypercorticism . In the blood of such patients, the content of LDL and VLDL, NEC increases. With hormonal obesity, hypertriacylglycerolemia develops early and hypercholesterolemia a little later . Violation of lipid metabolism is facilitated by changes in carbohydrate metabolism: hyperglycemia develops , which stimulates the secretion of insulin and its precursors. In turn, the secretion of proinsulin and insulin stimulate the synthesis of NEC, VLDL, and LDL. Increased release of glucocorticoids , which stimulate gluconeogenesis , and also increase the level of insulin in the blood. By pathogenesis, alimentary, metabolic, and energetic obesity are distinguished. Alimentary obesity - develops with excessive food consumption, which can be caused by: a) a violation of the activity of the hypothalamic food center (absolute or relative leptin deficiency, long-term excitation of the ventrolateral 28 nuclei as a result of injuries, hemorrhages, inflammation in the diencephalic region (the etiology is exogenous - constitutional or hypothalamic obesity); b) afferent impulse with frequent excitation of taste receptors; c) transition from an active to a sedentary lifestyle. At the same time, in some cases, a high level of excitability of the food center (characteristic of physical laborers or athletes) remains, which leads to systematic overeating; d) excessive stretching of the walls of the stomach when it is full. This reduces the sensitivity of the nerve endings of the mucous membrane, and inhibitory impulses are transmitted to the food center only when there is a very large accumulation of food in the stomach. As a result, overeating becomes permanent and obesity occurs; e) old age, which is explained by the discrepancy between the previous level of excitability of the hunger center and reduced energy expenditure (after 25 years, the basic metabolism decreases every next 10 years by approximately 7.5%). It is interesting to note that weight loss often develops in old age, because the activity of the food center is inhibited and the conversion of carbohydrates into fats is reduced. Metabolic obesity is caused by increased synthesis of fat from carbohydrates. Under normal conditions, up to 30% of glucose entering the body is converted into fat under the action of insulin. With hyperfunction of the insular apparatus, this percentage increases. A similar change in metabolism develops with increased production of prolactin (hormone of the anterior pituitary gland), glucocorticoids (the etiology is hormonal obesity). Energy-related obesity is caused by insufficient use of fats as an energy source. It develops with hypodynamia in combination with a good appetite, with a decrease in the tone of the sympathetic nervous system and insufficient production of fat-mobilizing hormones (STH, thyroid hormones, catecholamines), since the release of fat from the depot and its use as an energy substrate is delayed (the etiology corresponds to exogenous constitutional or hormonal obesity). Consequences of obesity With obesity, protein metabolism gradually changes, which is characterized by a decrease in the level of total blood protein mainly due to a decrease in the concentration of albumins, an increase in the content of fibrinogen, fibrin degradation products, and a decrease in the level of heparin. The consequence of this is a violation of the transport of triglycerides and other lipids, a

decrease in fibrinolytic activity and an increase in the thrombogenic properties of blood, and the occurrence of thromboembolic complications. These changes are risk factors for atherosclerosis, coronary heart disease, stroke, and hypertension. Disturbances in the functions of the central nervous system occur: fatigue, drowsiness, memory impairment, premature aging develop, and changes in internal organs occur. With primary obesity, many of the metabolic disorders are corrected after normalization of body weight (insulin resistance , hyper- and dyslipoproteinemia decreases or completely disappears). Nevertheless, a patient with diabetes has a leptin deficiency, increased activity of lipoprotein lipase of adipose tissue, reduced response of satiety centers to serotonin, and adipocytes to β- adrenomimetics , impaired insulin reception in the hypothalamus, and in hyperplastic and mixed obesity, an increased number of adipocytes and etc. With the rapid normalization of body weight, the production of thyrotropin decreases, and hunger adaptation worsens . With a further decrease in body weight, the basic metabolism decreases even more . A tendency to leukopenia, bradycardia and hypotension is noted, immunity decreases. In women, a violation of the ovarian - menstrual cycle is possible, which is associated with a decrease in the estrogen-producing function of adipocytes . Many of the patients who have lost weight experience dysphoria , obsessive neuroses due to a decrease in the production of 30 opiate peptides. Some psychosomatic features of emaciated patients with primary obesity resemble those of psychogenic anorexia. When fasting on diets, there is a lack of release of serotonin, norepinephrine , β-endorphin and other biologically active substances into the blood. A decrease in the level of serotonin is subjectively perceived by the human body as a state of depression, a decrease in the concentration of norepinephrine - a decline in strength, β-endorphin - dissatisfaction and discomfort. On the contrary, the release of norepinephrine after eating causes a feeling of strength and energy, and the level of basic metabolism increases. People with disorders of the central serotonergic system have particularly strong negative reactions to hunger, which are expressed in a decrease in serotonin production. Even with a slight starvation, they develop pronounced depression. Adequate treatment of an obese patient is possible only under the supervision of a doctor and should not be only symptomatic, that is, reduced to diet therapy and therapeutic gymnastics. After the discovery of leptin, great hopes were associated with its use for the treatment of new leptin deficiency, such as primary obesity. A violation of the breakdown and removal of fats from a cell (hepatocyte) is called its fatty infiltration. The combination of infiltration with disruption of the cytoplasmic structure of the cell and its protein components is called fatty dystrophy. The causes of fatty infiltration of the liver are: diabetes; adiposity; HLP, alcoholism; poisoning with phosphorus, arsenic, chloroform and other hepatotropic poisons ; starvation, hypovitaminosis ; infections and intoxications; prolonged stressful action; a lack of choline, methionine and other lipotropic factors in food, a decrease in the synthesis of lipocaine in the small ducts of the pancreas; pregnancy; hereditary defects in the oxidation of fatty acids. The pathogenesis of fatty liver is associated with excessive entry of lipids into hepatocytes and a decrease in their utilization as a result of inhibiting the oxidation of free fatty acids, violation of the

formation of VLDL and their 31 secretion into the blood. For example, hepatotropic poisons suppress the oxidation of VHD in liver mitochondria, disrupt the formation of VLDL, and form active oxygen radicals that damage hepatocytes. Fatty liver can end with the death of hepatocytes and the formation of fibrosis and cirrhosis of the organ . At the same time, it is worth knowing that this process is reversed and in some cases it can occur without symptoms. However, pathological liver tests, hyperketonemia and acidosis (acetone, acetoacetic and β oxybutyric acids are found in the blood) are more often detected with fatty liver, signs appear hepatocellular insufficiency and encephalopathy. Cholesterol is a derivative of cyclopentane and hydrated phenanthrene . Its name comes from the Greek words "bile" and "hard", as it was first described in the 18th century as a component of gallstones. The total content of CH in the human body ranges from about 100 to 300 g, while free CH predominates (it is almost 3 times more than CH esters). CH enters the body with food (egg yolk, liver, meat, butter, sour cream and cream). There is also an endogenous synthesis of CH in the liver from acetyl-CoA . In addition, the liver is the only organ where CH esters are formed, so a decrease in the level of CH is one of the indicators of liver failure. The daily fluctuation of CH varies from 0.2 to 0.5 g, and about 1 g is produced in the body itself per day. The role of CS in the body is huge, it is a component of cell membranes, affects their liquid properties and permeability, acts on the activity of membrane enzymes, can stimulate the proliferation of cells capable of division (due to its excess in the membrane). Cholesterol is a precursor of bile acids and steroid hormones: sex, glucocorticoids , mineralocorticoids , as well as vitamin D. Cholesterol is removed from the body in several ways - about 0.5 g of Cholesterol per day is converted into bile acids and is removed from the bile through the intestines, approximately the same its amount is lost per day with feces (coprosterol); sebaceous glands secrete about 0.1 g of cholesterol. 32 Blood plasma of a healthy person contains 5.2-6.2 mmol/l of CH. Both an excess and a lack of CS are pathogenic for the body. Hypercholesterolemia can be caused by: 1) excitation of the sympathetic nervous system (stress), which promotes increased mobilization of fat from the depot and synthesis of endogenous cholesterol; 2) violation of the resynthesis of fatty acids from acetyl CoA (with diabetes); 3) violation of the removal of cholesterol from the body in case of inhibition of intestinal peristalsis, dyskinesia of the biliary tract, in case of mechanical jaundice; 4) endocrine diseases that disrupt lipid metabolism, hypothyroidism, hypercorticism ; 5) pregnancy; 6) nephrotic syndrome (disruption of lipid metabolism and decrease in albumin content); 7) hypovitaminosis C, hypoxia, since the breakdown of cholesterol requires a sufficient amount of ATP; 8) increased consumption with food (however, in this case, endogenous CH synthesis is inhibited); 9) excessive consumption of animal fats and refined carbohydrates (endogenous cholesterol synthesis increases); 10) hereditary defects of lipid metabolism enzymes (including cholesterol). The consequences of hypercholesterolemia include the development of atherosclerosis, xanthomatosis , cholesteatosis (deposition of cholesterol and its esters in parenchymal organs with the subsequent development of cirrhosis), obesity, coronary heart disease, multiple sclerosis (hereditary forms of cholesterol

accumulation), retinopathy , etc. Among the causes of hypocholesterolemia, the following should be noted: 1) hereditary α-β- lipoproteinemia ; 2) liver disease with loss of ability to synthesize CH and its esters; 3) hyperthyroidism; 33 4) incomplete fasting (reduced consumption of foods rich in CH, animal fats, refined carbohydrates); 5) some types of anemia; 6) increased excretion of cholesterol during diarrhea. The consequences of hypocholesterolemia are: 1) violation of the barrier function of cell membranes, increased permeability and cytolysis (also hemolysis of erythrocytes); 2) neurological disorders associated with a violation of the structure of myelin nerve fibers and nerve impulse conduction (ataxia, hyporeflexia , paresthesias); 3) decrease in the formation of bile acids and, as a result, digestive disorders in the intestines (loss of fats and fat-soluble vitamins); 4) hypovitaminosis D and changes corresponding to it; 5) hypoproduction of steroid hormones.

Topic: Insufficiency of blood circulation. Pathophysiology of the heart.
Types of tasks: Insufficiency of blood circulation. Pathophysiology of the heart.
Number of hours: 5

Heart failure is a condition in which the heart, as a pump, does not provide the metabolic needs of organs and tissues with the required amount of blood.

Etiology:

• Cardiac activity overload (overloading);

• Primary violation of the myocardium (myocardial);

• Primary damage to the pericardium (extramyocardial);

• Severe cardiac arrhythmias;

• Combined heart lesions.

Classification:

- According to the predominant damage to the parts of the heart, the following are distinguished:

1. *Left ventricular heart failure* → blood stagnation in the veins of the small blood circulation → pulmonary edema. *Cardiac asthma* (asphyxia, paroxysmal nocturnal dyspnea) occurs as a result of blood stagnation in a small circle of blood circulation and the development of pulmonary hypertension and interstitial pulmonary edema. It is manifested by the development of shortness of breath and cough without sputum. *Pulmonary*

edema is a consequence of the progression of cardiac asthma. Pulmonary hypertension → transudation of plasma into the lumen of the alveoli. It is manifested by a cough with the release of frothy sputum.

2 . *Right ventricular heart failure* → stagnation of blood in the large blood circulation → edema on the legs, ascites, liver enlargement.

3. *Total heart failure.*

- By course: acute and chronic.

- According to the predominant insufficiency of the phase of the cardiac cycle:

1. Systolic (impairment of the pumping function of the heart → decrease in cardiac output);

2. Diastolic (violation of relaxation of the walls and filling of the left ventricle due to its hypertrophy or fibrosis → increase in end-diastolic pressure).

Types of overload:

1. Blood volume overload:

• Hypervolemia ;

• Insufficiency of heart valves → ↑ filling of heart cavities with blood during diastole.

2. Resistance overload:

• Stenosis of heart valves;

• Arterial hypertension of the small and large circles of blood circulation → ↑ resistance to ejection of blood from the heart in systole.

Compensation mechanisms for increasing the load on the heart:

Short-term:

• *Heterometric mechanism* - *Frank*- Starling law (↑ myofibril length during diastole increases systole → tonogenic dilation);

• *Homeometric mechanism* (↑ myocardial tension power without increasing the length of myofibrils);

• *Chronoinotropic mechanism* (Bowdych phenomenon) - when the

frequency of heart contractions increases, the strength of its contractions increases. At the same time, the relaxation time of the myocardium decreases, which contributes to the rapid filling of the ventricles of the heart with blood;

• *The inotropic effect of catecholamines* (and not the Frank- Starling law) is the leading mechanism of adaptation of the heart to physical exertion, as a result of their action, the number of Ca channels of the sarcolemma increases , as a result, the force of contractions of cardiomyocytes increases , as the number of calcium- troponin complexes increases.

Long-lasting:

Myocardial hypertrophy

Stages of hypertrophy according to F.Z. Meerson :

1. *Emergency* (compensatory hyperfunction of the heart) increase in the intensity of functioning of cell structures:

• Breakdown of macroergic phosphoric compounds , accumulation of ATP breakdown products (ADP, AMP, Fn);

• Increase in energy production ;

• Activation of the genetic apparatus of cardiomyocytes ;

• Increasing the synthesis of nucleic acids and protein.

Increase in heart function → prostaglandins , angiotensin II → activation of adenylate cyclase → ↑ intracellular cAMP → activation of the genetic apparatus → increase in synthesis of nucleic acids and protein.

2. *The stage of complete hypertrophy and relatively stable hyperfunction:*

• Normalization of the functioning of cell structures per unit of muscle mass;

• Normalization of energy generation and protein synthesis per myocardial unit.

• An increase in the mass of the myocardium due to an increase in the volume of each cardiomyocyte .

3. *Stages of progressive cardiosclerosis and depletion of myocardial*

function:

Loss of vital activity of a part of cardiomyocytes → proliferation of fibroblasts → growth of connective tissue → gradual decrease in strength and speed of contraction and relaxation of the heart → myogenic dilatation → chronic congestive heart failure.

Features of a hypertrophied heart:

1. The growth of the cell surface lags behind the growth of muscle mass → disruption of membrane-bound processes.

2. The growth of the mass of mitochondria lags behind the growth of muscle mass → energy deficit.

3. The growth of the nuclear mass lags behind the growth of the sarcoplasm → deficiency of plastic support.

4. The growth of blood vessels lags behind the growth of muscle mass → deficiency of blood supply.

5. The growth of nerve fibers lags behind the growth of muscle mass → deterioration of innervation .

6. Predominant violation of the diastolic function of the heart.

Myocardial form of heart failure (primary damage to the myocardium) (dystrophic and necrotic changes as a result of metabolic disorders in the myocardium):

• coronary origin (coronary insufficiency);

• of non-coronarogenic origin (damage to the myocardium by chemical, physical, biological factors).

Extramyocardial insufficiency develops in those cases when little blood flows to the heart through the veins or when it is unable to receive all the incoming blood. The first is observed in case of hypovolemia (blood loss) or sudden expansion of blood vessels (collapse), the second - in the accumulation of fluid in the pericardial cavity, which causes difficulty in expansion of the cavities during diastole.

