MINISTRY OF HEALTH OF UKRAINE
ODESA NATIONAL MEDICAL UNIVERSITY
Department of Medical Biology and Chemistry

CONFIRMED by
Vice-rector for scientific and pedagogical work
Eduard BURIACHKIVSKYI
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METHODOLOGICAL DEVELOPMENT TO THE PRACTICAL CLASSES ON THE EDUCATIONAL DISCIPLINE

Faculty, course	**International faculty, 5 year**
Specialty	**222 "Medicine"**
Academic discipline	**Fundamentals of clinical biochemistry**

The program was approved:
at a meeting of **the Department of Medical biology and chemistry**
Odesa National Medical University
Minute № 1 dated 26 august 2024
Head of Department _____ Hennadii STEPANOV
(signature)

Developers:
Head of the department, associate professor of the department, Ph.D., Stepanov H.F.
associate professor of the department, Ph.D., Storchylo O.V.
senior teacher, PhD Vasylieva A.G.
senior teacher, Kostina A.A.

Practical lesson No. 1

Topic:Introduction to clinical biochemistry. Pre-analytical stage of laboratory research.
Goal: Studygeneral tactical principles of clinical biochemistry. Biochemical constellations.
Basic concepts:nutrients, phytonutrients,antinutrients Micronutrients
Equipment: demonstration materials of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
- Definition of clinical biochemistry.
- The main objects of clinical and biochemical research.
- Recommendations for blood sampling.
- Blood storage conditions.
- Basic principles of biochemical research.
- Use of whole blood for biochemical studies.
- Obtaining plasma and blood serum.
- Anticoagulants used in laboratory practice.
- The influence of various manipulations and drugs on the results of biochemical studies.
- Modern methods of clinical biochemistry.

The student should be able to:
– receive plasma and blood serum.
–provide recommendations for blood sampling

Questions to check basic knowledge on the topic of the lesson:
- purpose of research;
- preparation of the examined person;
- taking material;
- its storage and delivery for research;
- analysis registration;
- choice of method, preparation, execution and design of the analysis;
- interpretation of the obtained results

3. Formation of professional skills and abilities.

Stages of laboratory analysis

Basic concepts and terms:
A sample is biological material taken from a patient for laboratory analysis. The sample can be whole blood, serum, cerebrospinal fluid, aspirated fluid, etc. The material will be a sample until the analysis has begun.
A sample is a part of a sample that is used in a measurement.

Stages of laboratory analysis

1. The pre-analytical period begins when the doctor prescribes a laboratory analysis, includes taking the material and ends when the sample arrives at the laboratory. The pre-analytical phase can be divided into: extra-laboratory and intra-laboratory stages.

2. Laboratory (analytical) period - includes: pre-instrumental, instrumental and the period associated with issuing results. Pre-device period includes: transportation, separation, transfusion.
3. Post-laboratory period – includes the analytical phase associated with the interpretation of the obtained results

Ways of expressing biochemical results

Most biochemical tests are quantitative, although qualitative and semi-quantitative analyzes also take place in biochemical studies. Many tests measure the amount of the analyzed substance in a small volume of samples, such as blood, plasma, serum, urine or other fluids and tissues. Test results expressed most often in molar units. Molar expression of concentration characterizes how many molecules of the analyzed substance are in the sample.

Molar units can be converted to mass units: one mole is molecular mass of a substance in grams. The results of biochemical studies are usually presented as concentration of substances — the number of moles in one liter of the studied liquid (mol/l). The results of enzymatic studies are not expressed in moles, but in units of enzymatic activity. Large molecules (proteins) are measured in grams or milligrams per unit volume Blood gases (PCO2 or PO2) are expressed in kilopascals (kPa)

Interpretation of results

The correct interpretation of the research results is possible only when sufficient knowledge of the peculiarities of biochemical changes in various conditions organism and mechanisms of emerging disorders.

When interpreting the obtained results, it is necessary to take into account a number of things methodological points:

1. The chemical composition of blood and urine reflect the state of the body's metabolism a person The vast majority of diseases are accompanied by changes in the content individual substances and ions in blood and urine, other biological fluids. The centuries-old experience of medicine allows us to consider blood as a mirror of exchange substances
2. The content of each individual biochemical component in blood and urine reflects the activity of many organs and systems, as well as the own function of this fluid.
3. The content of substances in blood and urine is subject to rhythmic changes that reflect periodic actions of external and internal factors (change of season, month, time of day and so on). This should be taken into account when interpreting the data.
4. Biochemical composition of blood, urine, other biofluids, its changes under the influence standard loads may have individual fluctuations in individual people, reflecting the influence of biological factors (geno-phenotype, age, gender, daily, monthly, seasonal rhythms of individual indicators), factors social (features of lifestyle, nutrition, work activity;bad habits — smoking, drinking alcohol) and natural (climatic features of geographical areas — solar radiation, temperature fluctuations, environmental humidity, water).

Control materials for the final stage of the lesson.

Questions to check the final level of knowledge:

- Definition of clinical biochemistry.
- The main objects of clinical and biochemical research.
- Recommendations for blood sampling.
- Blood storage conditions.
- Basic principles of biochemical research.
- Use of whole blood for biochemical studies.
- Obtaining plasma and blood serum.

- Anticoagulants used in laboratory practice.
- The influence of various manipulations and drugs on the results of biochemical studies.
- Modern methods of clinical biochemistry.
- Change in the results of clinical and biochemical studies under the influence of diagnostic and therapeutic measures (iatrogenic variation).
- Modern technologies of automated clinical and biochemical research.

Test tasks.

