

QUESTIONS FOR CREDIT

for foreign students for specialty “Dentistry” studying in English

INTRODUCTION TO THE ACADEMIC DISCIPLINE “NORMAL PHYSIOLOGY”. THE BASIC CONCEPTS OF PHYSIOLOGY. PRINCIPLES OF BIOMEDICAL ETHICS. THE INTERNAL ENVIRONMENT OF THE HUMAN BODY. PHYSIOLOGY OF THE BLOOD

1. The subject of normal physiology. The main stages of the development of physiology, the important discoveries and methodological approaches that contributed to the development of physiology as a science. Contribution of domestic scientists to the development of physiology. Physiology as a scientific basis of medicine. Application of knowledge of normal physiology by a dentist.
2. Blood system. Composition, amount, properties, basic functions of blood. Blood plasma. Organic and inorganic compounds of blood plasma. Basic physiological constants of blood maintaining homeostasis.
3. Acid-base state of blood. Physicochemical and physiological mechanisms that ensure the constancy of blood pH. The concept of acidosis and alkalosis. Acid-base state of the oral cavity.
4. The role of water in the body, its content, distribution, balance. Electrolyte composition of blood plasma. Osmotic pressure of blood and its regulation (ADH, RAAS, etc.).
5. Proteins of the blood plasma, their classification, physiological role. Oncotic (colloid-osmotic) pressure of plasma and its role. Blood viscosity and its changes according to water balance, its influence on hemodynamics.
6. Red blood cells (erythrocytes). The amount of RBC in the blood. Features of the structure and properties of erythrocytes, maintaining their functions. The amount of hemoglobin. Hemoglobin variants at different age periods. Physiological and pathological types of hemoglobin.
7. White blood cells (leukocytes). Number and subsets of WBC. Features of the structure and properties, ensuring the performance of their functions. Distribution of WBC in the vascular bed, in tissues, its features and physiological significance. Leukocyte formula, leukocyte formula shift. Leukocytosis and leukopenia.
8. Platelets: features of structure, number, functions. The concept of the hemostasis system and its links. Primary and secondary hemostasis. Methods of primary and secondary hemostasis assessment. Duration of bleeding after tooth extraction.
9. Nervous and humoral regulation mechanisms of hematopoiesis. The role of vitamins (B₁₂, B₉, etc.) and microelements (Fe²⁺, etc.) to perform hematopoiesis.
10. Blood type systems (ABO, RhD, HLA, etc.). ABO system: antigens (agglutinogens) and antibodies (agglutinins) of blood types, their features. Formation of agglutinogens and agglutinins of the ABO system. The role of agglutinogens and agglutinins in the ABO system. Their combinations in different types of the ABO system.
11. Blood type systems. Blood type of the Rhesus (Rh) system, features of antigens and antibodies. Formation of antigens and antibodies during ontogenesis, differences between the Rh system and the ABO system. Consequences of transfusion of incompatible blood according to the Rh system. Rhesus-conflict.
12. Principles of blood transfusion. Risk factors while working with blood: for medical personnel, patients, donors. Blood substitute solutions, their classification according to the type of performing function in the body and indications for them.