Coronary insufficiency is a pathological condition characterized by the inability of the coronary vessels to supply the heart with blood in accordance with its energy needs.

Relative coronary insufficiency occurs in the event of a primary increase in the energy needs of the heart (increased load on the heart during physical work, arterial hypertension). At the same time, the intensity of the coronary blood flow can increase, but it turns out to be insufficient to meet the growing needs of the heart.

Absolute coronary insufficiency occurs in the event of a primary violation of coronary blood circulation, as a result of which the delivery of oxygen and nutrients to the myocardium decreases, both at rest and when the energy needs of the heart increase. *Pathogenesis:* 1. Reduction of perfusion pressure (arterial hypotension , violation of venous outflow); 2. Increased resistance of coronary vessels (increased blood viscosity when its rheological properties are impaired, decreased vessel radius).

Ischemic heart disease is a disease that develops as a result of absolute insufficiency of coronary blood circulation and is manifested by damage to the myocardium of various degrees.

Myocardial infarction - necrosis of the heart muscle caused by coronary blood circulation disorders. Occurs with reversible ischemia lasting more than 40-60 minutes, or with irreversible coronary blood flow disorders. *Etiology:*

1. Atherosclerosis of coronary arteries.

2. Increased load on the heart (physical stress, arterial hypertension).

3. Stress.

Clinical syndromes in myocardial infarction:

1. Pain syndrome.

2. Acute heart failure. Manifested by a syndrome of cardiac asthma and pulmonary edema or cardiogenic shock.

3. Arrhythmic syndrome.

4. Resorption -necrotic syndrome.

Cardiogenic shock is a shock that occurs as a result of a sudden drop in the pumping function of the heart. *Pathogenesis:*

I stage - initial drop in blood pressure. A decrease in cardiac output leads to a decrease in cardiac output and a drop in blood pressure.

II stage - compensatory spasm of arterioles. The release of powerful vasoconstrictor factors causes a generalized spasm of arterioles, as a result of which the total peripheral resistance increases.

Stage III - secondary drop in blood pressure. Prolonged spasm of arterioles in peripheral tissues causes microcirculation disorders and hypoxia, which worsens the contractile function of the heart and causes a further drop in blood pressure.

IV stage - terminal changes. As a result of a significant drop in blood pressure, coronary and cerebral blood circulation is disturbed, acute kidney failure develops. The combination of these changes leads to death.

Topic: Coronary insufficiency. Arrhythmias.
Types of tasks: Coronary insufficiency. Arrhythmias.
Number of hours: 5

Cardiac arrhythmias are disorders of the frequency, rhythm, coherence and sequence of its contractions. Arrhythmias can be caused by various pathogenic factors acting on the myocardium, but most often they are observed in disorders of regulatory mechanisms, inflammation, ischemia, the effects of toxins, including drugs. Acting on the myocardium, these factors cause disturbances in the formation of impulses in the pacemakers and (or) their propagation along the conduction system and muscle fibers.

Types of arrhythmias. The main functions of the cells of the conducting system of the heart include automatism, excitability and conduction. Depending on which function of the conduction system of the heart is most damaged, the following are distinguished:

1. Arrhythmias caused by a violation of automatism

2. Arrhythmias caused by excitability

3. Arrhythmias caused by conduction disturbances

4. Arrhythmias associated with a combined disturbance of excitability and conduction.

Arrhythmias associated with a violation of automaticity:

Automatism is the ability of the cells of the heart's conducting system to spontaneously generate an action potential.

Normally, the generation of pulses before contraction occurs in the sinus-atrial nodes _ When the function of the sinus-atrial node is disturbed, pathological automatism (ectopic activity) can be observed not only in the sinus-atrial node nodes , but also in the tissues of the atria, ventricles, bundle of His , etc. In accordance with this, arrhythmias associated with a violation of automatism are divided into:

I. Nomotopic arrhythmias

II. Heterotopic arrhythmias

Nomotopic arrhythmias *are* arrhythmias associated with a violation of the generation of impulses in the sinus-atrial nodes _

These include:

Sinus tachycardia - an increase in heart rate for more than 90 minutes in adults. Physiological (increased heart rate under the influence of various influences in the absence of pathological changes in the cardiovascular system: during physical exertion, emotional stress, environmental change) and pathological tachycardia (intoxication, heart defects , myocardial infarction, rheumatism) are distinguished.

Sinus bradycardia (vagotonia - less than 60): in healthy individuals, either as a result of a congenital decrease in automaticity of the sinus-atrial node, or in athletes as a result of changes in the body's energy regime and hemodynamic regime. Pathological sinus bradycardia is often the result of irritation of the vagus nerve system (nervus vagus) with injuries of the central nervous system, pathological processes in the mediastinum, irritation of the

vagus nerve with ulcer and gallstone disease, with pathological processes in the myocardium.

Sinus arrhythmia: variability of the rhythm of heart contractions, associated with fluctuations in the activity of the sinus node. Under physiological conditions, it can be in young people and is associated with the act of breathing - an increase in the tone of n. vagus . In pathology, there may be alternation of tachy and bradycardia - an unfavorable indicator in severe heart conditions - an indicator of heart exhaustion.

Heterotopic arrhythmias (syndrome of weakness of the sinus-atrial node) - are observed when the sinus-atrial node is unable to provide a heart rhythm. In this case, the generation of impulses to the contraction of the myocardium occurs in automatic centers of the II and III orders. The following types of pathological rhythms can be observed on the ECG:

- *atrial slow rhythm* - the source of impulses is a focus located in the left atrium. ECG is characterized by rare (less than 70) excitation pulses;

- *atrioventricular (nodal) rhythm* - impulses are generated in the atrioventricular nodes _ The ECG is characterized by a decrease in heart rate from 60 to 40 per minute;

- *idioventricular (ideus - one's own) ventricular rhythm* - the source of impulses can be located in the bundle of His , in the legs of the bundle of His , in the Purkinje fibers . On the ECG - a decrease in heart rate to 40 or less contractions per minute.

Arrhythmias associated with myocardial excitability disorders.

The basis of the occurrence of these arrhythmias is the appearance of ectopic (from the Greek . Ektopos - moved) foci of excitation in relation to the sinus-atrial node, capable of generating an extraordinary impulse to contraction.

The cause of such arrhythmias can be:

- decrease in automatism of the sinus-atrial node;

- increase in excitability and, accordingly, the ability to generate

impulses in other areas of the myocardium.

The most common variants of this group of arrhythmias are:

a) extrasystole;

b) paroxysmal tachycardia.

Extrasystole - a heart rhythm disturbance with the occurrence of single or paired premature contractions of the heart (extrasystole), which are caused by a violation of the myocardium from a non-physiological source of the heart rhythm. They are divided into atrial (sinus), atrioventricular and ventricular:

- *sinus extrasystole* - arises from a premature impulse in part of the cells of the sinus-atrial node. On the ECG, there is a decrease in the T-R interval before extrasystole;

- *atrial extrasystole* - the source of excitation is located in different areas of the atria. On the ECG - a distorted P wave and an increased diastolic interval after extrasystole;

- *atrioventricular (atrioventricular) extrasystole* - the center of excitation is localized in the atrioventricular nodes _ On the ECG - a negative P wave, an increase in the diastolic interval;

- *ventricular extrasystole* - the center of excitation is localized in the ventricles. On the ECG, the P wave before the QRS complex of extrasystole is absent. The QRS complex itself is widened and distorted.

Paroxysmal tachycardia is an attack-like increase in heart rate caused by pathological circulation of extrasystolic excitation or pathologically high activity of the focus of heterotopic automatism in the heart. Heart contractions in paroxysmal tachycardia are strictly rhythmic, the heart rate is from 120 to 220 / min, in children it can be up to 260. The duration of the attack is from a few seconds to several days, sometimes weeks, and the heart rate does not change. There are also 3 forms: atrial , atrioventricular and ventricular . The first two forms are also called supraventricular paroxysmal tachycardia.

<u>Arrhythmias associated with conduction disturbances.</u>

Conduction is the property of cardiomyocytes to conduct an excitation

wave . Depending on the type of violation of this property, two groups of arrhythmias are distinguished:

A. Heart blocks.

B. Accelerated impulse conduction.

Heart block *is* a violation of the conduction of impulses in the heart muscle, which is accompanied by a slowing down of the speed and (or) a complete cessation of the propagation of the excitation wave.

Factors causing damage to the conduction system of the heart or changing the functional characteristics of the cellular elements of the myocardium may be the cause of the blockade.

Depending on the localization of the focus of violations, the following types of blockades are distinguished:

- *sinoatrial* - violation of impulse conduction from the sinus node to the atrium, characterized on the ECG by periodic complete failure of the cardiac cycle;

- *intra-atrial* - varying degree of intra-atrial inhibition or complete blockade of conduction of impulses leads to the appearance of an extended double-humped P wave on the ECG;

- *atrioventricular block* (atrioventricular block, AV block) - violation of conduction of impulses from the atria to the ventricles;

- *intraventricular* - characterized by a violation of conduction of impulses along the legs of the bundle of His , its branching and Purkinje fibers .

AB - blockades are divided into two groups:

- incomplete AB - blockade;

- full AB - blockade.

Incomplete AV - blockade, depending on the severity of violations, has two degrees:

a) 1st degree AB - blockade is characterized by the appearance on the ECG of a prolonged PQ (R) interval (more than 0.2 s)

b) 2nd degree AB - blockade, in turn, is divided into three types:

1. AV - blockade of the 2nd degree of the Mobits I type

- on the ECG, a gradually lengthened PQ interval is registered until the loss of a single QRS complex (Wenkebach period)

2. AB - blockade of the 2nd degree of Mobits II

- the sudden loss of two or more consecutive ventricular QRS complexes is noted on the ECG, and the P wave remains.

3. AB - blockade of the 3rd degree

- every second (2:1), or two or more gastric complexes in a row (blockade 3:1, 4:1, etc.) appear on the ECG .

With complete AV block, the heart is functionally divided into two unrelated parts. The atria are excited by impulses from the sinus-atrial node with a rhythm frequency within the range of 60 - 80 per minute. The ventricles are excited by impulses from heterotopic foci of rhythmic activity of the II and III orders with a rhythm frequency within the range of 30 - 40 per minute. On the ECG, P waves and QRS complexes are registered independently of each other.

With blockades, the pumping function of the heart is sharply disturbed, which causes acute ischemia of organs and tissues, and, above all, of the brain (Morganhi -Adams-Stokes syndrome). In the patient, it is manifested by a sudden loss of consciousness, absence of a pulse, epileptiform convulsions. The duration of attacks can be from 5 to 20 seconds . up to 1 - 2 minutes.

Arrhythmias associated with accelerated conduction of impulses. The reasons for the acceleration of conduction between the atria and ventricles or individual areas of the myocardium can be:

1. Inclusion in the conduction of excitation of additional conductive paths (bundles):

a) bundle of Kent - additional atrioventricular connections that bypass the atrioventricular node. Along this beam, impulses from the sinus-atrial node reach the ventricles faster.

On the ECG:

- shortened PQ interval;

- a wide QRS complex (this is due to the fact that the impulses go to the ventricle and along the bundle of Kent and the usual way).

Clinical manifestations - paroxysmal tachycardia, flickering or fluttering of the ventricles (Wolf-Parkinson-White syndrome) may develop.

b) bundle of James - connects one of the atria with the atrioventricular node. In this way, the excitation can quickly reach the ventricles of the heart.

On the ECG:

- shortened PQ interval;

- the parameters of the QRS complex are not changed, since the impulses arrive in the usual way (that is, through the AV node)

2. Increased excitability of heterotopic foci of excitation under the influence of adverse factors (for example, during the development of ischemia and hypoxia of the myocardium, activation of the sympathoadrenal system, etc.)

Clinical manifestations - developing tachycardia, atrial fibrillation, atrial flutter.

Arrhythmias associated with a combined disturbance of excitability and conduction.

The causes of combined arrhythmias can be:

- damage to the central nervous system (neurosis, vagotonia , impaired cerebral circulation, etc.);

- damage to the myocardium (myocarditis, heart attack, cardiosclerosis, etc.);

- violation of the ratio of electrolytes (K +, Na +, Mg +, Ca2 +);

- action of toxins and drugs (adrenomimetics , cardiac glycosides, etc.).

As a result of the action of these factors in the myocardium, the following may occur:

a) blockade of the normal source of impulses (sino-atrial node);

b) activation of an ectopic focus of excitation that generates its own impulses (parasystolic source);

c) re-entry and circular movement of pulses - Re - entry .

Re-entry is a theory of the circulation of the excitation wave in the myocardium along a closed path. The basis of this phenomenon is the mechanism of unidirectional blockade of a certain section of the conducting system in the antegrade direction, but it disappears when the impulses propagate in the opposite direction. This phenomenon most often occurs in places where fibers of the conducting system branch, anastomoses , in the area of contact of Purkinje fibers with myocardial cells.

Types of combined arrhythmias:

1. Fluttering of the atria and ventricles;

2. Atrial and ventricular fibrillation.

Fluttering of the atria and ventricles is characterized by the occurrence of impulses of high excitation frequency and, as a result, an increase in the number of heart contractions:

- atrium - up to 230 - 350 per minute;
- ventricles - up to 150 - 300 per minute.

Clinical manifestations:

- the rhythm of contractions is usually correct;
- there are no diastolic pauses;
- myocardial contraction - superficial and ineffective.

Fibrillation (flickering) of the atria and ventricles is characterized by irregular, chaotic bioelectrical activity of the atria and ventricles with a frequency of 300 to 500 pulses per minute. At such a frequency of excitation, myocardial cells cannot respond with normal synchronous, coordinated contraction.

Clinical manifestations

- the pumping function of the heart is completely stopped.

Topic: Pathophysiology of blood vessels.
Types of tasks: Pathophysiology of blood vessels.
Number of hours: 5

Atherosclerosis is a chronic focal lesion of arteries of the elastic and muscular-elastic type (that is, of large and medium caliber), in which their intima thickens due to lipid deposits and the development of fibrous tissue.

Pathogenesis of atherosclerosis:

A large number of theories, hypotheses, assumptions have been put forward regarding the pathogenesis of atherosclerosis:

- The theory of lipoprotein infiltration of the intima and its cellular response to altered (modified) lipoproteins ;
- Theory of endothelial dysfunction;
- Monoclonal theory;
- Autoimmune theory.

However, there are common points between them. Atherogenesis proceeds sequentially in several stages: initiation, progression, formation of atheroma, formation of fibroatheroma , development of complications of atherosclerosis.

Initiation of atherogenesis

Risk factors for atherosclerosis

↓

Damage to endothelial cells

↓

Activation of synthesis and expression on the surface of endothelial cells of adhesion molecules (selectins and integrins , etc.)