1. What is the importance of biochemical research methods?
   A. Diagnostic
   B. Criterion of the effectiveness of the treatment
   C. Criterion of recovery and rehabilitation
   D. There is no correct answer
   E. All answers are correct
2. On what criteria should the choice of research method be based?
   A. Analytical
   B. Medical
   C. All answers are correct
   D. Technical and economic
   E. There is no correct answer

3. Which of the listed criteria are analytical?
   A. Specificity
   B. Reproducibility
   C. Sensitivity
   D. All answers are correct
   E. There is no correct answer

4. What factors affect the results of laboratory tests?
   A. Physiological (gender, age, etc.)
   B. All answers are correct
   C. There is no correct answer
   D. External environment
   E. Toxic, therapeutic

5. Which of the listed appointments contribute to the improvement of diagnostics anddetection of hidden forms of pathologies?
   A. Appointment of examination under separate programs, depending onstage of the examination and nature of the disease (differential diagnostic programs) in dynamics
   B. Assignment of one or two studies
   C. Designation of a number of studies
   D. Multiple assignment of one study
   E. All answers are correct

6. What errors are noted in the work of the laboratory?
   A. Random
   B. Systematic
   C. Rough
   D. All answers are correct
   E. There is no correct answer

7. Modern ideas about clinical biochemistry:
   A. The science of the value of laboratory parameters in diagnosticsdiseases
   B. Medical scientific discipline that studies regularityinterrelationships between physiological and pathological conditions, cellular and chemical composition of biological fluids to detect deviations from the norm, establish a diagnosis and control treatment
   C. All answers are correct
   D. The science of the value of laboratory indicators in the norm and atpathological processes, diagnosis, treatment and prognosis of diseases
   E. There is no correct answer

8. What is the basis of changes in laboratory indicators?
   A. The state of organs and systems of the human body, the depth of damage to organs andcells at the time of the study
   B. Changes in organs during the disease
   C. Changes in biological fluids under investigation
   D. There is no correct answer
   E. All answers are correct

9. What is laboratory quality control?
   A. Checking the work of laboratory employees
   B. System of measures for quantitative assessment of accuracy, reproducibility,correctness of research, systematic identification and elimination of the causes of identified errors
   C. Comparison of research results
   D. Quantification of accuracy
   E. There is no correct answer

10. What research methods should be used in KDL?
   A. Standardized
   B. Unified
   C. Routine
   D. All answers are correct
   E. There is no correct answer

11. What are the tasks of clinical biochemistry?
   A. Development of specific methods of chemical composition researchbiological fluids
   B. Study of patterns of inter-individual fluctuations of chemicalthe composition of biological fluids of the body
   C. Establishing the diagnostic value of laboratory tests and theircombinations
   D. Development of sets of biochemical tests for differential diagnosis andtreatment control
   E. All of the above

12. What parameters determine the quality of biochemical analyses?
   A. Features of the applied method and technical excellenceequipment
   B. Qualification of laboratory assistants
   C. Cleanliness of reagents and accuracy of measuring utensils
   D. All listed
   E. There is no correct answer

13. Which of the listed factors affect the results of biochemicalresearch?
   A. Time of collection of biological material for research
   B. All answers are correct

C. Influence of diagnostic procedures and drugs
D. Conservation, preservation and delivery of biomaterial to the laboratory
E. There is no correct answer

14. What changes in biochemical indicators of blood are caused by long-term compression of blood vesselstourniquet when taking blood from the veins?
A. Reduction of PCO2, pH, glucose concentration
B. Increase in PCO2, concentration of lactic and pyruvic acids,ammonia, calcium
C. All answers are correct
D. Activation of the blood coagulation system and fibrinolysis
E. There is no correct answer

15. What factors contribute to the occurrence of hemolysis when taking blood forbiochemical research?
A. Poorly dried dishes, wet syringes
B. Removal of blood from the syringe through a needle with a small diameter and a large oneat speed and under pressure
C. Centrifugation of blood at high speeds and with a sharpby switching the number of revolutions
D. All answers are correct
E. There is no correct answer

16. What are the causes of intra-laboratory errors?
A. Incorrect choice of method, non-observance of laboratory rulestechniques
B. Low qualification of personnel, negligence in work
C. Non-observance of the rules for building a calibration graph
D. Low quality measuring utensils and reagents
E. All of the above

17. Does the level of biochemical indicators in the blood change depending onbody position before and during blood sampling?
A. In the lying position, the concentration of substances is lower than in the standing position
B. Does not change
C. The concentration of substances in the supine position increases
D. All answers are correct
E. There is no correct answer

18. At what hours of the day are the most stable and reliable biochemical indicatorsin the blood?
A. At night
B. 8-9 o'clock in the morning
C. In the evening
D. At noon
E. There is no correct answer

19. What does quality control of laboratory research include?
A. Convergence of measurements
B. Reproducibility of measurements
C. Correctness of measurements
D. Accuracy of measurements
E. All of the above

20. Name the control materials for quality controllaboratory research
    A. Freeze-dried human or horse serum with the studied andunexamined content of components
    B. Pooled human serum
    C. Aqueous solutions of standards
    D. All answers are correct
    E. There is no correct answer

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
2. Lunyova H.G. Clinical biochemistry. – Magnolia, 2021. – 400 p.
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4. William Marshall, Martha Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432
5. Medical Biochemistry/ Baynes J., Dominiczak M.. - Saunders, Elsevier, 2018. - 712 p.
6. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. - Philadelphia: Wolters Kluwer, 2017. - 560 p.