MECHANISM OF PHYSIOLOGICAL FUNCTIONS REGULATION. HUMORAL REGULATION

13. The concept of physiological function and its regulation. Systemic principle of regulation of functions. Types of regulation of body functions. Nervous and humoral mechanisms of regulation of functions, their comparative characteristics.
14. Modern ideas about the structure and functions of membranes. Transport of substances through the cell membrane.
15. Molecular (cellular) receptors and their ligands. Classification and properties of ligands. Classification, structure and functions of membrane and intracellular receptors. Main physiological effects of ligand-receptor interaction between the cells. The concept of main pathways regulating the functional activity of molecular receptors.
16. The endocrine system. Pituitary gland, its relationship with the hypothalamus. Hormones of the pituitary gland and hypothalamus, their role in regulating the activity of endocrine and non-endocrine organs.
17. Endocrine function of the thyroid and parathyroid glands. Mechanisms of hormones action and their effects. Typical manifestations of excessive or insufficient hormones secretion.
18. Adrenal glands. Hormones of the outer cortex and the inner medulla. Mechanisms of hormones action and their effects. Regulation of hormone secretion. Typical manifestations of excessive or insufficient hormones secretion.
19. Endocrine function of the pancreas. The role of pancreatic hormones in the regulation of carbohydrate, fat and protein metabolism. Regulation of hormone secretion. The concept of normo-, hypo- and hyperglycemia and their causes.
20. Sex hormones. Mechanisms of hormones action and their effects. Regulation of hormone secretion. Typical manifestations of excessive or insufficient secretion of hormones.
21. Regulation of calcium and phosphorus metabolism in the body. Influence of calcitonin, parathyroid hormone and calcitriol on calcium and phosphorus metabolism. Daily needs for calcium and sources of its intake.
22. Hormonal mechanisms for maintaining water-electrolyte balance in the body (antidiuretic hormone, renin-angiotensin-aldosterone system, atrial natriuretic hormone). Indicators of water-electrolyte balance. Sources and ways of water excretion in the human body.
23. The concept of endocrine function of the epiphysis (melatonin), heart (atriopeptides), kidneys (calcitriol, erythropoietin, etc.), salivary glands (parotin P, etc.), liver (somatomedin C, thrombopoietin, 25(OH)-VitD3).

GENERAL PHYSIOLOGY

24. General properties of excitable tissues. Excitation and forms of its manifestation. Parameters of excitability. Change of excitability in the process of excitation. Refractoriness, its causes and physiological significance. Laws of excitable tissues response to the stimuli. Chronoximetry. The force-duration curve. Reaction of excitable tissues to the direct current.
25. Biopotentials as information carriers in a living organism. Types of electrical signals in the organism, their comparative characteristics. Resting potential and graded potentials. Factors determining the value of membrane potential. The concept of galvanism.
26. Sensory receptors: definition, classification, role, basic properties. Receptor and generator potentials. The concept of information coding principles in sensory receptors.
27. Action potential as a carrier of information. Generation of action potential, phases and mechanisms of its development. Features of the structure and functioning of potential-dependent sodium channels.
28. Neuron: structure, functions, properties, relationship with glial cells. The role of neuroglia.
29. Physiological role of the structural elements of the nerve fiber. The role of afferent and efferent nerve fibers. Classification of nerve fibers. The role of nerve fibers of various types.

Mechanism of excitation conduction along myelinated and unmyelinated nerve fibers, laws of excitation conduction. Axonal transport. Physiological basis of conduction anesthesia in dental practice.

30. Synapse. Classification of synapses, their physiological role. Structure of electrical and chemical synapse. Receptors of postsynaptic membrane. Mechanism of signal transmission in neuromuscular synapse. Endplate potential. The role of acetylcholinesterase. Mechanisms of neurotransmitter reuptake. Mechanism of action potential generation on the postsynaptic membrane.

31. Physiological properties of skeletal muscles. Single contraction (a twitch), its phases. Summation of contractions, tetanic contraction. Types and modes of skeletal muscle contraction. Motor units and their features in different muscles. Types of muscle fibers.

32. Structure of skeletal muscle fibers. Sarcomere. Mechanism of contraction and relaxation of a single muscle fiber and muscle as whole. Functional role of muscles of mastication.

33. Smooth muscles. Classification, physiological properties and features. Factors causing contraction of smooth muscle cells. Membrane receptors and ion channels involved in contraction. The role of calcium, mechanisms of its concentration increase in sarcoplasm. Mechanism of contraction and relaxation of smooth muscle.

MECHANISM OF PHYSIOLOGICAL FUNCTIONS REGULATION. NERVOUS REGULATION

34. Central nervous system. Its functions and role in maintaining the vital activity of whole organism and its relationship with the environment. Features of the structure and functions of CNS synapses in comparison with neuromuscular synapses. Neurotransmitters, their classification, the main types of receptors.

35. Reflex principle of the nervous system functioning. Reflex. Types of reflexes. Structure of the reflex arc. Feedback system, its significance.

36. Inhibition in the CNS, types and role. Mechanisms of central inhibition. Primary (postsynaptic and its types, presynaptic) and secondary (pessimal, inhibition after excitation) inhibition. Inhibitory neurotransmitters. Mechanism of the inhibitory synapse functioning. Inhibitory postsynaptic potential.