↓

Adhesion on the surface of endothelial cells of monocytes and platelets

↓

Penetration of monocytes and platelets into the subendothelial space

Transport of lipoproteins into the subendothelial space

↓

An increase in the degree of modification of lipoproteins as a result of POL, oxidation, acetylation , reduction, etc. processes

↓

Absorption of modified lipoproteins by macrophages and formation of foam cells

↓

Progression of atherogenesis

Migration to the zone of intima damage in large numbers monocytes and platelets

↓

They activate the formation of chemotaxis, growth, and necrosis factors

tumors, kinins , prostaglandins , reactive forms of oxygen, lipoperoxides

↓

Stimulation of damage to endothelial cells and the subendothelial layer, transport into the intima and modification of lipoproteins

↓

Increased absorption of modified lipoproteins by macrophages (mostly LDL)

↓

Migration of smooth myocytes to the zone of damage to the intima , their proliferation and transformation into macrophage-like cells

↓

Formation of lipid spots and strips

↓

Increase in migration, proliferation and transformation of smooth myocytes into macrophage-like

↓

Their absorption of a large amount of lipoproteins ;

Their synthesis of components of the intercellular substance (elastin, collagen, proteoglycans , etc.)

↓

Formation of ater and fibroater

↓

Narrowing of the lumen of arteries

Arterial hypertension (AH) - persistent increase in blood pressure over 140/90 mm Hg . *Primary (essential , hypertensive disease)* and *secondary (symptomatic) arterial hypertension* are distinguished .

Essential hypertension is a disease in which an increase in blood pressure is not associated with primary organic damage to organs and systems. The basis of the disease is a violation of the neurohumoral regulation of vascular tone.

Risk factors:

• Genetic factors (hereditary predisposition):

- High concordance in identical twins;
- Increased risk of hypertension (by 6 times) in families where one of the parents suffers from hypertension;
- The possibility of hypertension at a young age;
- Defects in the transmembrane transfer of ions (Ca^{2+});

↑ Ca^{2+} in the myocytes of resistance vessels → persistent muscle contraction

- Defects in the transmembrane transfer of ions in the renal tubules → retention of sodium and water;
- Violation of endothelium-dependent mechanisms of resistance vessel tone regulation, leading to a decrease in the formation of endogenous vasodilators (nitric oxide, prostacyclin , etc.) by endotheliocytes ;

- Peculiarities of the angiotensinogen gene structure ;
- Defects of aldosterone metabolism enzymes.

• Prolonged action of stressors:

- AH develops more often in people after emotional upheavals;

- Hypertension occurs more often in people whose professional activity is associated with psycho-emotional stress.

• Excessive consumption (more than 5 g per day) of table salt.

• Smoking, alcohol, hypokinesia, noise, vibration, working at night.

• Obesity, atherosclerosis, endocrine diseases

Pathogenesis:

1. Neurogenic mechanism

Risk factors → Disorders of blood pressure regulation centers → Violation of the dynamics of cortical processes (excitation and inhibition) → Deficiency of inhibition in the cerebral cortex → Formation in SDC neurons of a generator of pathologically increased excitation and formation of a pathological system → Persistent activation of the sympathetic division of the autonomic nervous system → An increase in the frequency and strength of heart contractions, spasm of resistive vessels → ↑ minute blood volume and total peripheral vascular resistance.

2. Hormonal mechanism

Activation of the hypothalamus - pituitary -adrenal system → Increased secretion of glucocorticoids and other stress hormones.

3. Renal mechanism.

- Hereditary defects of the angiotensin- aldosterone system (RAAS) and tubular epithelium;
- RAAS activation due to renal ischemia.

Secondary arterial hypertension occurs as a result of pathological processes in various organs and systems. *Species:*

1. Renal arterial hypertension:

a) arterial hypertension can occur with nephropathy in pregnant

women; in autoimmune -allergic kidney diseases, both inflammatory (diffuse glomerulonephritis , collagenoses) and dystrophic (amyloidosis, diabetic glomerulosclerosis).

b) with infectious interstitial diseases of the kidneys - with chronic pyelonephritis, hypertrophy and hyperplasia of the juxtaglomerular apparatus and persistent increase in renin secretion are observed.

c) renovascular or vasorenal - with impaired blood supply to the kidneys and with congenital narrowing of arteries, or their hypoplasia, aneurysms, with acquired lesions of arteries with atherosclerosis, thrombosis, calcenosis . In this case, the leading role in the stimulation of renin secretion belongs to the reduction of blood flow in the renal arteries. The formed angiotensin-II has a direct pressor effect and stimulates the synthesis of aldosterone, which in turn increases the accumulation of Na^+ in the vascular walls and strengthens the pressor reactions.

d) with urological diseases of the kidneys and urinary tract (congenital - renal hypoplasia, polycystosis) or acquired (kidney stone disease, tumors of the structure of the urinary tract).

e) renoprior arterial hypertension develops after removal of both kidneys. Normally, the kidneys produce antihypertensive factors - kinins and prostaglandins , and their deficiency increases blood pressure.

2. Neurogenic symptomatic arterial hypertension:

a) centrogenic - associated with damage to the brain - encephalitis, tumors, hemorrhage, ischemia, injuries (in the experiment - by creating negative emotions in animals - fear, rage, inability to avoid danger; overstrains of the VND - restructuring of stereotypes, distortion of daily rhythms, vascular ligation, compression of brain tissue).

b) peripheral - associated with damage to the peripheral nervous system - with poliomyelitis, polyneuritis.

3. Endocrine arterial hypertension:

a) with hormonal tumors of the pituitary gland - acromegaly + increased

blood pressure, Itsenko-Cushing's disease + increased cortisol level ;

b) with tumors of the cortex of the adrenal glands - an increase in the level of glucocorticoids , mineralocorticoids → hyperaldosteronism , pheochromocytoma → an increase in the level of norepinephrine ;

c) with diffuse toxic goiter - increased thyroxine level → hyperkinesia ;

d) with discrination during the climax.

4. Hemodynamic arterial hypertension:

a) when the elasticity of the walls of the aorta and large vessels is reduced, there is no adequate stretching of the vascular wall by the pulse wave passing through the vessels;

b) hypertension with aortic valve insufficiency is caused by an increase in the end-diastolic volume of blood in the left ventricle as a result of regurgitation of blood from the aorta during diastole;

c) hypertension with coarctation of the aorta is associated, on the one hand, with a sharp increase in blood flow resistance in the area of narrowing of the aorta, and on the other hand, with impaired blood supply to the kidneys, since the renal arteries depart below the site of coarctation ;

d) narrowing of the carotid, vertebral or basilar artery leads to ischemia of the brain - cerebroischemic arterial hypertension.

Hemodynamic variants of arterial hypertension:

1. Hyperkinetic type , which is due to a significant increase in the work of the heart, as a result of which its minute volume increases.

2. The eukinetic type occurs with a moderate increase in cardiac output and total peripheral vascular resistance.

3. Hypokinetic type associated with a significant increase in total peripheral vascular resistance.

Arterial hypotension (sustained decrease in blood pressure) is observed more often in people with an asthenic constitution and is manifested by general adynamia, rapid fatigue, tachycardia, shortness of breath,

dizziness, hunger pangs, fainting and a depressed state with periodic increase in nervous excitability.

Classification:

I. *Physiological* (not accompanied by painful symptoms, in athletes, asthenics).

P. *Pathological* (with a characteristic symptom complex):

1. Primary hypotonic disease. It is believed that its main etiological and pathogenetic factor, as well as hypertensive disease, is overstrain of the main processes of the cerebral cortex (excitation and inhibition). However, in contrast to primary hypertension, there is a prevalence of inhibition and its spread to subcortical autonomic formations, in particular to the vasomotor center.

2. Secondary:

a) *acute* (shock, collapse, fainting);

b) *chronic* , which is the result of a number of general somatic acute and chronic diseases of the heart (defects, myocarditis, myocardial infarction), brain, lungs (croupous pneumonia, tuberculosis), liver (hepatitis, mechanical jaundice), blood (anemia), endocrine glands , as well as exogenous intoxications.

Topic: Pathophysiology of external breathing.
Types of tasks: Pathophysiology of external breathing.
Number of hours: 5

Breathing is a set of processes that ensure the entry of oxygen into the organism , its use in the biological oxidation of organic substances and the removal of carbon dioxide.

External respiration: a) gas exchange in the alveoli between the lungs and the external environment; b) exchange between alveolar gases and blood gases; c) transport of gases by blood to tissues and cells - specifically to functional elements of organs.

Respiratory insufficiency is a state of the body in which either maintenance of the normal gas composition of the blood is not ensured , or the latter is achieved due to the intense work of compensatory mechanisms: an increase in the minute volume of breathing due to its depth and frequency - that is, shortness of breath; increase in the number of red blood cells and hemoglobin, which leads to a decrease in the functional capabilities of the organism .

Types of respiratory failure :

I. According to the clinical course: *acute* (asphyxia) and *chronic* respiratory failure (bronchial asthma, COPD).

II. According to the severity of clinical signs: *compensated* (blood gas composition has not yet changed) and *decompensated* (gas homeostasis is disturbed).

III. According to pathogenesis: *ventilation* and *parenchymal* insufficiency of external breathing.

Pathogenetic variants of ventilatory failure of breathing:

1. Dysregulatory insufficiency (violation of the central regulation of breathing).

2. Restrictive insufficiency.

3. Obstructive insufficiency.

Dysregulatory insufficiency can manifest itself in the following types:

1) *tachypnea* - frequent but shallow breathing in case of fever, functional disorders of the central nervous system (hysteria), damage to the lungs (atelectasis, pneumonia, congestion), pain localized in the areas of the body involved in the act of breathing (chest, abdominal wall, pleura).

2. *hyperpnea - deep, frequent breathing - when the partial pressure of oxygen in inhaled air decreases or when* the concentration of CO_2 in it increases , during anemia, acidosis, etc. The extreme degree of excitation of the respiratory center manifests itself in the form of Kussmaul breathing , which is most often observed in patients in a state of diabetic coma. It is loud, frequent breathing, in which a deep breath is followed by an intensified exhalation with the active participation of the expiratory muscles.

3) *bradypnea* - shallow shallow breathing with increased blood pressure (reflex from baroreceptors of the aortic arch and carotid sinus), with hyperoxia (due to periodic excitation of chemoreceptors sensitive to a decrease in oxygen tension in arterial blood).

Deep liquid breathing can appear with increased resistance to air movement in the upper respiratory tract - *stenotic breathing* . The alveoli are filled slowly, their irritation is weak and the change of inhalation to exhalation slowly occurs (slowing down of the Hering-Breuer reflex).

4) *apnea* - temporary cessation of breathing, which may be associated with a decrease in reflex or direct chemical stimulation of the respiratory center (hypoxia, intoxication, organic brain lesions).

Periodic breathing is such a violation of the breathing rhythm, in which periods of breathing alternate with periods of apnea:

Cheyne -Stokes breathing is characterized by a gradual increase in the frequency and depth of breathing, which, reaching a maximum, gradually decreases and disappears completely. There is a complete, sometimes lasting up to (0.5 min) pause - apnea, and then a new wave of respiratory movements. *Etiology:* 1) chronic nephritis, 2) nephrosclerosis, 3) uremia, 4) heart decompensation, 5) severe pulmonary insufficiency, 6) liver failure, 7)

diabetic coma, 8) brain damage - tumors, hemorrhages, injuries, brain edema.

Pathogenesis: as a result of a decrease in the excitability and lability of the respiratory center, the usual concentration of CO_2 in the blood becomes insufficient to excite it . The respiratory center is not disturbed, breathing stops and CO_2 accumulates . Its concentration reaches such a significant level that it begins to act on the respiratory center, despite the decrease in its excitability, and leads to the appearance of breathing. But since lability is reduced, breathing increases slowly. As breathing increases, CO_2 is removed from the blood and its effect on the respiratory center weakens. Breathing becomes less and less and finally stops completely - again a pause.

Biot's breathing - occurs with deeper damage to the respiratory center - morphological, especially inflammatory and degenerative lesions in nerve cells. It is characterized by the fact that the pause occurs after 2-5 respiratory movements. The pause is long, that is, the smallest decrease in pCO_2 leads to a pause. *Etiology:* 1) meningitis , 2) encephalitis, 3) severe poisoning, 4) heat stroke, etc.

Restrictive insufficiency - when lung distensibility is reduced in pneumonia, atelectasis, fibrosis, edema and congestion in the lungs, complete blockage of the large bronchi, after removal of part of the lung.

Obstructive insufficiency is observed as a result of a decrease in the patency of small-caliber bronchi due to a decrease in their lumen: spasm of the bronchial muscles, edema of the mucous membrane and accumulation of sputum in the lumen of the bronchi. First of all, exhalation is disturbed due to the narrowing of the bronchi.

Terminal breathing.

Gasping breaths **are** single, rare, decreasing in strength "sighs", which are observed in agony, for example, in the final stage of asphyxiation.

Apneic breathing is characterized by a convulsive effort to inhale, which is occasionally interrupted by exhalation.

parenchymatous , which occurs as a result of disturbances in the gas

exchange between the alveoli of the lungs and the blood. Its causes are focal lesions of the lung parenchyma (exudative and proliferative inflammatory diseases), which lead to disturbances in pulmonary blood circulation.

There are three main mechanisms of gas exchange violations between alveoli and blood:

1) violation of gas diffusion;

2) violation of pulmonary perfusion (blood circulation);

regional violations ventilation-perfusion relations.

Violation of gas diffusion in the lungs. *Etiology:*

1) reduction of the diffusion coefficient;

2) reduction of the diffusion area (respiratory surface of the lungs);

3) an increase in the thickness of the alveolar-capillary membrane;

4) reduction of the difference between the partial pressure of gases in the alveolar air and their tension in the blood of the pulmonary capillaries;

5) reduction of blood contact time with alveolar air.

Violation of pulmonary perfusion. *Etiology:*

a) decrease in pressure in the right ventricle (right heart failure, decrease in venous return in case of blood loss, shock, collapse);

b) increased pressure in the left atrium (stenosis of the mitral valve opening, left ventricular heart failure);

c) an increase in the resistance of the blood vessels of the small circle of blood circulation (increased blood viscosity, the presence of obstacles to the movement of blood - thrombosis, embolism).

Asphyxia is a pathological process, a syndrome with an acute course, which occurs due to a lack of oxygen in the blood and tissues, with the subsequent accumulation of carbon dioxide in the body.

And the period of asphyxia is characterized by a rapid increase in the depth and frequency of breathing with a predominance of the inhalation phase over the exhalation phase. General excitement develops, the tone of the sympathetic part of the autonomic nervous system increases - pupils dilate,

tachycardia appears, blood pressure increases, convulsions are possible.

In the II period, the frequency of breathing gradually decreases while maintaining the maximum amplitude of respiratory movements, the exhalation phase increases. The tone of the parasympathetic part of the autonomic nervous system prevails - the pupils narrow, blood pressure decreases, and bradycardia is noted.

In the III period of asphyxia, there is a decrease in the amplitude of breathing, its frequency and, finally, cessation of breathing. Blood pressure is significantly reduced. After a short-term cessation of breathing, several rare convulsive breathing movements (gasping breathing) usually appear , after which respiratory paralysis occurs.