Auxiliary

1. Biological chemistry: textbook / O.Ya. Sklyarov, N.V. Apron, T.I. Bondarchuk. – Ternopil: TDMU, 2020. – 706 p.
2. Functional biochemistry/ edited by N. O. Sibirnoi. - LNU, 2018. - 644 p.
3. Popova L. Biochemistry / Popova L., Polikarpova A. – Kharkiv: KNMU, 2012. - 540 p.
4. Harper's Illustrated Biochemistry / VW Rodwell, DA Bender, KM Botham et al. - McGraw Hill Education, 2015. - 817 p.
5. Molecular Cell Biology / H. Lodish et al. - WH Freeman and Company, N. York. - 2016. - 1170 p.
6. Clinical biochemistry (textbook) / edited by Prof. O. Ya. Sklyarova - K.: Medicine, 2006. - 432 p.
7. Clinical biochemistry: teaching. manual / edited by O.P. Tymoshenko. - K.: VD "Professional", 2005. - 288 p.
8. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
9. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
10. Storchylo OV (2019) Mechanisms of radioprotective and radiocorrective effects of dietary phytoadditive of milk thistle fruits. Environment&Health 2019, No. 1 (90). - P. 33-37.doi.org/10.32402/dovkil2019.01.033.
11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.
12. G.F. Stepanov, O.O. Mardashko, A.A. Kostina Epigenetic changes of enzyme proteins in

animal tissues after ionizing radiation // Advances in biology and medicine No. 2(34). – 2019. – P.26-30.
13. Stepanov G.F., Kostina A.A., Mardashko O.O. Metabolism of amino acids in the offspring of irradiated animals // Advances in biology and medicine. - No. 1(29). - 2017. - P. 26-32. 15. Mardashko O.O., Stepanov G.F., Kostina A.A. Hematological indicators in the dynamics of extreme injuries / Actual problems of transport medicine. - No. 3 (49). - 2017 - p. 109-114.

Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files
2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 2

Topic:Basics of clinical enzymology (enzymodiagnosis, enzymopathies, enzyme therapy).
Goal: Studygeneral tactical principles of clinical biochemistry. Biochemical constellations.
Basic concepts:compartmentalization, indicator enzymes, enzymopathology, enzyme therapy
Equipment: demonstration materials of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
- Subcellular localization and function of enzymes.
- Distribution of diagnostically important enzymes in the human body.
- Indicator enzymes. Isoenzymes.
- Methodical bases of enzyme activity determination.
- Enzymopathies: classification, mechanisms of development, biochemical manifestations.
- Clinical and diagnostic significance of determination of individual enzymes.
- Enzyme therapy. Enzymes, their activators and inhibitors as drugs.

The student should be able to:
–detectthe cause of a pathological change in the activity profile of enzymes in the blood plasma.
–provide recommendations for blood sampling

Questions to check basic knowledge on the topic of the lesson:
- chemical nature of enzymes, their structure, biological role and basic properties of proteins as biocatalysts;
- types of chemical reactions that form the basis of the International Classification of Enzymes and the principles of their nomenclature;

- characteristics of individual classes of enzymes and give examples of each class of enzymes;
- meaning of four-digit codes of enzymes;
- specificity and types of enzyme specificity;
- the role of active and allosteric centers in the action of enzymes;
- principles of enzyme activity regulation;

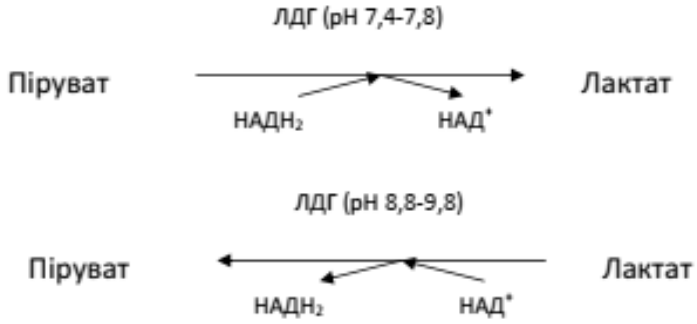
3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «Optical test of Warburg and conjugated enzymatic reactions".

Recommendations for performing tasks.

The optical test itself was developed by O. Warburg in the late 1930s century to determine the activity of NAD (nicotinamide adenine dinucleotide) and NADP (nicotinamide adenine dinucleotide phosphate)-dependent dehydrogenases. In his the basis was laid on the differences of the light absorption spectra of the reduced and oxidized forms of coenzyme NAD. At a wavelength of 340 nm NADH2 and NADPH2 has the ability to absorb light, while NAD and NADPH - it is practically not absorbed.

Warburg's direct and indirect optical test are distinguished. Directly to the optical test, the coenzyme NAD+ is added to the incubation medium or NADH, a buffer solution, the source of the enzyme is the material under study - most often serum or blood plasma. Depending on the selected conditions (in this case case - the pH value) reaction catalyzed by an enzyme (for example, lactate dehydrogenase - LDH), can go in both directions:



Warburg's indirect optical test contains, in addition to the main reaction, indicator and auxiliary reactions. An example of this type of reaction can be the conjugation variant of these reactions used to determine the activity of alanine aminotransferase (AlAT):

Визначення активності інших ферментів, наприклад креатинкінази:

Основні реакції:

$$\text{Креатинфосфат + АДФ} \xrightarrow{\text{Креатинкіназа}} \text{Креатин + АТФ}$$

$$\text{АТФ + Глюкоза} \xrightarrow{\text{Гексокіназа}} \text{Глюкозо-6-фосфат + АДФ}$$

Індикаторна реакція:

$$\text{Глюкозо-6-фосфат + НАДФ}^{+} \xrightarrow[\text{дегідрогеназа}]{\text{Глюкозо-6-фосфат}} \text{6-фосфоглюконат + НАДФН}_2$$

Due to the fact that the production of highly purified preparations of NAD and NADN2 is successfully carried out by most companies producing reagents, Warburg's optical test is widely used to determine both the activity of many enzymes and the content of low molecular weight components.