37. Principles of CNS coordination activity: reciprocal inhibition, final common pathway, dominance, reverse afferentation. Excitatory and inhibitory neurotransmitters, receptor mechanisms of their action. Mechanisms of interaction of excitation and inhibition processes in a neuron. Integrative activity of a neuron.

38. Comparative characteristics of somatic and autonomous nervous system (sensory receptors, afferent, inter and efferent sections, effector organs). Differences between neuroeffector junction of smooth muscles and neuromuscular synapses of skeletal muscles.

39. Spinal cord. Functions of the spinal cord. Spinal regulation of muscle tone, posture and movement. Basic spinal reflexes. Functions of the main ascending and descending conductive tracts of the spinal cord. Consequences of spinal cord injury. Spinal shock.

40. Medulla oblongata and the pons. Sensory, somatic and autonomic functions. Vital centers, reflex activity. Functional interaction with other parts of the CNS. Defense reflexes.

41. Functions of the cerebellum. Consequences of the cerebellum damage.

42. Midbrain (mesencephalon). Thalamus, metathalamus, epithalamus. Functional features of thalamic nuclei. Participation of thalamus in pain sensation and in the implementation of higher integrative functions of the brain. Hypothalamus. Centers and functions of the hypothalamus. Neurosecretory cells. Sensory neurons (osmo-, thermo-sensitive, etc.) Integration of somatic, autonomic and endocrine functions.

43. The role of the autonomic nervous system (ANS) in maintaining vital activity of the whole organism. ANS functions. Comparative characteristic of structure and physiological properties of ANS and somatic nervous system (afferent, central, efferent parts). Differences between

neuroeffector junctions of smooth muscles and neuromuscular synapses of skeletal muscles.

44. Comparative characterization of the structure and functions of sympathetic and parasympathetic parts of ANS. Synergism and relative antagonism of influences of sympathetic and parasympathetic parts of ANS. Influence of sympathetic ANS on effector organs, sensory functions. Mechanisms of their performance. The concept of metasympathetic nervous system.

45. The autonomic reflex arc. Preganglionic and ganglionic neurons and their axons: morphological, functional and neurochemical differences. Neurotransmitters, receptors of nerve and effector cells. Morphofunctional features of effector nerve endings and synapses in ANS. Influences parasympathetic department of ANS on effector organs, sensory functions. Mechanisms of their realization.

ASSESSMENT METHODS FOR ANALYZING PHYSIOLOGICAL FUNCTIONS (PRACTICAL SKILLS)

1. Measures to prevent infection with viral hepatitis and human immunodeficiency virus (HIV) during the blood and other biological materials analysis.
2. Physiological assessment of parameters in complete blood count
3. Assessment of primary hemostasis indices (bandage test). Features of bleeding duration from the tooth cavity.
4. Assessment of blood typing result in ABO and Rh systems using standard sera and monoclonal antibodies.
5. Measurement and evaluation of height. Evaluation of endocrine system functions (height as index of endocrine axis hypothalamus-pituitary-liver).
6. Evaluation of endocrine system functions (comparison of muscle strength of men and women, axis hypothalamus-pituitary-sex glands).
7. Evaluation of dental formula of primary and permanent teeth.
8. Assessment of extracellular concentration of K^+ and Na^+ shifts on membrane potential values.
9. Possibility of pharmacological effect on process of signal transmission in synapses (example of neuro-muscular junction).
10. Features of innervation of skeletal and smooth muscles and impact of neurotransmitters.
11. Dynamometry (manual and standing) and physiological evaluation of the results.
12. Study of the main tendon reflexes on the example of the knee reflex (morphological basis [reflex arc]). Physiological assessment of the obtained data.
13. Comparison of mono- and polysynaptic reflexes.
14. Evaluation of EEG rhythms in different functional states of the CNS.
15. Assessment of tone and reactivity of sympathetic and parasympathetic parts of ANS by heart rate on the example of clinostatic and orthostatic reflexes. Necessity of knowledge of these reflexes for a dentist.

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