Topic: Pathophysiology of the digestive system. Insufficiency of digestion.
Types of tasks: Pathophysiology of the digestive system. Insufficiency of digestion
Number of hours: 5

The main function of the digestive system is to ensure the entry into the body of energy and plastic materials, as well as elements necessary for the formation of the internal environment (water, salts, etc.).

Structurally and functionally, the digestive system can be divided into two main departments:

a) executive (effector)

b) regulatory

In the executive department, food is digested and the body absorbs the substances it needs. This department is represented

- smooth muscle cells, which carry out contraction processes necessary for the mechanical processing of food and its movement through the digestive tract;

- secretory cells that provide the secretion of digestive enzymes necessary for the digestion of proteins, fats, carbohydrates and nucleic acids;

- cells of the mucous membrane of the digestive tract (enterocytes), which perform membrane hydrolysis and transport digestion products into the internal environment of the body.

The regulatory department, with the help of central and local neurohumoral mechanisms, regulates all processes that take place in the executive department.

The central regulatory link of digestion processes is a number of structures of the brain and spinal cord, which form a food center that regulates eating behavior and coordinates local mechanisms.

Local regulatory mechanisms are carried out both by the nervous system and by neuroendocrine cells located in the gastrointestinal tract (GI).

Cholinergic and adrenergic neurons participate in the transmission of regulatory nerve impulses . At the same time , cholinergic neurons, the

mediator of which is acetylcholine, have an excitatory, activating effect on the executive department of the digestive system (increased motility, secretion), and adrenergic neurons, the mediator of which is norepinephrine , cause inhibitory effects (repressed secretion, motility).

Along with the nervous system, the diffuse endocrine system (APUD-system), whose cells are located in the mucous membrane of the gastrointestinal tract and produce various BAS (neuropeptides , biogenic amines, etc.), has an active effect on the function of the digestive system.

The main neuropeptide hormones of the gastrointestinal tract:

1. Gastrin - stimulates the secretion of hydrochloric acid in the stomach and enzymes in the pancreas, activates intestinal peristalsis.

2. Cholecystokinin - stimulates the release of bile into the intestines and the secretion of enzymes in the pancreas, suppresses intestinal peristalsis and stomach motility.

3. Secretin - accelerates the evacuation of a food lump from the stomach , stimulates the secretion of pancreatic juice, suppresses intestinal peristalsis and acid secretion in the stomach.

4. Vasoactive intestinal peptide (VIP) - activates stomach motility and intestinal peristalsis; powerful vasodilator .

5. Motilin - stimulates the motility of the stomach .

6. Somatostatin - suppresses all digestion processes in the gastrointestinal tract.

8. Glucagon - suppresses intestinal peristalsis, stimulates the secretion of mucus and bicarbonates.

Digestive insufficiency is a pathological condition in which the digestive system does not ensure the assimilation of nutrients entering the body.

Classification of indigestion:

I. According to the clinical course, *acute* and *chronic* indigestion are distinguished.

II. According to the anatomical principle, insufficiency of digestion can be disturbed: in the oral cavity; in the stomach; in the intestine

III. Insufficiency of digestion can be *general* (total) - impaired absorption of all nutrients, and *selective* (partial) - only individual ones their classes (for example, lipids, lactose, etc.).

IV. By etiology, *hereditary* (some types of malabsorption) and *acquired* indigestion (of infectious origin) are distinguished. due to the effects of physical factors; associated with the effects of chemical agents; alimony).

V. According to the pathogenesis: a) violation of the motor function of the digestive system; b) violation of its secretory function; c) violation of absorption processes.

Causes of indigestion:

I. Alimentary factors: a) intake of poor-quality and rough food; b) irregular eating; c) unbalanced nutrition (for example, a decrease in the content of vitamins in the diet); e) alcohol abuse.

II. Physical factors (ionizing radiation).

III. Chemical agents (poisoning by inorganic and organic compounds at work and in everyday life).

IV. Biological factors: a) bacteria (cholera vibrio, causative agents of dysentery, typhoid, paratyphoid, etc.); b) bacterial toxins (with salmonellosis , staphylococcal infection); c) viruses (adenoviruses); d) helminths.

V. Organic lesions: a) congenital abnormalities of digestive organs; b) postoperative conditions; c) tumors of the digestive system.

VI. Violation of nervous and humoral regulation in: a) psychoemotional disorders (neurotic and neurosis-like states); b) mental illnesses (schizophrenia, manic-depressive syndrome); c) organic diseases of the central nervous system (encephalitis); d) lesions of peripheral structures of the autonomic nervous system; e) reflex disorders (various viscero -visceral reflexes).

Violations of the humoral regulation of digestion can be associated with disorders of the synthesis and secretion of gastrointestinal hormones (gastrin , secretin, cholecystokinin-pancreozymin , etc.).

Clinical syndromes with digestive disorders:

1 . ***Dyspeptic syndrome*** includes various combinations of the following symptoms: a) anorexia; b) heartburn; c) belching; d) nausea; e) vomiting; g) flatulence; g) fasteners; h) diarrhea

Anorexia is a complete lack of appetite with an objective need for food. The following types of anorexia are distinguished: a) *intoxication* - develops in case of acute and chronic poisoning (for example, mercury salts, drugs, bacterial toxins); b) *dyspeptic* - occurs in diseases of the digestive system, most often has a conditionally reflex nature; c) *neurodynamic* - develops as a result of reciprocal inhibition of the appetite center when certain structures of the limbic system are excited (for example, pain syndrome during myocardial infarction, colic , peritonitis); d) *neurotic* - associated with excessive excitation of the cerebral cortex and strong emotions (especially negative); e) *psychogenic* - is the result of a conscious restriction of food (for example, for the purpose of losing weight or as a result of an obsessive idea in case of mental disorders).

Heartburn is a burning or burning sensation along the esophagus. Its development is associated with irritation of the receptors of the esophagus when the contents of the stomach are thrown into the esophagus (reflux). This may be due to: a large amount of gastric juice and functional insufficiency of the cardiac sphincter.

Belching is a sudden involuntary release of gas from the stomach or esophagus into the oral cavity, sometimes with small portions of stomach contents. An increase in the content of gases in the stomach can be caused by: intake of a large amount of gases with food and drinks (for example, carbonated drinks), swallowing air (aerophagia); the formation of gases in the stomach itself, especially when food stays there for a long time (happens

with peptic ulcer disease, stomach cancer).

Nausea is a kind of heavy feeling in the epigastric region, in the chest and oral cavity, often preceded by vomiting and often accompanied by general weakness, sweating, increased salivation, coldness of the extremities, pallor of the skin, a decrease in blood pressure, that is, signs of activation of the parasympathetic nervous system. The basis of nausea is the excitation of the vomiting center, but not yet enough to cause vomiting.

Vomiting is a complex reflex act that causes the contents of the stomach to be expelled through the mouth. It occurs as a result of a violation of the vomiting center located in the medulla oblongata.

Constipation is a delayed, difficult or systematically insufficient bowel movement. There are two mechanisms of constipation development - spastic and atonic. The first is caused by long-term constant contraction of the smooth muscles of the intestines (spasm), the second by their atony.

Flatulence is an excessive accumulation of gases in the digestive tract due to their increased formation (when eating food containing a lot of fiber, starch (legumes, cabbage, potatoes); digestive disorders (enzymopathies , malabsorption, intestinal dysbacteriosis) or insufficient removal from the intestine (as a result of intestinal patency disorders (spasms, adhesions, tumors), with disorders of the motor function of the intestines).

Diarrhea is an accelerated emptying of the intestines with the release of thin, and in some cases, abundant stools. Diarrhea occurs when the normal ratio between secretion and absorption of liquid in the intestines is disturbed, when intestinal motility is disturbed.

2. The main causes of ***body dehydration*** in digestive disorders are:

- hypersalivation - increased formation and secretion of saliva - hyperosmolar dehydration;

- uncontrollable vomiting and diarrhea - hypoosmolar dehydration.

3. Violation of the acid-base state:

1) non-gaseous alkalosis - due to uncontrollable vomiting;

2) non-gaseous acidosis - due to the loss of a large amount of hydrocarbonates of pancreatic juice and bile during diarrhea.

4. Intestinal autointoxication **-** associated with dysbacteriosis and the formation of large quantities of toxic products of fermentation and decay.

5. Pain syndrome with lesions of the digestive system. Mechanisms: a) *spastic mechanism* - pain caused by spasm of smooth muscles of different parts of the digestive tract; b) *hypotonic mechanism* - with a decrease in the tone of smooth muscles (hypotonia), pain occurs as a result of stretching the walls of hollow organs (stomach, intestines, gall bladder) by their contents; c) *influence of biologically active substances* (histamine , serotonin, kinins , prostaglandins , etc.) on nerve endings.

Violation of the motor function of the digestive tract:

1) chewing disorder . *Etiology:* damage to teeth and their absence; damage to the chewing muscles (myositis); disturbance of innervation of masticatory muscles (bulbar paralysis, neuritis); damage to the temporomandibular joints; damage to the mucous membrane of the oral cavity and gums (stomatitis, gingivitis); hyposalivation . *Consequences:* decrease in the reflex secretion of gastric and pancreatic juices; slowing of digestion in the stomach; traumatization of the mucous membrane of the oral cavity, esophagus, stomach; refusal to take some foods that are necessary for the body, but which require chewing.

2) swallowing disorder. Dysphagia is a violation of the complex reflex act of swallowing. *Etiology:* damage to the receptors of the mucous membrane of the mouth (stomatitis) and pharynx (angina); damage to sensitive afferent and motor efferent nerve conductors, which participate in the implementation of swallowing reflexes (fibers V, VII, IX, X, XII pairs of ChMN); damage to nerve centers - in the cerebral cortex and the swallowing center located in the area of the bottom of the IV ventricle; damage to the muscles of the tongue, pharynx and esophagus; congenital and acquired defects of the soft and hard palate; mechanical obstacles (tumors, scars, compression of the esophagus

from the outside). *Consequences:* extremely difficult eating leads to starvation and exhaustion.

3) gastric dyskinesias - disturbances of motor (motor) function of the stomach. The *hypertensive variant* of gastric dyskinesia is characterized by an increase in the tone of the stomach muscles (hypertension) and increased peristalsis (hyperkinesia). *Etiology:* some food factors (rough food, alcohol); increased gastric secretion; increased tone of the vagus nerve; hypersecretion of motilin . *Consequences:* long-term retention of contents in the stomach, which contributes to the increase in gastric secretion and the development of ulcers on the mucous membrane; the development of antiperistalsis of the stomach, which leads to the appearance of belching, nausea, vomiting. *The hypotonic variant* , on the contrary, is characterized by hypotonia and hypokinesia. *Etiology:* dietary factors (fatty food); decrease in gastric secretion; decrease in the tone of the vagus nerve; general weakening of the body. *Consequences:* a decrease in the time that food stays in the stomach, which leads to a violation of its digestion, which causes an increase in intestinal peristalsis and diarrhea.

4) intestinal dyskinesias - disturbance of motor (motor) function of the intestine. The *hyperkinetic variant* of intestinal dyskinesia is characterized by increased peristalsis of the intestines, manifested by the development of diarrhea. *Etiology:* increased excitability of intestinal receptors to adequate stimuli, which accompanies the development of inflammation of the intestinal mucosa (enteritis , colitis); action on intestinal receptors of unusual, pathological irritants - undigested food (for example, with achilles), products of decay and fermentation, toxic substances, etc.; increased excitability of the vagus nerve centers; increase in formation of motilin . *Consequences:* digestive disorders (digestion, absorption); dehydration; excretory non-gaseous acidosis (loss of hydrocarbons). *The hypokinetic variant* is characterized by a weakening of the motor activity of the intestines, resulting in constipation (spastic and atonic). *Etiology of spastic constipation:* persistent

long-term tonic contraction of the smooth muscles of the intestines (spasms), action of toxic factors (for example, lead poisoning). *Etiology of atonic constipation* : low fiber content in consumed food products; excessive digestion of food in the stomach (for example, with gastric hypersecretion); age-related changes in the receptor apparatus of the intestines in the elderly, as well as structural changes in the intestinal wall in obesity; decrease in the tone of the vagus nerve. *Consequences:* development of intestinal autointoxication ; occurrence of flatulence; formation of fecal stones; intestinal obstruction.

5) dyskinesia of the gallbladder and bile ducts;

6) violation of defecation. *Etiology:* loss of influence of the cerebral cortex on the spinal defecation center (fear, fear); damage to the defecation center in the lumbar -sacral region of the spinal cord; damage to peripheral nerves; disorders of muscle function involved in defecation.

Violation of the secretory function of the digestive system:

a) hypersecretory states:

1) hypersalivation - increased formation and secretion of saliva. *Etiology:* violation of the receptors of the oral cavity, esophagus and stomach (reflex mechanism); stimulation of the salivary center located in the medulla oblongata; irritation of the vegetative nerves innervating the saliva glands *Consequences:* the development of hyperosmolar hypohydration ; neutralization of gastric juice, which is associated with the slightly alkaline environment of saliva.

2) gastric hypersecretion - increased formation and secretion of gastric juice. *Etiology:* increased tone of the vagus nerve, hyperproduction gastrin , histamine . *Consequences:* long-term retention of contents in the stomach causes a decrease in peristalsis of the intestines and the development of constipation; strengthening of the processes of fermentation and gas formation; increased motor activity of the stomach - hypertonus and hyperkinesia of its smooth muscles; formation of ulcers in the stomach and

duodenum.

3) pancreatic hypersecretion - increased formation and secretion of pancreatic juice. *Etiology:* increased tone of the parasympathetic nervous system (vagus nerve); increased production of gastrointestinal substances - secretin and cholecystokinin-pancreozymin . *Consequences:* improvement of cavity digestion processes.

4) hypercholia ;

b) hyposecretory states:

1) hyposalivation - a decrease in the production and release of saliva. *Etiology:* central inhibition of salivary gland secretion (fear, fright, pain); damage to the secretory cells of the salivary glands (inflammation, tumors); impaired excretion of secretions (clogging of the salivary ducts glands with stones); body dehydration. *Consequences:* disturbance of chewing, formation of a food lump, swallowing; traumatization of the mucous membrane of the mouth with the development of its inflammation (stomatitis); active development of microorganisms; violation of the trophic effects of saliva on the teeth, which contributes to the development of caries.

2) gastric hyposecretion - decrease in the formation and secretion of gastric juice. *Etiology:* decrease in tone of the vagus nerve, hypoproduction gastrin , histamine . *Consequences:* insufficient formation of gastric juice leads to inhibition of secretin production, as a result of which the secretion of pancreatic juice decreases and the processes of cavity digestion in the intestines are disturbed; increased intestinal peristalsis and development of diarrhea; activation of pathogenic microflora.