The methods developed and proposed by various scientific societies and associations differ in a number of parameters: substrate concentration, type of buffer solution, and reaction temperature. When choosing the reaction conditions, select the optimal ratio between the components of the incubation medium that determine the reaction rate. For example, in the so-called "optimized" methods of determining the aminotransferase activity of the studied sample, the determination is carried out in the presence of the aminotransferase coenzyme pyridoxal-5'-phosphate. The concentration of the substrate used provides a reaction rate within 96% of the theoretical Vmax values

Control materials for the final stage of the lesson.

Questions to check the final level of knowledge:

- Subcellular localization and function of enzymes.
- Distribution of diagnostically important enzymes in the human body.
- Indicator enzymes. Isoenzymes.
- Methodical bases of enzyme activity determination.
- Enzymopathies: classification, mechanisms of development, biochemical manifestations.
- Clinical and diagnostic significance of determination of individual enzymes.
- Enzyme therapy. Enzymes, their activators and inhibitors as drugs.
- Use of enzymes as reagents in clinical and diagnostic laboratories
-

Test tasks.

1 What is catalysis?

a) inhibition of the rate of chemical reactions

c) acceleration of chemical reactions contrary to the laws of thermodynamics

+c) change in the speed of chemical reactions under the influence of catalysts

d) the ability of enzymes to initiate reactions contrary to the laws of thermodynamics

f) the course of a chemical reaction without an enzyme

2 What temperature is optimal for the action of most enzymes?

a) 28-32 °C

+c) 37 – 43 °C

c) 45-50 °C
d) 50-60 °C
f) 90-100 °C
3 What is the optimal pH value for the action of pepsin?
a) pH 4.5-5.0
c) pH 6.8-7.0
c) pH 7.5-8.5
+d) pH 1.5-2.5
f) pH 9.3-10.5
4 What is the Michaelis constant?
a) a value equal to the concentration of the enzyme at which the reaction rate is maximal
c) ratio of enzyme and substrate concentrations
c) a value equal to the concentration of the reaction product at which the reaction rate is half of the maximum
+d) a value equal to the concentration of the substrate at which the reaction rate is half the maximum
e) a value equal to the concentration of the enzyme at which the reaction rate is half the maximum
5 What mechanisms of lowering the energy barrier occur during enzymatic reactions?
a) formation of additional covalent bonds between apo- and coenzyme
+c) formation of an intermediate enzyme-substrate complex
c) participation of macroergic compounds in enzymatic catalysis
d) reducing the area of the contact area between the enzyme and the substrate
f) participation of additional compounds in enzymatic catalysis
6 What are the stages of the catalytic action of enzymes?
a) initial and terminal
c) preparatory, initial, working and terminal
+c) attachment of the substrate to the enzyme, conversion of the substrate, cleavage of the final products of the reaction from the enzyme
d) activation of the substrate-enzyme complex of substrate conversion, cleavage of the modified enzyme from the substrate or reaction product
e) preparatory and terminal
7 The child was diagnosed with galactosemia. The concentration of glucose in the blood does not change significantly. Deficiency of which enzyme causes this disease?
+a) galactose-1-phosphate-uridyltransferases
c) amyl-1,6-glucosidases
c) phosphoglucomutase
d) galactokinase
e) glucokinase
8 Cataract (clouding of the lens), mental retardation, enlarged liver, galactosemia, galactosuria were found in the sick child. Which enzyme is deficient in the child's body?
+a) galactose-1-phosphate-uridyltransferases
c) galactokinase
c) sorbitol dehydrogenase
d) phosphoglucosmutase
f) amyl-1,6-glucosidases
9 In a patient with acute pancreatitis, the activity of one of the specified enzymes is sharply increased in the blood and urine, which confirms the diagnosis of the disease:
+a) α-amylase
c) pepsin
c) dipeptidase
d) sucrase

e) hexokinase

10 Name the enzyme, the determination of which in the blood is the most informative in the first hours after the occurrence of a myocardial infarction:

+a) creatine phosphokinase

c) alanine aminotransferase

c) pyruvate decarboxylase

d) diastasis

f) dihydrolipoyltransacetylase

11 Name the enzyme whose determination in the blood is the most informative in Botkin's disease:

a) creatine phosphokinase

+c) ornithine carbomoyltransferase

c) lactate dehydrogenase

d) diastasis

f) pepsin

12 Trasylol and Kontrical are used to treat pancreatitis. What biochemical processes do these drugs affect?

+a) reduce the activity of proteinases

c) increase the activity of proteinases

c) increase amylase activity

d) reduce amylase activity

f) increase the activity of amylo-1,6-glucosidase

13 Congenital oligophrenia is accompanied by inhibition of the conversion of phenylalanine into tyrosine. A sign of the disease is the accumulation of organic acids in the body:

+a) Phenylpyruvine

c) Lemon

c) Pyruvinogradnoi

d) Dairy

f) Glutamine

14 An increase in LDH activity is characteristic of heart and liver diseases. What additional research should be conducted to clarify the localization of the pathological process?

+a) Determination of LDH isozymes

c) Determination of amylase activity

c) Determination of alkaline phosphatase activity

d) Determination of creatine kinase isoenzymes

f) Determination of aminotransferase activity

15 An increase in the activity of which enzyme can be observed in a patient with an early stage of muscular dystrophy:

+a) Creatine kinases

c) Alanine aminotransferases

c) Collagenases

d) Hyaluronidase

f) Glutaminase

16. The patient was diagnosed with toxic hepatitis, which arose against the background of the use of drugs. The activity of which serum enzymes should be determined to confirm this diagnosis?

+a) Ornithine carbomoyltransferases

c) Creatine phosphokinase

c) Pyruvate dehydrogenase

d) Maltases

f) Malate dehydrogenase

17 When prostate cancer metastasizes to other tissues, acid phosphatase activity increases in the serum. What class does this enzyme belong to?