3) pancreatic hyposecretion - a decrease in the formation and secretion of pancreatic juice. *Etiology:* neurogenic inhibition of the exocrine function of the pancreas (decreased tone of the vagus nerve, atropine poisoning, etc.); decrease in formation of secretin and cholecystokinin-pancreozymin ; violation of the removal of pancreatic juice (clogging of the ducts, their compression); decrease in the number of secretory cells (destruction, chronic

pancreatitis). *Consequences:* violation of cavity digestion in the intestines - development of maldigestion syndrome . *Maldigestion syndrome* is manifested by: disorders of digestion of fats, proteins, carbohydrates, disorders of absorption of fat-soluble vitamins - A, D, E, K; violation of cleavage of nucleic acids.

4) acholia.

Violation of absorption function - malabsorption syndrome . Etiology: 1) *preenterocytic* disorders: disorders of the motor function of the alimentary canal, cavity digestion (maldigestion syndrome), parietal digestion (disorders of the formation and embedding of enzymes in the plasma membrane of microvilli enterocytes); 2) *enterocytic :* decrease in absorption area (state after bowel resection, atrophy of villi and microvilli); hereditary and acquired disorders of the formation of proteins - carriers of monosaccharides (intolerance of glucose, galactose, fructose), amino acids, calcium ions (hypovitaminosis D); dysfunction of ion pumps of enterocytes ; energy deficit; 3) *postenterocytic :* blood circulation disorders in the intestinal wall (ischemia, venous hyperemia, thrombosis, embolism, vascular reactions during inflammation); violation of lymph flow .

Ulcer disease is a chronic relapsing disease characterized by the formation of ulcers in the stomach or duodenum.

According to modern concepts, gastroduodenal ulcers occur both when the aggressive properties of gastric contents increase and when the protective capabilities of the mucous membrane of the stomach and duodenum are weakened.

Factors of aggression:

1. Negative psycho-emotional stress, neurosogenic effects on the body. *Pathogenesis:* cause increased secretion and acidity of gastric juice; prolonged spasm of blood vessels and muscles of the stomach and intestines; dystrophic process in the mucous membrane.

2. High concentration of hydrochloric acid and pepsin, which causes

destruction of the mucous membrane.

3. Hyperchlorhydria , which is observed when the number of parietal cells increases; excessive stimulation of hydrochloric acid secretion, for example, with increased tone of the vagus nerve, with gastrinoma (Zollinger-Ellison syndrome); deficiency of secretin (atrophy of the intestinal mucosa), somatostatin .

4. Helicobacter pylori , which produces enzymes that destroy the protective layer of mucus, cytotoxins with a direct damaging effect, stimulates gastric T-lymphocytes to damage epitheliocytes , causes inflammation and a phagocytic reaction, which through inflammatory mediators (interleukins , lysosomal hydrolase , tumor necrosis factor) damages epitheliocytes .

5. Non-steroidal anti-inflammatory drugs: reduction of the cytoprotective properties of the mucous membrane due to a decrease in the synthesis of prostaglandins in the stomach due to the inhibition of cyclooxygenase activity .

6. Smoking: decrease in the exocrine function of the pancreas (decrease in the excretion of alkaline secretion in the duodenum and decrease in the concentration of bicarbonate anions), decrease in the tone of the pyloric sphincter and increase in the release of acidic stomach contents into the duodenum, increase in the secretion of pepsinogen .

7. Corticosteroids during long-term pharmacotherapy or prolonged stress reactions: inhibit reparative processes in the gastric epithelium, increase the sensitivity of adrenoceptors to endogenous catecholamines , leading to spasm of resistant vessels of the stomach and mucosal ischemia.

8. Hypergastrinemia , as well as an increase in other gastrointestinal hormones (for example, cholecystokinin), an increase in histamine ; reduction of prostaglandin E2; genetically determined increase in the mass of lining , enterochromatophynic cells, etc. - increase the acid-aggressive activity of gastric juice.

Protection factors:

1. Mucus and bicarbonate anions are secreted mucosal epitheliocytes , creating a pH just above the cell equal to that of arterial blood.

2. Normal microcirculation: removal of protons from the stomach wall into the blood when they penetrate through the protective mucous barrier.

3. Prostaglandins of the stomach increase the volumetric speed of blood flow through microvessels , stimulation of the secretion of mucus and bicarbonate anions by epitheliocytes .

4. Regeneration - complete renewal of the epithelium of the gastroduodenal zone occurs within 2 - 6 days. Minor damage to the mucous membrane can be restored within 15-30 minutes, but not due to cell division, but as a result of their movement from the crypts of the glands along the basement membrane and thus closing the defect in the area of the damaged epithelium.

Acute pancreatitis is an inflammation of the pancreas characterized by an acute course. *Etiology:* intake of fatty food; alcohol abuse; gallstones and pancreatic duct polyps ; mechanical damage to the pancreas during injuries and surgical interventions ; infectious agents (epidemic parotitis virus, Coxsackie , bacterial infection); intoxication, including the effect of some drugs (immunosuppressants , thiazides , etc.).

Pathogenesis: premature activation of pancreatic juice enzymes in pancreatic ducts causes self-digestion of glandular tissue. Active enzymes of pancreatic juice, prostaglandins , kinins cause secondary alteration of pancreatic tissue, increased vascular permeability with development of edema, hemorrhages ; occurrence of pain

Pathogenetic variants of acute pancreatitis:

I. Primary-alterative.

II. II. Hypertensive .

III. III. Reflux .

Pancreatic shock is a severe general manifestation of acute pancreatitis, which is characterized by disturbances in general hemodynamics (a decrease in blood pressure) and generalized disorders of microcirculation.

Pathogenesis: I. Pain mechanism. A sharp, acute shingles pain that occurs with pancreatitis, on the one hand, is caused by swelling of the pancreas (pressure on the solar plexus), on the other hand, by the action of active digestive enzymes (trypsin, phospholipase, etc.) and biologically active substances (kinins , prostaglandins)) on the nerve endings of the gland.

II. Humoral mechanism. Caused by enzymeemia - the entry of active pancreatic enzymes into the blood. As a result of the activation of the kallikrein-kinin system, the system of blood coagulation and fibrinolysis , a generalized expansion of blood vessels occurs , which leads to a decrease in total peripheral resistance, an increase in vascular permeability, as a result of which the volume of circulating blood decreases and blood pressure decreases; development of DVZ-syndrome and microcirculation disorders.

Intestinal obstruction is a disease characterized by a violation of the passage of intestinal contents due to obturation, compression , or a violation of its functions.
Species: mechanical: - *obturation* (due to blockage of the lumen of the intestine by a tumor, fecal stones , a ball of helminths); - *strangulation* (as a result of squeezing the intestine from the outside (vertigo, entrapment in the hernia gate); dynamic: - *spastic* (spastic due to contraction of the smooth muscles of the intestines); - *paralytic* (due to deep inhibition of the motor function of the intestines).
Pathogenesis: pain syndrome due to spasm of smooth muscles muscles, necrosis of the intestinal wall, its distension by liquid; dehydration; violation of the turnover of digestive enzymes; violation of the acid-base state (non-gas alkalosis develops as a result of unrestrained vomiting, diarrhea - non-gas acidosis); intestinal autointoxication ; development of acute peritonitis (inflammation of the peritoneum) and disorders general blood circulation and microcirculation.

Topic: Kidney pathophysiology. Kidney failure.
Types of tasks: Kidney pathophysiology. Kidney failure.
Number of hours: 5

Kidneys are the main human excretory organ. The main functional unit of the kidney (nephron) combines structures adapted for the processes of blood plasma filtration, reabsorption of components of the initially filtered liquid, and secretion of a number of substances from the blood into the urine.

A high level of filtration in the capillaries of the kidney glomeruli is ensured by the intensive blood supply to the kidneys. So, in humans, blood flow in the kidneys per 100 m of tissue is 430 ml / min. (For comparison: in the heart muscle 66 ml / min.; in the brain 53 ml / min.).

In addition to urine formation and excretion of end products of metabolism, the kidneys perform a number of other functions:

- regulation of acid-base status and osmotic pressure;
- regulation of circulating blood mass and blood pressure level;
- synthesis and secretion of BAS (prostaglandins , renin, kinins , etc.);
- regulation of erythropoiesis (formation of erythropoietin), etc.

The above-mentioned functions make it possible to include the kidneys among the main organs that ensure the maintenance of homeostasis in the body. Impairment of kidney function is always accompanied by a pronounced disturbance of homeostasis, which causes a high level of mortality in patients with renal failure.

Kidney failure is a pathological condition characterized by a violation of the stability of the body's internal environment due to the inability of the kidneys to perform their homeostatic functions.

Classification:

I. According to the clinical course, acute and chronic are distinguished renal failure.

II. By etiology: prerenal , renal , postrenal and arenal .

III. Depending on the volume of impaired functions, kidney failure can be total (all functions are impaired) or partial (only some functions are impaired).

IV. According to the mechanism of development, kidney failure is distinguished:

1) associated with primary glomerular damage - glomerular ;

2) associated with the primary damage to tubules - tubular .

Acute renal failure (ARN) is a sudden impairment of kidney function.

Reasons:

Prerenal : blood loss, body dehydration → hypovolemia , shock, collapse → hypotension ; acute heart failure, massive hemolysis of erythrocytes;

Renal : local blood circulation disorders in the kidneys (thrombosis, renal artery embolism, renal vein thrombosis), acute kidney diseases (acute glomerulonephritis , acute pyelonephritis), damage by nephrotoxic poisons (salts of heavy metals, antibiotics, sulfonamides, barbiturates, organic solvents, fungal and snake poisons, bacterial toxins, toxic metabolites).

Postrenal : obstruction of the ureters (stones , blood clots, inflammatory edema), compression of the ureter from the outside (tumors of the abdominal organs, adhesions), delayed release of urine at the level of the bladder (adenoma of the prostate).

Pathogenesis:

- temporary ischemia of the kidneys, mainly cortical substance;
- direct damage to glomeruli and tubules;
- increased pressure in the Bowman-Shumlyansky capsule .

A drop in the effective filtration pressure → a sharp decrease in the filtration process → a sharp decrease or complete cessation of urine formation.

In the clinical course of ARF, 4 stages are distinguished: 1) initial; 2) oligo -, anuria; 3) polyuria; 4) recovery.

Chronic renal failure (CKD) is a progressive decrease in kidney function.

Causes: chronic kidney diseases: glomerulonephritis , pyelonephritis , polycystic kidney disease, kidney amyloidosis, urolithiasis, kidney damage in diabetes, hypertension, atherosclerosis.

Pathogenesis:

Progressive death of nephrons and their replacement by connective tissue (nephrosclerosis) → progressive decrease in the function of tubules and glomeruli → decrease in urine production → uremia → uremic coma.

In the pathogenesis of CKD, the following stages are distinguished: 1) initial, 2) early polyuric ; 3) late oligouric and 4) terminal.

Quantitative changes in urine: 1) oligo - and anuria; 2) polyuria; 3) nocturia ; 4) hypo- and isosthenuria .

Oliguria - this is a decrease in daily urine output below the mandatory volume, that is, less than 700 ml / day. Causes: impaired glomerular filtration. Consequences: 1) an increase in the volume of extracellular fluid - hyperhydria ; 2) accumulation of osmotically active substances in the body (hypernatremia , hyperkalemia); 3) accumulation of end products of metabolism in the blood - azotemia.

Anuria is a complete absence of diuresis.

Polyuria is an increase in daily urine output of more than 1.8 liters. Causes: extrarenal (psychogenic polydipsia , violation of water-salt metabolism and its regulation, for example, diabetes insipidus) and renal (polyuric stage of acute and chronic kidney failure) factors.

Nocturia is the predominance of the nocturnal part of the diuresis over the daytime. Reasons: 1) cardiac nocturia - develops with heart failure. During the day, patients increase the load on the heart and water intake, which leads to blood stagnation and water retention in tissues (edema). At night, in a horizontal position, venous outflow improves and the load on the heart decreases. This causes atrial fibrillation of natriuretic hormone, increasing

diuresis and reducing swelling;

2) renal nocturia - characteristic of kidney damage. It is explained by the improvement of disturbed renal blood flow at night. As a result, the movement of blood through the vessels of the kidneys accelerates, hypertensive diuresis develops .

Hyposthenuria - a decrease in the relative density of urine (less than 1.008 in all portions of the sample according to Zimnitsky).

Isosthenuria - the constant relative density of urine, which is equal to the density of primary urine (1.010 - 1.012), indicates a lack of concentration ability of the kidneys.

Hypersthenuria - an increase in the relative density of urine.

Qualitative changes in urine: 1) proteinuria; 2) hematuria; 3) cylindruria; 4) leukocyturia (pyuria).

Proteinuria - excretion of protein in the urine. *Pathogenesis:* 1) increased permeability of the glomerular filter due to damage to the basal membrane (glomerular proteinuria); 2) decrease in tubular reabsorption of filtered protein (tubular proteinuria); 3) pathological influx of protein into the lumen of the tubules from damaged cells of the tubular epithelium or from the peritubular lymphatic fluid (secretory proteinuria). *Selective proteinuria* - only low molecular weight proteins are detected in the urine. *Non-selective proteinuria* - the appearance of both low- and high-molecular proteins in the urine.

Hematuria - the appearance of erythrocytes in the urine. Reasons: 1) damage to the glomerular filter and entry of erythrocytes into primary urine. At the same time, "leached" erythrocytes are determined in the final urine; 2) damage to the urinary tract.

Leukocyturia - the appearance in the urine of more than 5 leukocytes in the field of vision. Causes: inflammatory processes in the kidney tissue and urinary tract.

Cylindruria - the appearance of cylinders in the urine. Causes: damage

to the tubule epithelium. Depending on the structure, hyaline , granular and epithelial cylinders are distinguished.

Uremia is a syndrome that occurs when kidney functions are decompensated. *Pathogenesis:*

1. Autointoxication of the body with metabolic products (ammonia, creatinine, uric acid, urea, phenol, skatole, indole, etc.);

2. Violation of water-electrolyte exchange:

- hypoosmolar hyperhydration ;

- hyperkalemia , hypermagnesemia , hypocalcemia , hyponatremia , hyperphosphatemia , hypersulfatemia ;

3. Violation of acid-base balance - metabolic acidosis (violation of reabsorption of bicarbonates, decrease in secretion of hydrogen ions);

4. Violation of the metabolism of hormones, vitamins (vit. D);

5. Violation of formation of erythropoietins , prostaglandins , kinins , etc.

Changes in the body with uremia:

I. Neuropsychic symptoms: fatigue, headache, inhibition of reflexes, impaired taste and hearing, tremor, insomnia, depression, brain edema, coma. *Pathogenesis:* intoxication ; violation of the acid-base state; hyperhydration ; violation of electrolyte metabolism; hypoxia

II. Violations of the function of the cardiovascular system: myocardial dystrophy, cardiac arrhythmias (disruption of electrolyte metabolism, hypoxia, intoxication), pericarditis (excretion of toxic substances through the serous membranes), hypertension (activation of the renin-angiotensin-aldosterone system , decrease in the formation of depressor substances).

III. Violation of respiratory function: pulmonary edema, pneumonia, pleurisy.

IV. Hematological changes: anemia (erythropoietin deficiency , erythrocyte hemolysis), blood coagulation disorders (hemorrhagic syndrome, DIC syndrome).

V. Disorders of the gastrointestinal tract: nausea, vomiting, anorexia. *Pathogenesis:* intoxication; hypoxia; excretion of nitrogenous residues through the mucous membrane of the gastrointestinal tract.

VI. Dermatological changes: itching (irritation of nerve endings by nitrogenous residues), "uraemic frost" - secretion of uric acid salts, urea by sweat glands, hyperpigmentation .

VII. Disorders of the musculoskeletal system: disorders of the formation of the active form of vitamin D, hypocalcemia , secondary hyperparathyroidism , osteomalacia, calcinosis (renal rickets).

Nephrotic syndrome is a condition that occurs with various kidney lesions and is manifested by massive proteinuria, hypoproteinemia , the development of edema, and hyperlipidemia .

Glomerulonephritis is a bilateral diffuse kidney disease of an allergic nature. Acute and chronic glomerulonephritis are distinguished .

Acute *glomerulonephritis is characterized by a rapid* onset, oliguria , proteinuria, azotemia, arterial hypertension, edema, hematuria, and disorders of the central nervous system. Occurs with (or after) any infection, more often of a streptococcal nature.

There are two main pathogenetic variants of acute glomerulonephritis :

1. Damage to the basal membrane of glomeruli of nephrons by antibodies against its antigens is nephrotoxic glomerulonephritis (passes quickly with a progressive course).

2. The development of the inflammatory process in the glomeruli as a result of fixation on the basement membrane and intramembrane immune complexes - immune complex glomerulonephritis . An exogenous (infectious or non-infectious origin) or endogenous (tissue protein, DNA) antigen serves as an antigen in this mechanism. Formed antibodies (IgG , IgM) interact directly with the specified antigens in the blood serum, then enter the glomeruli in the form of immune complexes (antigen-antibody-complement), being deposited on their basal membrane. The implementation of the harmful

effect of immune complexes, as well as nephrotoxic antibodies, is carried out by induction of immune inflammation.

Chronic glomerulonephritis is a long-term progressive diffuse bilateral inflammation of the kidneys of an inflammatory nature, heterogeneous in origin, clinical manifestations and pathogenesis. Depending on the causes of development, the following forms are distinguished: 1) of infectious origin (post-streptococcal , with protracted septic endocarditis, malaria, syphilis, tuberculosis and other infections); 2) non-infectious (serum, vaccine, medicinal, in case of poisoning with various poisons, traumatic, in case of cooling, in case of renal vein thrombosis); 3) with diffuse connective tissue diseases (rheumatoid arthritis, lupus erythematosus, hemorrhagic vasculitis, etc.).

glomerulonephritis is generally accepted . Along with nephrotoxic and immunocomplex mechanisms, hypersensitivity of the delayed type is of certain importance in its pathogenesis .

Pyelonephritis is an infectious -inflammatory disease of the mucous membrane of the urinary tract and kidney parenchyma with predominant damage to the interstitial tissue. The clinical course of pyelonephritis is characterized by signs of a severe infectious process, which is manifested by severe intoxication (especially in the acute stage); the development of arterial hypertension, moderately expressed edematous syndrome and anemia; urinary syndrome (polyuria, in the late stage - oliguria , pollakiuria - frequent urination, hyposthenuria ; in the final stage - isosthenuria , leukocyturia , hematuria, moderate proteinuria, cylindruria).

The disease occurs in connection with the introduction of the causative agent of the infection into the kidneys by a hematogenous route or its spread in the ascending direction along the urinary tract. The causative agents are most often Escherichia coli, cocci. The occurrence of the disease, the transition of acute pyelonephritis to chronic contributes to various conditions that cause urinary stasis (narrowing, blockage of the ureters, prostate

adenoma), disorders of urinary tract trophism, general diseases that reduce the body's reactivity (diabetes, atherosclerosis, obesity, chronic intoxication, etc.) .).

Urolithiasis is a disease caused by the formation of stones in the parenchyma of the kidneys and in the pelvic-ureteral segment of the urinary tract. In its severe form, urolithiasis is characterized by attacks of renal colic , the cause of which is acute retention of urine caused by mechanical blockage and spasm of the pelvis and ureter; hematuria resulting from damage to the urinary tract; fever, leukocytosis. A complication of the disease is the addition of infection and the development of calculous pyelonephritis, kidney abscess, infected hydronephrosis, etc. as a result . In these cases, a mandatory symptom is pyuria (the presence of pus in the urine). The composition of stones includes salts of oxalic and phosphoric acids, uric acid, sodium and ammonium urates , sometimes cystine , xanthine . Most often, the composition of stones is mixed.

Topic: Pathophysiology of the endocrine system. General violations.
Types of tasks: Pathophysiology of the endocrine system. General violations.
Number of hours: 5

The endocrine system is a system consisting of specialized structures located in the central nervous system, various organs and tissues, as well as endocrine glands that produce specific biologically active substances (hormones). Along with the nervous system, it participates in the regulation of the functions of various systems, organs and metabolic processes. This allows us to talk about a single neuroendocrine system. It has several links:

1. The central link is the hypothalamic-pituitary system ("endocrine brain") as a whole and the hypothalamic-pituitary the neurosecretory apparatus, in particular, is a functional complex consisting of the hypothalamic region, the midbrain, and the pituitary gland. Its main functional significance is the regulation of vegetative functions. On the part of the hypothalamus, this is done in two main ways:

1) *transadenohypophyseal* , when autonomic functions are regulated through a complex of peripheral endocrine target glands dependent on the pituitary gland;

2) *parahypophyseal* - through the system of efferent central neurons of the brain stem and spinal cord, peripheral sympathetic and parasympathetic neurons. This pathway exerts secretory, vascular and trophic effects on the central nervous system and is the most important for the medulla of the adrenal glands, the islets of Langerhans , and the parathyroid glands.

The following are involved in the formation of hypothalamic-pituitary relationships:

1) releasing factors , or *liberins* (thyroliberin , gonadoliberin , somatoliberin , etc.) - stimulants and *statins* (thyrostatin , somatostatin , etc.) - inhibitors of the release of pituitary hormones. These are substances of oligo- and polypeptide nature, which are secreted in the hypothalamus and enter the capillaries of the portal system of the adenohypophysis ;

2) oxytocin and vasopressin - active substances that are synthesized in

the hypothalamus and accumulate in the neurohypophysis (rear part of the pituitary gland);

3) opioid peptides, endorphins (enkephalins , β-endorphins) - morphine-like compounds that play the role of neurotransmitters and neuromodulators .

Violation of the formation of any liberin in the hypothalamus or increased statin production leads to a violation of the production of the corresponding tropic hormone in the adenohypophysis .

2. Peripheral link - glands, dependent (thyroid gland, cortex of adrenal glands, gonads) and independent (brain part of adrenal glands, parafollicular cells of the thyroid gland, α-, β-, γ-cells of the pancreas, as well as hormone-producing cells of the gastrointestinal tract tract, thymus , etc.) from the adenohypophysis .

3. Disperse (diffuse) endocrine system - APUD system. The discovery of this system undermined the classic principle "one cell - one hormone", as apodocytes , as it turned out, are able to produce different peptides and even amines and peptides within the same cell. At the same time, peptides act both as hormones and as mediators. Based on this, the concept of diffuse endocrine epithelial organs was formulated. Similar cells were found in the gastrointestinal tract, mucous membranes of the bronchi, thyroid gland, kidneys, islets of Langerhans , etc. In addition, the endocrine functions of the heart (atrial natriuretic polypeptide), kidney (renin, erythropoietin), adipose tissue (leptin , resistin, adiponectin).

The main manifestations of disruption of endocrine functions

Normal incretory function means such a level of incretion that provides the needs of the organism at each given moment of its existence in specific environmental conditions. Violation of secretory function is called *endocrinopathy* .

Classification of endocrinopathies:

Principle of classification	Types of endocrinopathies
Secretory activity of the gland	1. Hyperfunctional (excessively high incretion) 2. Hypofunctional (excessively low incretion) 3. Dysfunctional (qualitative change in incretion)
Prevalence of the process	1. Monoglandular (injury of one gland) 2. Pluriglandular (multiple lesions of the glands)
Involvement of gland hormones	1. Total (violation of the production of all hormones of the gland) 2. Partial (isolated violation of the secretion of one or another hormone)
A change in hormone production by the gland or a violation of the peripheral effect	1. Absolute deficiency or excess of the hormonal effect (low or high production of the hormone by the gland) 2. Relative insufficiency or excess of the hormonal effect (secretion of hormones is normal, but the peripheral effect is disturbed) 3. Relative-absolute insufficiency or excess of the hormonal effect (simultaneous presence of both components)
Damage level	1. Primary (damage to the gland itself) 2. Secondary (disruption of gland function associated with damage to the pituitary gland) 3. Tertiary (disruption of gland function associated with damage to the hypothalamus)

There are three main mechanisms of development of endocrine pathology:

1. Violation of the central mechanisms of regulation of endocrine functions.
2. Primary glandular mechanisms of disorders.
3. Peripheral (extraglandular) mechanisms of hormone activity disturbance.

Violations of the central mechanisms of regulation of endocrine

functions can be caused by damage to:

a) at the level of the cerebral cortex of CNS neurons that secrete hypothalamic hormones (thrombosis, embolism, hemorrhages, infections (encephalitis), tumors);

b) adenohypophysis (disruption of its blood supply, genetic defects, injuries, infections (tuberculomas , syphilis), tumors, autoimmune processes).

Primary glandular mechanisms of disorders :

Local pathological processes in endocrine organs, changing their functional activity, lead to disruption of biosynthesis and secretion of hormones. Causes: infection, intoxication: with adrenal tuberculosis, necrosis of tubercular tubercles and Addison's disease develops , with syphilis - necrosis of the syphilitic gum. Both lead to the gradual destruction of the gland tissue and its hypofunction. Epidemic parotitis develops orchitis, which leads to testicular atrophy.

Characteristics of the etiology, pathogenesis and clinical manifestations of dysfunction of individual endocrine organs:

Etiology	**Pathogenesis**	**Clinical manifestations**
Total hypopituitarism		
Pituitary cachexia (Symonds disease)		
Violation of blood circulation in the hypothalamus and adenohypophysis , infections, starvation	Dystrophic changes in tissues and metabolic disorders caused by a decrease in the secretion of tropic hormones of the pituitary gland	Severe exhaustion, premature aging, severe metabolic and trophic disorders, osteoporosis, loss of teeth, hair, arterial hypotension , hypoglycemia, dyspepsia, insufficiency of all pituitary glands
Sheehan's disease (syndrome).		

Pronounced blood loss during childbirth or in the postpartum period	Pregnancy is accompanied by hyperplasia of the adenohypophysis , which increases its sensitivity to hypoxia	The manifestations are the same as in Symonds' disease , but usually less pronounced, the disease can drag on for years and be accompanied by pluriglandular insufficiency
Partial hypopituitarism		
Pituitary dwarfism (nanism)		
Various pathological processes in the hypothalamus and pituitary gland, including in the intrauterine period	Insufficient formation of STH and gonadotropins leads to delayed growth and development of the skeleton	Sharp growth retardation, early cessation of physical development, body proportions characteristic of children (predominance of trunk length over limb length), early appearance of wrinkles, underdevelopment of the reproductive system (gonads, secondary sexual characteristics, often infertility). Infantile behavior, reduced memory, and mental capacity may be observed
Pituitary hypogonadism		
Vascular, infectious, tumor, autoimmune lesions of the hypothalamus and pituitary gland	As a result of insufficient production of gonadotropins, the development of gonads and secondary sexual characteristics	In men, the formation of androgens is suppressed, which manifests itself in the form of eunuchoidism. Characteristic are tall stature, long slender limbs, weak development of skeletal muscles, a relatively wide pelvis, pale skin, reduced growth of

	is disturbed	facial hair, high-pitched voice, impaired sexual function, and infertility. Girls have pituitary infantilism. It is characterized by a thin physique, underdevelopment of the mammary glands, irregular menstrual cycles, and sometimes the inability to conceive. There may be mental instability, easy vulnerability, mood swings
Hypothalamic obesity		
Damage to the hypothalamus or pituitary gland	A decrease in the biosynthesis of lipotropin leads to a violation of the use of fat in energy metabolism	The deposition of fat on the abdomen, back and proximal parts of the limbs with relative "thinness" of the lower legs and forearms is characteristic
Hyperfunctional states		
Pituitary gigantism		
Eosinophilic pituitary adenoma, hypothalamic tumors	Hypersecretion of THG or hyperproduction somatoliberin hypothalamus in childhood leads to an increase in the growth rate of the skeleton	Enhanced growth of skeletal bones and internal organs. At the same time, the proportions of the body are usually preserved, although there may be lengthening of the lower legs and forearms . The height of patients can reach more than 250 cm. Muscular weakness, increased fatigue, depression, sleep disturbances, infertility, trophic disorders, hyperglycemia,

		hypofunction of the thyroid gland, adrenal glands, weakening of immune defense are observed.
Acromegaly		
Eosinophilic adenoma of the pituitary gland, tumors of the hypothalamus with the development of the disease in adults	Hyperproduction of THG leads to restoration of periosteal bone growth, increase in the size of internal organs and disruption of metabolic processes	The growth of bones is accompanied by their thickening and deformation, which leads to an increase in the distal parts of the limbs (hands and feet), superbrows, zygomatic arches, and the lower jaw. The patient's soft tissues hypertrophy - the nose, ears, lips, and tongue enlarge. Characteristic: splanchnomegaly , kyphoscoliosis , changes in hair, skin, general weakness, reduced work capacity, headache, drowsiness, sexual dysfunction, urolithiasis, diabetes
Itsenko-Cushing's disease		
Basophilic pituitary adenoma	An increase in the level of ACTH causes hyperproduction of GCS by the glands	Manifestations are the same as in Itsenko-Cushing syndrome
Early puberty		
Adenohypophysis tumors , infections	Early development of gonads is caused by hyperproduction gonadotropins	It is manifested in childhood by early puberty (girls before 8 years, boys - 9 years). Sometimes at the age of 6-7 years, boys begin spermatogenesis, girls - menstruation, secondary sexual characteristics appear

Etiology, pathogenesis and clinical manifestations of the main forms of neurohypophysis pathology

Etiology	Pathogenesis	Clinical manifestations
Neurohypophysis hypofunction		
Diabetes insipidus		
Tumors, infections, injuries, impaired blood circulation in the hypothalamus, hereditary defect of renal receptors for ADH	ADH deficiency leads to a decrease in water reabsorption in the renal tubules	Characteristic polyuria, sometimes reaching 10 liters per day (urine has a low relative density), strong thirst (polydipsia), frequent urination. The function of the digestive system is disturbed: hypoacid gastritis, constipation and colitis. Headaches, insomnia are noted. If there is no fluid, dehydration develops
Hyperfunction of the neurohypophysis		
Parkhon's syndrome		
Hormone-producing tumors, injuries, inflammation, impaired blood circulation of the hypothalamus, ectopic synthesis of ADH by tumors	Increased reabsorption of water in the kidneys due to excess ADH	Oliguria , hyponatremia , plasma hypoosmolarity and hyperhydration are observed . A decrease in sodium content below 110 mmol / l and plasma osmolality below 250 mmol / kg is accompanied by drowsiness, apathy, disorientation, convulsions, nausea, a decrease in body temperature, which is associated with brain edema