+a) Hydrolases
c) Oxidoreductases
c) Transferases
d) Lyases
f) Synthetases

18 The patient complains of pain in the chest area that is not relieved by nitroglycerin, weakness, increased sweating. He has cyanosis of the lips, pallor of the skin, and bradycardia. 4 hours have passed since the beginning of the anginal attack. Determining the activity of which enzyme will make it possible to make a diagnosis of myocardial infarction?

+a) Creatine kinases (MV)
c) LDH4
c) LDH5
d) ASAT
f) AlAT

19 The patient, 55 years old, was hospitalized in the infectious department with a diagnosis of viral hepatitis. An increase in the activity of which organ-specific liver enzyme will be observed in the patient's blood serum?

+a) Sorbitol dehydrogenase
c) Acid phosphatases
c) Lactate dehydrogenase
d) Cholinesterases
f) Creatine kinases

20 The temperature at which the enzyme denatures:

a) 0 °C
+c) 80-100 °C
c) 20-30 °C
d) 30-40 °C
e) 92 °C
f) by nine

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
2. Lunyova H.G. Clinical biochemistry. – Magnolia, 2021. – 400 p.
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4. William Marshall, Martha Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432
5. Medical Biochemistry/ Baynes J., Dominiczak M.. - Saunders, Elsevier, 2018. - 712 p.
6. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. - Philadelphia: Wolters Kluwer, 2017. - 560 p.

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11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.
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Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files
2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 3

Topic:Violation of carbohydrate metabolism. Pathobiochemistry of diabetes.

Goal:ATintroducing students toalgorithms for diagnosing disorders of carbohydrate metabolism

Basic concepts: glycosylated hemoglobin, fructosamine, diabetes, glycogenosis

Equipment:laboratory of the department.

Plan:

1. Organizational measures:greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation

2. Control of the reference level of knowledge

2.1. Requirements for students' theoretical readiness:

- The biological role of carbohydrates in the human body.
- Biochemistry of carbohydrate metabolism.
- Biochemical methods of researching the level of glucose in the blood.
- Factors that ensure the correctness and reliability of laboratory research of glucose.
- Algorithms for diagnosing disorders of carbohydrate metabolism. Conditions for conducting a glycemic and glucosuric profile.
- Diabetes mellitus: etiology, pathogenesis, classification, clinical manifestations, laboratory diagnosis.
- Laboratory diagnosis of hypoglycemic conditions.
- Retrospective markers of hyperglycemia (glycosylated hemoglobin, fructosamine).
- Clinical and diagnostic value of determination of C-peptide.

2.2. Questions to check basic knowledge on the topic of the lesson:

1. What enzymes and coenzymes are involved in gluconeogenesis?
2. What is the biological significance of gluconeogenesis?
3. What mechanisms of gluconeogenesis regulation do you know?
4. Why is blood glucose determined?
5. Glycogenesis. Reactions, enzymes, process regulation.
6. Glycogenoses. Types. Causes of occurrence.
7. Diabetes.

3. Formation of professional skills and abilities:demonstration and practical work.

3.1. Content of demonstration and practical work "Glucose tolerance tests (GTT)"

3.2. Implementation recommendations:

1. Simplified version. It is allowed to confirm the diagnosis of diabetes using a test that consists in determining glucose in the blood through 2 hours after a meal equivalent to approximately 70 - 100 g of carbohydrates. At the same time, the glucose level should not exceed 6.7 mmol/l. IN otherwise, there is reason to assume that the patient has diabetes diabetes

2. Test with a single glucose load. Within 3 days before carrying out the load, the examinee must adhere to a diet with with a sufficient content of carbohydrates, but a low level of proteins. Disposable glucose load consists in oral administration of a solution which contains 75 g of glucose (dissolve this amount in 200 ml of warm water or tea and drink for 5 minutes). Blood for research is taken to load, 1 and 2 hours after receiving the load.

Pathophysiological mechanisms of glucose level changes during HTT.

The first rise in the level of glucose in 30 minutes is the hyperglycemic phase, which reflects the force of reflex irritation of sympathetic nerve endings when glucose enters the gastrointestinal tract. Further promotion concentration of glucose up to 1 hour is related to the peculiarities of absorption carbohydrates The subsequent decrease in glucose content (at the beginning of the 2nd hour) - hypoglycemic phase, reflects insulin production, as well as functional activity of the parasympathetic nervous system.

For the integral assessment of glycemic curves, various coefficients are calculated:

- Hyperglycemic coefficient (K. Baudouin) - obtained by the ratio indicators of the highest concentration of glucose in the blood to the initial level. It's normal is 1.3 - 1.5.
- Postglycemic coefficient (K. Rafalskyi) - is a share of dividing the glucose concentration 2 hours after the load by the indicator initial glucose level. In healthy people, it is 0.9 - 1.04.

3. Test with double load (according to Staub-Traugott). The principle of the study is that if an additional amount of glucose is injected into a practically healthy person during the period of a decrease in the glucose level, that is, at the time of the highest insulin content in the blood, then the new increase in its concentration will be significantly less than the first rise or it will not be there at all. This phenomenon is called the positive Staub-Traugott effect. The absence of an increase in blood glucose reflects the high intensity of insulin production by the pancreas. In patients with type 1 diabetes, in whom the islets of Langerhans secrete only a small amount of insulin, after the second

administration of glucose there is a pronounced increase in the level of glucose, often more pronounced than the first increase. This is the so-called negative Staub-Traugott effect.
There are 3 main types of glycemic curve:
1). diabetoid - a curve with a high rise, which after 3 hours after the load does not return to the initial values. It is observed in diabetes, pheochromocytoma, acromegaly, Itsenko-Cushing's disease, etc.;
2). irritating - a curve with a high rise and a rapid fall. Such curves are observed in hyperthyroidism, glycogenosis, strong emotional or toxic infectious states;
3). torpid - a curve with a low rise and a fast or slow decline. It is observed in insulinomas, liver pathology, myxedema, etc.