Etiology, pathogenesis and clinical manifestations of the main forms of pathology of the adrenal glands

Hypofunctional conditions of the adrenal cortex glands

sharp insufficiency (Waterhouse-Friederiksen syndrome)		
Injuries , hemorrhage , vascular thrombosis adrenal glands , DVZ-syndrome, sepsis	Deficit glucocorticoids , mineralocorticoids , catecholamines	Quickly are developing progressive muscular weakness , severe arterial hypotension , dyspepsia , maybe come death from sharp deficiencies blood circulation
Chronic deficiency (Addison's disease , bronze disease)		
Bilateral damage adrenal glands (tuberculosis , autoimmune processes), sometimes ACTH deficiency	Decrease secretions glucocorticoids , mineralocorticoids , androgens causes metabolic disturbance , disorder electrolyte exchange and regulation vegetative functions	Aldosterone deficiency leads to a violation of the water- electrolyte balance - hyponatremia , polyuria , hypohydration organism with development hemoconcentration . GKS deficit is accompanied hypoglycemia and arterial hypotension . Drawback androgens leads to a decrease muscular masses _ Characteristic muscular weakness , apathy , decline working capacity , arterial hypotension , polyuria , anorexia , disorders digestion _ Primary hypocorticism is accompanied hyperpigmentation skin covers associated with melanophores _ effects of ACTH
Hypoaldosteronism		
Violation of aldosterone synthesis or decrease sensitivity epithelium renal tubules to aldosterone	Decrease reabsorption sodium because of aldosterone deficiency	Hyponatremia , hyperkalemia , hypohydration . Ambulance fatigue , muscular weakness , arterial hypotension , bradycardia , fainting , disturbances digestion

Hyperfunctional state of the adrenal cortex glands		
Hyperaldosteronism (Kon's syndrome)		
Hormonally active tumor glomerular zones	Excess aldosterone causes delay sodium and violation of the water -electrolyte balance	Delay sodium and loss potassium lead to the development of alkalosis. They are observed arterial hypertension , main pain , heart rhythm disturbances , weakness , convulsions and paresthesias . Early disease - decrease diuresis , then stand polyuria , conditioned degeneration epithelium tubules and decrease their sensitivity to ADH
Itsenko -Cushing syndrome		
Hormonally active tumors beam zones of the adrenal cortex glands	Excess glucocorticoids causes violation protein , fat, carbohydrate , water-salt exchange	Local (trunk) obesity with fat deposition in the area face (moon-shaped face), shoulder girdle, abdomen, breasts glands and back (region VII cervical vertebra). On the skin pink-purple stripes - stretch marks , sometimes - acne, ecchymoses , hirsutism . Characteristic osteoporosis, arterial hypertension , hyperglycemia , muscular weakness , decline immunity
Congenital adrenogenital syndrome		
Genetic defect of enzyme systems of biosynthesis gluco - and	Violation of the synthesis of cortisol, corticosterone, aldosterone is	In the first years of life children quickly are growing For individuals both sexes are characteristic low height , disproportionate physique :

mineralocorticoids	accompanied accumulation androgenic predecessors and increase the formation of ACTH (according to the reverse principle connection because of cortisol deficiency)	wide shoulder girdle, narrow pelvis, well -developed muscles (the so-called " Hercules child "), rough voice, acne, hirsutism (growth hair on the face , chest, stomach , limbs). In girls in puberty missing secondary female sexual signs and menstruation . In boys observed premature development secondary sexual signs _ With hypertension form except virilization is noted increased arterial pressure _ With soul-losing form from the first weeks life observed vomiting , disorders stools , dehydration , decrease arterial pressure , loss masses bodies , darkening skin
Hyperfunction adrenal medulla _ glands		
Tumor adrenal medulla _ glands - pheochromocytoma	Hyperproduction catecholamines	Characteristic tachycardia , vasospasm and pronounced arterial hypertension , hyperglycemia . When paroxysmal form - muscular trembling , anxiety , headache pain , abundant sweating , sometimes abdominal pain , nausea , vomiting _

Etiology, pathogenesis and clinical manifestations of the main forms of thyroid pathology

Principles of treatment and prevention of endocrine disorders:

Replacement therapy - the introduction of natural hormonal substances, their close derivatives and analogues obtained from glands or

synthesized, transplantation of endocrine organs, as well as normalization of cortico-hypothalamic-pituitary regulation by filling the deficit of components necessary for the synthesis of hormones, by direct stimulation of the processes of formation and release of hormones, stimulation of the action of certain peripheral hormones. It is used in disorders of a hypofunctional nature.

Suppressive therapy - partial or total extirpation of the gland with subsequent transfer to replacement therapy, X -ray and radio therapy, chemical suppression of the hormone-producing function, as well as inhibition of the functions of the endocrine glands by blocking individual stages of hormone biosynthesis, dosed damage to the gland tissue by pharmacological means, inhibition of the action of individual peripheral hormones. It is used for hyperfunctional disorders.

Stimulating therapy - the use of stimulating hormones (corticotropin and other tropical hormones), transplantation of endocrine organs.

Stress is a non-specific reaction of the body that occurs under the influence of unusual and unfavorable stimuli and is accompanied by the activation of non-specific adaptation mechanisms. The term was introduced by H. Selye .

Causes of stress - stressors: physical, chemical, biological, social factors.

Stress manifests itself in the form of a general adaptation syndrome.

Selye's triad :

1. Involution of the thymus and lymphoid tissue;
2. Hypertrophy of the cortex of the adrenal glands;
3. Stomach and duodenal ulcers.

Stages of general adaptation syndrome:

I. Anxiety stage: a) shock phase - hypotonia of muscles, blood pressure, hypothermia, hypoglycemia, negative nitrogen balance, eosinopenia , lymphopenia , neutrophilia, increased permeability of capillaries, involution of lymphoid tissue, ulcerative lesions of the stomach and duodenum; b)

antishock phase - increase in blood pressure and muscle tone, hyperglycemia, increased secretion of corticotropin and glucocorticoids .

II. The stage of resistance is hypertrophy of the adrenal cortex, an increase in the concentration of glucocorticoids in the blood , activation of anabolic processes, and an increase in gluconeogenesis . The adaptive capabilities of the body reach the highest level.

III. Exhaustion stage - atrophy of the adrenal cortex, decrease in production of glucocorticoids , blood pressure, hypothermia, hypoglycemia, increased breakdown of tissue proteins, depletion of the body's functional capabilities.

Topic: Dysfunction of the thyroid, parathyroid , adrenal , and gonads.
Types of tasks: Dysfunction of the thyroid, parathyroid , adrenal , and gonads.
Number of hours: 5

Hypothyroid state		
Myxedema		
Drawback thyroliberin , TSH, disorders functions thyroid glands (iodine deficiency , autoimmune damage)	Because of shortage thyroid hormones is slowing down basic exchange decreases _ speed nervous processes , is violated metabolism and physiological regeneration	Characteristic specific edema (myxedema) as a result accumulation of hyaluronic acid , chondroitin sulfuric acid and mucin in tissues . Simultaneously depressed lipolysis is disturbed metabolism proteins and carbohydrates . sick people complain of frostbite , increase masses body , drowsiness , dryness skin , decrease attention and memory , depression , loss and fragility hair , nails , Often are developing bradycardia , myocardial dystrophy , hypoacid gastritis, decrease intestinal secretions and motility. In men is violated sexual function , in women - the menstrual cycle
Cretinism		
Hypoplasia thyroid glands , congenital defects biosynthesis hormones , iodine deficiency	In the early children's of age drawback thyroid hormones leads to violations of protein synthesis , formation of the central nervous system, secretion and	In children observed delay physical development - low height (dwarfism), coarse features face , delay cutting and changes teeth , long-term non-overgrowth tetanus , disorder mental and mental development up to idiocy , sometimes deaf and dumb

	effects of STH	
Endemic goiter (increase thyroid glands)		
Iodine deficiency in the environment existence (water and food)	When decreasing blood concentration _ thyroid hormones increases product thyrotropin , which is on the background iodine deficiency leads to hyperplasia fabrics glands	Magnification thyroid glands in the size of , proceeds with voice complications . In case of hypothyroidism , the manifestations are characteristic as well as for myxedema or cretinism
Hyperthyroid state		
Diffuse toxic goiter (Graves-Basedov disease)		
Disease autoimmune nature	Accumulation in the blood Ig (mainly class G), capable interact with TSH receptors on thyrocytes and stimulate secretion thyroid hormones	They are celebrated increased nervous and mental excitability , irritability , sleep disturbances , tremors. Characteristic increase appetite and loss masses body through amplification catabolism . Tachycardia and arterial hypertension lead to development hypertrophy myocardium _ It is observed shortness of breath , increase sweating , heat transfer , muscular weakness _ Autoimmune ophthalmopathy (eye damage) due to infiltration retroorbital fibers mucoid by the masses With _ the bed of the eyeball decreases , it pushes out and develops ostracism . These

		masses , squeezing vascular-nerve bundle, disturb hemodynamics and lymph drainage - develops dryness corneas , photophobia

Etiology, pathogenesis and clinical manifestations of the main forms of parathyroid gland pathology

Hypoparathyroidism		
Removal parathyroid glands during thyroidectomy , inflammation , autoimmune damage	Parathyroid hormone deficiency reduces resorption calcium from bones , it absorption in the intestines , and also strengthens reabsorption of phosphorus and reduces reabsorption calcium in the kidneys	Hypocalcemia , hyperphosphatemia , alkalosis. Characteristic paroxysmal convulsive abbreviation muscles (tetany). Convulsions more often occur in muscles face , upper limbs _ It is possible asphyxia due to laryngospasm
Hyperparathyroidism (Recklinghausen's disease)		
Adenoma or hyperplasia parathyroid glands	Hyperproduction of parathyroid hormone stimulates Entrance calcium from bone tissues , reduces reabsorption of phosphorus in the kidneys tubules	Hypercalcemia , hypophosphatemia . Osteoporosis, deformation limbs , spontaneous , that bone fractures do not heal for a long time . Magnification breeding calcium and phosphorus with urine leads to development urolithiasis diseases _ Characteristic : polyuria , polydipsia , muscular weakness , drowsiness , decline appetite

Topic: Pathophysiology of the nervous system.
Types of tasks: Pathophysiology of the nervous system.
Number of hours: 5

Classification of disorders of the nervous system:

I. According to the anatomical principle, the following are distinguished:

1) disorders of the peripheral nervous system;

2) disorders of the central nervous system, including disorders of the function of the spinal cord, medulla oblongata, midbrain, etc.

II. By origin, *hereditary* and *acquired* disorders of the nervous system are distinguished. Acquired can be *primary* (due to the direct effect on the nervous system of pathogenic factors: physical (trauma, radiation, thermal effects), chemical (toxins, poisons), biological (viruses, bacteria), social (word) and *secondary* (due primarily to homeostasis disturbances (hypoxia, hypoglycemia, acidosis, etc.), immune factors (autoallergic reactions), disorders of cerebral circulation).

Sh. Depending on the type of impaired functions, the following disorders of the nervous system are distinguished:

1) violation of sensory functions (sensitivity);

2) violation of effector functions: motor, vegetative, trophic;

3) violation of integration functions.

The concept of *somatovisceral sensitivity* includes skin sensitivity (tactile, temperature, pain), deep sensitivity (proprioreception) and pain sensitivity of the whole body (nociception).

The following types of somatovisceral sensitivity disorders are distinguished:

1) *hyperesthesia* - increased sensitivity;

2) *hypoesthesia* - decreased sensitivity;

3) *anesthesia* - lack of sensitivity.

Mechanisms underlying disorders of somatovisceral sensitivity:

1. Violation of reception. When the threshold of receptor excitation is increased, hypoesthesia occurs , when it is decreased, hyperesthesia occurs .

2. Damage to peripheral nerves. At the same time, all types of sensitivity in the innervation zone of this nerve are lost .

3. Damage to the posterior roots of the spinal cord. It is characterized by the loss of all types of sensitivity in the area of the corresponding segments.

4. Damage to the spinal cord. When half of the spinal cord (left or right) is cut, *Brown-Sécart syndrome develops . So, below the level of transection*, proprioceptive and complex types of tactile sensitivity fall out on its side (the lemniscal pathway is damaged before its crossing), and on the opposite side - temperature, simple tactile and partially pain sensitivity (the antero -lateral pathway is damaged after its crossing).

5. Violation of the function of subcortical structures that participate in the implementation of sensory functions. Damage to the nuclei of the thalamus is of greatest importance .

6. Damage to the sensory areas of the cerebral cortex. Violations of neurons of the postcentral gyrus lead to disorders of complex tactile and proprioceptive sensitivity on the opposite side of the body.

Pain is an unpleasant sensory and emotional sensation associated with a threat or tissue damage itself.

Classification:

I. According to clinical characteristics (subjective sensations) pain can be sharp and dull, localized and diffuse, have nature of pinching, tingling, heat, etc.

II. Depending on the duration of the pain, the pain can be *acute* or *chronic.* Acute pain passes quickly after the cessation of pain stimuli, chronic pain is long-lasting, which causes suffering to the patient.

III. According to the meaning for the body, pain can be *physiological* and *pathological* . Physiological pain has a protective value. It signals damage or its possibilities, contributes to the inclusion of certain behavioral reactions aimed at eliminating the damage, limits the functions of the affected body Pathological pain does not carry a signal function, it becomes a mechanism of

disruption of vital activity, including the brain, leads to disorders of the function of various organs and systems.

Somatic superficial pain is pain that occurs in the skin. There are two types of it: early and late pain. If a strong mechanical injury is inflicted, a sharp, sharp, well-localized pain immediately occurs, which quickly passes after the end of the action of the pathogenic factor - this is the so-called early pain. After a certain time (0.5-1 s), late pain occurs. It is a dull, aching, diffuse pain. It continues for some time after the cessation of the action of the pathogenic factor .

Somatic deep pain is pain that occurs in deep tissues. It includes headache, toothache, muscle and joint pain. It is often dull, has no clear localization, is accompanied by affective (general malaise, painful condition) and vegetative (nausea, sweating, decrease in blood pressure) reactions.

Visceral pain is pain that occurs in internal organs.

Types of pain depending on its localization:

- *Local pain* - localized at the site of action of the stimulus, in the area of development of the pathological process.

- *Projection pain* - the place on which the painful stimulus acts does not coincide with the place where the pain is felt. For example, when intervertebral discs are damaged , spinal nerves are compressed . At the same time, it hurts in the area that is innervated by the pinched nerve, that is, there is a projection of pain on the areas that receive innervation from the damaged nerve .

- *Radiating pain* – a painful sensation arising as a result of impact on internal organs, often localized not in this organ (or not only in it), but in distant surface areas of the skin.