3.4. Control materials for the final stage of the lesson: test tasks for the topic:

1. In a patient exhausted by starvation, the process in the liver and kidneys intensifies:
A Bilirubin synthesis
B Urea synthesis
C Gluconeogenesis
D Formation of hippuric acid
E Uric acid synthesis

2. For the synthesis of polysaccharide chains of glycogen, a precursor - the active form of glucose - is used. The direct donor of glucose residues in the process of glycogen synthesis is:
A ADP-glucose
B glucose-1-phostat
C UDF-glucose
D glucose - 6-phosphate
E glucose-3 phosphate

3. When there is a lack of blood circulation during intense muscle work, lactic acid accumulates in the muscle as a result of anaerobic glycolysis. What is her future fate?
A Involved in gluconeogenesis in the liver
B It is removed through the kidneys with urine
C It is used in the muscle for the synthesis of amino acids
D It is used by tissues for the synthesis of ketone bodies
E It is used in tissues for the synthesis of fatty acids

4. A characteristic sign of glycogenosis type V (McArdle's disease) is muscle pain during physical work. Congenital deficiency of which enzyme causes this pathology?
A Glycogen synthases
In Glucose-6-phosphatase
C Glycogen phosphorylase
D Amylo-1,6-glycosidases
E Lysosomal glycosidase

5. In Itsenko-Cushing's disease (hyperfunction of the adrenal cortex with increased production of corticosteroids), hyperglycemia occurs. What process is stimulated in this case?
A Gluconeogenesis
B Glycogen phosphorolysis
C Krebs cycle
D Pentose phosphate pathway of glucose oxidation
E Glycolysis

6. As a result of prolonged starvation in the human body, reserves of carbohydrates quickly

disappear. Which of the metabolic processes restores the glucose content in the blood?

A Glycogenolysis
B Anaerobic glycolysis
C Aerobic glycolysis
D Gluconeogenesis
E Pentophosphate pathway

7. A 40-year-old woman with complaints of thirst and increased appetite is being treated in the endocrinology department with a diagnosis of diabetes. What pathological components were found during the laboratory examination of the patient's urine?

A Glucose, ketone bodies
B Protein, amino acids
C Protein, creatine
D Bilirubin, urobilin
E Blood

8. With a chronic overdose of glucocorticoids, the patient develops hyperglycemia. Name the process of carbohydrate metabolism due to which the concentration of glucose increases:

A Aerobic glycolysis
B Seeandcogenolandwith
C Gluconeogenesis
D Pentose phosphate cycle
E Seeandcogenesis

9. A 40-year-old woman has Itsenko-Cushing's disease - steroid diabetes. During biochemical examination: hyperglycemia, hypochloremia. Which of the following processes is activated first?

A Gluconeogenesis
B Glycogenolysis
C Reabsorption of glucose
D Transport of glucose into the cell
E Glycolysis

10. In the patient's blood, the glucose content on an empty stomach is 5.6 mmol/l, after 1 hour after the sugar load - 13.8 mmol/l, and after 3 hours - 9.2 mmol/l. Such indicators are likely for:

A Hidden form of diabetes
B A healthy person
C Thyrotoxicosis
D Itsenko-Cushing diseases
E Acromegaly

11. In a patient with a diagnosis of Itsenko-Cushing's disease (hyperproduction of the adrenal cortex), an increased concentration of glucose, ketone bodies, and sodium was determined in the blood. What biochemical mechanism is the leading cause of hyperglycemia?

A Glycogenesis
B Gluconeogenesis
C Glycogenolysis
D Glycolysis
E Aerobic glycolysis

12. A one-year-old child lags behind his peers in mental development. In the morning: vomiting, convulsions, loss of consciousness. Fasting hypoglycemia in the blood. Which enzyme defect is this associated with?

A. Glycogen synthases
B. Phosphorylases
C. Arginases
D. Sucrase
E. Lactases

13. A patient with signs of acute alcohol poisoning was brought to the clinic. What changes in carbohydrate metabolism are characteristic of this condition
A. The rate of gluconeogenesis decreases in the liver
B. Glycogen breakdown increases in the liver
C. Anaerobic breakdown of glucose prevails in muscles
D. Gluconeogenesis increases in the liver
E. Aerobic breakdown of glucose increases in muscles

14. As a result of prolonged fasting, hypoglycemia occurs, which is aggravated by alcohol, because it slows down:
And Lipolysis
In Glycolysis
C Glycogenolysis
D Gluconeogenesis
E Proteolysis

4. Summary of the lesson. Assessment.

5. List of recommended literature

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
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4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 4

Topic:Disorders of lipid metabolism: atherosclerosis, dyslipoproteinemia, metabolic syndrome.

Goal: Formation of system knowledge withclinical manifestations of lipid metabolism disorders**Basic concepts:**cholesterol, acetoacetic acid, ketone bodies, blood plasma lipoproteins, atherosclerosis, gallstone disease.

Equipment:laboratory of the department.

Plan:

1. Organizational measures:greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation

2. Control of the reference level of knowledge

2.1. Requirements for students' theoretical readiness:

- The main characteristic of lipoproteins.
- Properties and functions of apoproteins.
- Algorithm of laboratory diagnosis of disorders of lipid metabolism.
- Normal lipidogram.
- Classification of dyslipoproteinemias. Primary and secondary dyslipoproteinemias.
- Laboratory evaluation of the activity of the atherosclerotic process.
- Clinical and laboratory criteria of metabolic syndrome.