Severe, long-lasting, debilitating pain that causes suffering to the patient is called *chronic* . The following forms of chronic pain are distinguished:

1. *Neuralgia is a pain syndrome associated with peripheral* nerve

dysfunction in viral infections, vitamin deficiency , blood circulation disorders, and metabolic disorders (diabetes).

2. *Causalgia* - severe burning pain that occurs when large somatic nerves are damaged (incomplete nerve transection).

3. *Phantom pain.* Occurs after limb amputation - the limb that is no longer there "pains". At the same time, the pain is very strong and often unbearable.

4. *Thalamic pain* - severe spontaneous pain in the entire half of the body with a subjective impression of increased sensitivity. It develops with damage to the nuclei of the thalamus.

Antinociceptive natural mechanisms limit pain sensations by suppressing the transmission of pain signals at all levels of the nervous system involved in the formation of pain. 4 antinociceptive systems function in the body:

I. Neuronal opiate antinociceptive system. It is formed by enkephalinergic neurons of three levels: dorsal, oblong and midbrain

II. Hormonal opiate analgesic system. It consists of five levels: spinal cord, medulla oblongata, midbrain, hypothalamus, adenohypophysis .

III. Neuronal non-opiate analgesic system. It is represented by monoaminoergic structures of the brain stem, which are located in the nuclei of the seam, the blue spot, and the central gray matter.

IV. Hormonal non-opiate analgesic system. It is activated during a stress reaction.

The main syndromes characterizing disorders of the motor function of the nervous system

Hypokinesia - limitation of the volume, number and speed of movements. They, as a rule, are combined with a decrease in motor activity and the strength of muscle contractions (hypodynamia).

Types of hypokinesia:

1. According to the severity of the movement disorder:

- *paresis* (decrease in amplitude, speed, strength and number of voluntary movements);

- *paralysis* (complete absence of voluntary movements).

2. According to the prevalence of movement disorders:

- *monoplegia* (paralysis or paresis of one limb);

- *paraplegia* (paralysis or paresis of both arms or both legs);

- *hemiplegia* (paralysis or paresis of the left or right half of the body);

- *triplegia* (paralysis or paresis of three limbs);

- *tetraplegia* (paralysis or paresis of arms and legs).

3. By changing muscle tone:

- *spastic* (increased muscle tone, as a rule, of one group when the central motoneurons are damaged in any part of the pyramidal path);

- *rigid* (increased tone of one or more groups of antagonist muscles, a limb or trunk keeps its given pose for a long time - " wax-like stiffness", which is a consequence of damage to the extrapyramidal system);

- *lethargic* (decreased muscle tone in the area of innervation of the damaged nerve trunk or center in case of damage to motoneurons or anterior roots of the spinal cord).

4. Depending on the predominant damage to nerve structures, the following are distinguished:

- central,

- peripheral,

- extrapyramidal ,

- myasthenic forms of hypokinesis .

Central paralysis and paresis. *Etiology:* damage to pyramidal neurons, damage to the cortico -spinal pathways of the pyramidal system. *Manifestations:*

- muscle hypertension (increased muscle tone of the spastic type);

- hyperreflexia (increase in segmental tendon and periosteal reflexes -

increase in the amplitude of the response and expansion of the reflex triggering zone);

- pathological reflexes (for example, Babinsky's , Rosolimo's , Bekhterev's , which are due to an increase in segmental reflexes of the spinal cord due to the weakening of the inhibitory descending effects of the brain);

- clonus (a high degree of increase in tendon -muscle reflexes; manifested by a series of rapid rhythmic contractions of individual muscles);

- synkinesias (involuntary joint muscle contractions and movements that occur in a paralyzed limb during voluntary movements of another limb or other part of the body)

Peripheral paralysis and paresis . *Etiology:* inherited, congenital or acquired lesions of peripheral motor neurons . Acquired paralysis and paresis develop as a result of degenerative changes, inflammation, mechanical trauma, and neuromuscular transmission disorders (for example, with botulism, myasthenia, the effects of poisons, toxins). *Manifestations:*

- muscle hypotonia (decreased muscle tone, muscles are weak to the touch, lethargic);

- hyporeflexia (decreased or absent segmental reflexes);

- muscle atrophy (formed as a result of long-term inactivity of muscles, as well as as a result of neurotrophic effects on them), degeneration of muscle fibers with their replacement by fat and connective tissue, decrease in muscle excitability;

- excess of passive movements in the paralyzed limb.

Extrapyramidal paralysis and paresis . *Etiology:* damage to the extrapyramidal system. *Manifestations:*

- muscle hypertension (of the rigid type; approximately the same simultaneous increase in the tone of flexors and extensors, pronators and supinators);

- postural , postotonic reflexes (eye or head nystagmus when changing body posture);

- catalepsy (long-term stiffening of the trunk in an extended position);

- pathological reflexes and pronounced hyperreflexia are not observed

.

Myasthenic hypokinesias. These include myasthenia gravis , Lambert-Eton syndrome . *Etiology:* violation of synaptic transmission in cholinergic neuromuscular synapses - from the terminal of motor nerve fibers to skeletal muscle fibers. *Pathogenesis:* postsynaptic blockade cholinergic antibodies - Ig are fixed on the postsynaptic membrane of the muscle fiber and thus prevent the interaction of acetylcholine with cholinergic receptors ; a decrease in the response of muscle fibers to acetylcholine due to a decrease in the sensitivity of cholinergic receptors . *Manifestations:* muscle weakness (myasthenia) of varying severity, rapid muscle fatigue during physical exertion.

Hyperkinesia - an increase in the volume and number of involuntary movements - develops as a result of damage to neurons of various brain structures (extrapyramidal system, thalamus, subthalamic nucleus, cerebellar dentate nucleus, red nucleus, cortex and their communication systems).

Types of hyperkinesis :

1. By localization of affected brain structures: cortical, subcortical, trunk.
2. According to the prevalence of the process:
   - general (involving several or most muscle groups);
   - local (involuntary contraction of individual muscles or their fibers).
3. With the predominance of phasic (quickly changing) or tonic (slow) components, contractions: fast and slow.

Fast hyperkinesias :

Cramps are involuntary muscle contractions of varying intensity, duration and prevalence:

- *clonic* (short-term and irregular contractions of individual muscle groups, most often resulting from excessive stimulation of the cortex of the large hemispheres or damage to the structures of the pyramidal system;

widespread pronounced clonic convulsions are designated as convulsions);

- *tonic* (prolonged muscle contractions, as a result of which the trunk or limbs "freeze" in various forced positions; develop with excessive excitation of subcortical structures and some types of intoxication; opisthotonus may develop during tetanus) ;

- *mixed* (clonic -tonic, tonic- clonic ; observed in diabetic, hepatic or uremic coma; burn or anaphylactic shock).

Chorea - disorderly, fast, violent contractions of various muscle groups. Can have a hereditary origin (for example, Huntington's chorea).

Tremor - hyperkinesis of the shaking type, characterized by involuntary, stereotyped rhythmic oscillatory movements of the body or its parts due to repeated contractions and relaxations of muscles. Occurs mainly when the brain stem is affected. It is observed in organic lesions of the brain, exogenous intoxication of the body.

A tic is a rapid involuntary stereotyped muscle contraction that causes violent movements (for example, blinking, gesticulation). They are observed mainly in the case of damage to the extrapyramidal system as a result of encephalitis, intoxications, when using psychopharmacological agents, as well as in some mental disorders.

Slow hyperkinesias :

Athetosis - involuntary stereotyped, slow, worm-like chimerical movements that occur as a result of simultaneous long-term activation of agonist and antagonist muscles. Most often, the distal parts of the extremities of the fingers and toes are affected. They develop with damage to the caudate nucleus, shells with encephalitis, disorders of cerebral circulation, craniocerebral injuries, tumors of the subcortical regions of the brain.

Spastic torticollis - deformation of the neck and incorrect position of the head (inclination to one side) as a result of long-term neurogenic contraction - spasm of the neck muscles. Neurogenic torticollis is observed as a result of brain damage (for example, edema, hemorrhage, tumor) in the area

of the tentorium cerebelli , hind brain. It is often the result of birth trauma (rotational subluxation of the 1st cervical vertebra) in children.

Forms of cerebral circulation disorders:

I. Acute disorders of cerebral circulation. *Strokes* are acute disorders of cerebral blood circulation that lead to persistent disorders of brain functions. Allocate:

a) hemorrhagic strokes - hemorrhages in the brain. Most often, it is the result of persistent arterial hypertension (rupture of the altered wall of an arterial vessel);

b) ischemic strokes (brain infarction). The reason for their development is atherosclerotic lesions of blood vessels (thrombosis, stenosis).

II. Chronic disorders of cerebral circulation - vascular encephalopathy. They develop as a result of the atherosclerotic process and lead to focal dystrophic changes in brain tissues.

Brain edema is the accumulation of fluid in the interstitial tissue of the brain, and *swelling* is its intracellular swelling.

The etiology of cerebral edema can be traumatic, tumoral, postoperative, toxic, inflammatory, etc.

The following are important in the pathogenesis of cerebral edema:

I. Vascular factors:

a) increase in hydrostatic pressure in capillaries (arterial hyperemia, venous hyperemia, hypervolemia);

b) reduction of oncotic blood pressure;

c) increased permeability of the blood-brain barrier.

II. Tissue factors:

a) increase in oncotic pressure in the brain tissue (release of proteins from damaged cells, cleavage of proteins);

b) reduction of hydrostatic pressure in brain tissue;

c) damage to hematoencephalic glial elements the barrier

In the pathogenesis of cerebral edema, "enchanted circles" are of great

importance. One of them: brain edema → increase in intracranial pressure → compression of venous vessels (venous hyperemia) → increase in hydrostatic pressure in capillaries → brain edema.

Intracranial hypertension is an increase in intracranial pressure. *Reasons:*

1) increase in blood flow to the brain (arterial hyperemia, venous hyperemia);

2) an increase in the amount of cerebrospinal fluid (CSF) - hydrocephalus. It can be due to either an increase in the formation of cerebrospinal fluid, or a decrease in its outflow from brain ventricles;

3) an increase in the volume of brain tissue - edema and swelling of the brain;

4) the appearance of additional volumetric structures in the skull cavity. These can be inflammatory exudate (for meningitis), hematomas, tumors, abscesses. An increase in intracranial pressure leads to compression of cerebral veins. This, in turn, causes impaired cerebral circulation and hypoxia, and on the other hand, contributes to the development of cerebral edema.

Violations of the integration functions of the central nervous system:

1. Violation of sensations and perception - higher sensory functions. An example is *agnosia* - recognition disorders. There are visual, auditory and others

types of agnosia.

2. Disorders of consciousness. These include, in particular, various degrees of stupor (a form of darkening of consciousness): obnubilation (darkening), somnolence (drowsiness), sopor (insensitivity, non-awakening sleep), coma.

3. Thinking disorders. One of the extreme forms of thinking disorders is *dementia* .

4. Speech disorders - *aphasia*. A distinction is made between motor aphasia (difficult or impossible reproduction of speech, understanding of

speech may be preserved) and sensory aphasia (disorders of speech perception).

5. Violation of behavioral reactions. An example can be *apraxia* - violation of purposeful actions (a person cannot light a match, wave his hand, cut bread, although his hands are not paralyzed).

6. Violation of emotions. Among them are *hypothymia* (depressive syndrome), *hyperthymia* (manic syndrome), neuroses (neurasthenia, obsessional neurosis, hysterical neurosis).

7. Violation of motivations. Abnormally strengthened motivations (bulemia , polydipsia , sexual perversions), abnormally weakened motivations (anorexia, adipsia , impotence, frigidity), artificially created motivations (drug addiction, alcoholism, tobacco smoking) are distinguished.

8. Violation of the ability to study. Inability to learn is one of the leading signs of oligophrenia (congenital mental retardation). Depending on the degree of intellectual defect, moron, imbecility, and idiocy are distinguished.

9. Memory disorders - *amnesia.*

10. Sleep-wake cycle disorders. They can be manifested by insomnia and drowsiness.

Neurosis is a chronic disorder of higher nervous activity, caused by psycho-emotional overstrain and manifested by disturbances in the integral activity of the brain - behavior, sleep, emotional sphere and somato-vegetative activity. This is a psychogenic disease that arises against the background of personality characteristics and insufficient mental protection with the formation of a neurotic conflict.

Scheme of the pathogenesis of neuroses : psychoemotional stress → stimulation of brain activity; stress reactions → disturbance of integrative activity (disintegration of nervous activity, behavior and sleep disorders) → disturbance of autonomic nervous activity, neurotransmitter activity, endocrine system (sympathoadrenal shifts, increase in dopamine production , vagotonia , insular shifts) → disturbance of metabolism of microstructures and microcirculation → disturbance of internal organs and the somatic sphere. A "vicious circle" is formed - brain hypoxia stimulates psycho-emotional stress and stimulates brain activity.

List of recommended literature (main, additional, electronic information resources):

Recommended Books

Main:

1. 1. Ataman O.V. Pathophysiology: General pathology. – Vinnytsia: New book, 2018. – Volume 1. - 584 p.
2. 2. Ataman O.V. Pathophysiology: Pathophysiology of organs and systems. – Vinnytsia: Nova kniga, 2019. – Vol. 2. – 448 p.
3. 3. Yu.V. Byts, G.M. Butenko, A.I. Gozhenko . Pathophysiology: a textbook / edited by M.N. Zaika , Yu.V. Bytsia, M.V. Crystal . - Kyiv: VSV "Medicine", 2015. - 752 p.
4. 4. Zaiko M.N., Byts Y.V., Kryshtal M.V. etc. Pathophysiology: a textbook / edited by M.N. Zaika , Yu.V. Bytsia, M.V. Crystal . – Kyiv: Medicine, 2017. - 736 c.

Additional:

1. 1. Ataman O.V. Pathological physiology in questions and answers. – Vinnytsia: New book - 2007. – 512 p.
2. 2. Zaiko M.N., Byts Yu.V., Butenko H.M. and others. Pathophysiology: a textbook / edited by M.N. Zaika , Yu.V. Bytsa . - K.: Medicine, 2008. - 704 p.
3. 3. Krishtal NV, Mikhnev VA, Zayko NN et al . Pathophysiology : Textbook / Ed . by NV Krishtal , VA Mikhnev : Textbook , the 3rd Edition . — Kyiv : AUS Medicine Publishing , 2019. - 656 p.
4. 4. Robbins and Cotran pathological basis of disease / Ed. by Vinay Kumar, Abul K. Abbas, Jon C. Aster : Textbook, the 9 th Edition. - Philadelphia: Elsevier Saunders, 2015. - 1392 p. 952

13. Electronic information resources

1. https://info.odmu.edu.ua/chair/pat_physiology/ - information resource of the department of general and clinical pathological physiology
2. http://moz.gov.ua – Ministry of Health of Ukraine
3. www.who.int - World Health Organization
4. www.dec.gov.ua/mtd/home/ - State Expert Center of the Ministry of Health of Ukraine
5. http://bma.org.uk - British Medical Association