2.2. Questions to check basic knowledge on the topic of the lesson:

1. Write the synthesis reactions of acetoacetic acid followed by the formation of beta-hydroxybutyric acid and acetone.
2. Pathways of acetoacetate metabolism in tissues.
3. Biological role of ketone bodies in the human body.
4. Explain the reasons (from a biochemical point of view) for the occurrence of acetonemia and acetonuria.
5. Give examples of the relationship between carbohydrate and lipid metabolism. Name the common metabolites of carbohydrate and lipid oxidation processes.
6. Which tissues of the human body are the richest in cholesterol?
7. What is cholesterol synthesized from? Write the initial reactions of cholesterol biosynthesis (up to and including mevalonic acid).
8. Name the intermediate products of cholesterol biosynthesis. Explain the structural features of squalene and lanosterol as important intermediates in cholesterol biosynthesis. What is the difference between them?
9. Regulation of cholesterol biosynthesis.
10. Cholesterol as a precursor of other steroids in the body. Biological role of cholesterol.
11. Name the transport forms of lipids in the blood. Their structure.
12. General concepts about the mechanisms of development of atherosclerosis and gallstone disease

3. Formation of professional skills and abilities:demonstration and practical work.

3.1. Content of demonstration and practical work"The use of blood plasma lipids in the diagnosis of diseases"

3.2. Implementation recommendations:

In the clinic, it is customary to assess the content of lipids only in plasma or serum (v in serum there is an average of 3% more total C and total T than in plasma).

Formula for calculation:

plasma X = crude. X : 1.03

plasma TG = crude. TG: 1.03

The level of lipids in the blood depends on age, gender, external factors and internal environment: the nature of nutrition, physical activity, hormonal status. Seasonal fluctuations are characteristic of

blood plasma CH: in healthy people, cholesterol is higher in winter and lower in summer, this can be explained the peculiarities of food and the way of life of a person in these seasons.
At birth, Chlyolny ≤2.6 mmol/l, and Chlpnsch < 1 mmol/l. In childhood General≤4.1 mmol/l. The scrotum begins to increase during the sexual period maturation. In developed countries, it is customary to consider the content of HCZAG as the norm adults, which does not exceed the value≤6.47 mmol/l

Таблиця Класифікація рівня холестеролу

Рівень Х	$Х_{загальний}$ (ммоль/л)	$Х_{ЛПНЩ}$ (ммоль/л)
Припустимий	<5,2	<3,4
Суміжний	5,2-6,2	3,4-4,1
Підвищений	>6,2	>4,1

На даний час рівень $Х_{загальний}$ в плазмі крові розглядають як бажаний меньш ніж 5,2 ммоль\л. (см. табл.3) Через те, що ризик виникнення ішемічної хвороби серця (ІХС) значно зростає при $Х_{загальний}$ більше ніж 5,2 ммоль/л, критичним або суміжним вважають діапазон від 5,2 до 6,2 ммоль\л.

При диференційній діагностиці порушень ліпідного обміну має місце визначення не тільки $Х_{загальний}$, але і його концентрація у фракціях ліпопротеїнів плазми крові (табл..4).

Таблиця Класифікація рівня холестеролу

у фракціях ЛПНЩ, ЛПВЩ

Концентрація в плазмі, ммоль\л	Іде-альна	Макси-мальна	Ано-мальна
Хлпнщ	<4,0	4,0-5,0	>5,0
Хлпвщ	>1,0	0,9-1,0	<0,9

Гіперхолестеролемія (ГХС) в ізольованому вигляді діагностується при $Х_{загальний}$ більше ніж 6,47 ммоль\л. При гіперліпопротеїнеміях атерогенного типу звичайно спостерігається стан гіпер-холестеролемії (ГХС) в ізольованому вигляді чи в поєднанні з гіпертригліцерідемією (ГТГ). ГТГ в ізольованому вигляді вста новлюється при показниках $ТГ_{загальні}$ › 2,3 ммоль/л (рекомендований рівень $ТГ_{загальні}$ для здорової людини не більш як 2,0 ммоль\л). Розрахунок показника $Х_{ЛПНЩ}$ можна вести за формулою Фрідевальда (за умовою, якщо $ТГ_{загальні} < 4,5$ ммоль/л):

$$Х_{ЛПНЩ} = Х_{загальний} – (Х_{ЛПВЩ} + ТГ_{загальні}/2,2),$$

One of the important parameters for assessing the degree of atherosclerosis of vessels human is the coefficient of atherogenicity (K), which can be calculated according to formulas (1) and (2):

K= Hlpnshch+ Hlpdnshch/ Hlpvshch (1)

K= General – Human Rights/ Human Rights (2)

In healthy people, K = 3.0-3.5 (in men it is higher than in women). In patients with CHD it is 5-6

units. Sometimes there is a need to consider the ratio of apoprotein content B-100/ apoprotein A1 (normally this ratio is 1.37±0.21), when the diagnosis of coronary artery disease is made in patients who do not have HLP

3.3. Control materials for the final stage of the lesson: test tasks for the topic:

1. During the examination of the patient, an increased content of low-density lipoproteins in the blood serum was found. What disease can be predicted in this patient?

A Gastritis
B Kidney damage
C Acute pancreatitis
D Atherosclerosis
E Pneumonia

2. In the human body, the main place of deposition of triacylglycerols (TAG) is adipose tissue. However, their synthesis occurs in hepatocytes. In the form of what is the transport of TAG from the liver to adipose tissue?

A LDL
B Chylomicrons
C LPDNSH
D HDL
E Complex with albumin

3. An increase in the level of HDL leads to a decrease in the incidence of atherosclerosis. What is the mechanism of antiatherogenic effect of HDL?

A Cholesterol is removed from tissues
B Cholesterol is supplied to tissues
C Take part in the breakdown of cholesterol
D Activate the transformation of cholesterol into bile acids
E Contribute to the absorption of cholesterol in the intestine

4. During the patient's examination, bile stasis in the liver and gallstones in the gall bladder were found. Name the main component of gallstones that form in this condition.

A White.
B Triglycerides.
C Calcium bilirubinate.
D Cholesterol.
E Mineral salts.

5. With diabetes and starvation, the content of acetone bodies, which are used as an energy material, increases in the blood. Name the substance from which they are synthesized:

A Malat
B Succinyl-CoA
C Citrate
D Acetyl CoA
E Ketoglutarate

6. Ketone bodies were found in the patient's urine. In which disease do ketone bodies appear in the urine?

A. Diabetes.
B. Acute glomerulonephritis.
C. Urinary stone disease.
D. Kidney tuberculosis.

E. Kidney infarction.

7. During a blood test, a high cholesterol content in the β-lipoprotein fraction was revealed. What are the possible consequences of this phenomenon for the body?

A. Hypertension
B. Diabetes mellitus
C. Obesity
D. Atherosclerosis
E. Jaundice

8. During the treatment of patients with coronary heart disease as a result of atherosclerotic degeneration of blood vessels, statins are prescribed, inhibitors of HMC-CoA reductase, which inhibit the synthesis of:

A Fatty acids
In ketone bodies
With cholesterol
D Corticosteroids
E Bile acids

9. Analysis of the lipid metabolism indicators of the patient's blood plasma revealed the risk of developing atherosclerosis, which is caused by an increase in the ratio of lipoproteins:

And LDL/LDL
In VLDL/LDL
With LDL/LDL
D Chylomicrons/LDL
E VLDL/Chylomicrons

10. When examining the patient's blood plasma 4 hours after he took fatty food, it was found that it is cloudy. The most likely cause of this condition is an increase in plasma concentration:

A. Cholesterol
B. LPVHD
C. LPG
D. Chylomicrons
E. Phospholipids

11. Complaints and objective data suggest that the patient has an inflammatory process in the gallbladder, a violation of the colloidal properties of bile, and the possibility of the formation of gallstones. What can mainly cause their formation?

A. Cholesterol
B. Urates
C. Oxalates
D. Chlorides
E. Phosphates

12. When examining a teenager with xanthomatosis, familial hypercholesterolemia was established. The concentration of which lipoproteins is significantly increased in the blood in this pathology?

A LPDNSH
B Chylomicrons
C LDL
D HDL
E NEZHK

13. In a sick 12-year-old boy, the cholesterol content in blood serum is up to 25 mmol/l. There is a history of hereditary familial hypercholesterolemia, the cause of which is a violation of the synthesis of receptor proteins for:

A High-density lipoproteins
B Low-density lipoproteins
C Chylomicrons
D Very low density lipoproteins
E Intermediate density lipoproteins

14. A 58-year-old man has signs of atherosclerotic damage to the cardiovascular system. An increase in which of the following indicators of biochemical blood analysis is most characteristic of this condition?

A LDL (β-lipoprotein) level
B Ericoproteins
C HDL (α-lipoprotein) level
D Activities of alanine aminotransferase
E Activities of succinate dehydrogenase

15. When examining a patient with signs of atherosclerosis in the blood, a significant decrease in HDL, an increase in LDL, and a cholesterol concentration of 11 mM/l were found. A decrease in the activity of which enzyme is the most likely cause of such changes?

A Lecithin cholesterol acyltransferase
In blood Lipoprotein lipase
With Tissue lipases
D Pancreatic phospholipases
E Cholesterolesterase

4. Summary of the lesson. Assessment.

5. List of recommended literature

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
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4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

***Practical class no*5.**

Topic:Violations of protein and nitrogen metabolism. Nitrogen balance in various pathological conditions.

Goal: To study the main mechanism of ammonia detoxification in the human body, urea is the main end product of nitrogen metabolism. Violation of tissue metabolism of individual amino acids (cyclic, sulfur-containing and others); arginine-succinic aciduria, Hartnup's disease, glycinuria and others.

Basic concepts:ornithine cycle, ammonia toxicity, ways of its neutralization, glutamine, asparagine.

Equipment: Laboratory of the department

Plan:

1. Organizational measures (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
- Nitrogen balance in normal and pathological conditions.
- End products of nitrogen metabolism: ammonium salts and urea.
- The role of glutamine in the neutralization and transport of ammonia.
- Formation, causes of toxicity and neutralization of ammonia.
- Urea synthesis. Hyperammonemia.
- Activation of kidney glutaminase in acidosis.
- Violation of synthesis and excretion of urea.

The student should be able to:
- write the reactions of the ornithine cycle
- write the formula of carbomoyl phosphate
- explain the difference between urea and urine
- write the formula of the vitamin present in the reaction with carbomoyl phosphate
- write reactions with consumption of ATP

Questions to check basic knowledge on the topic of the lesson:
- The role of dicarboxylic acids in the processes of binding and transport of ammonia in the blood
- A compound formed from ammonia and carbon dioxide in the presence of ATP
- What vitamin is necessary for the functioning of carbamoyl phosphate synthetase
- Reaction catalyzed by ornithine carbamoyltransferase.
- The reaction of formation of citrulline, arginine in the process of urea biosynthesis.
- The energy of how many ATP molecules is spent on the synthesis of one molecule of urea
- Under which pathological conditions can the synthesis of urea increase
- What lesions of the liver lead to a decrease in its urea-forming function
-

3. Formation of professional skills:

3.1 Demonstration and practical work: "Quantitative determination of urea in urine"

Recommendations for performing tasks.

Content of laboratory work

Principle of the method: urea forms a red complex with diacetyl monooxin in the presence of Fe3+ ions and thiosemicarbazide, and its concentration is determined by the intensity of the color.

Progress:solutions of diacetyl monoxide, biological fluid or physiological solution and thiosemicarbazid are measured sequentially in test tubes, in accordance with the table. Urine must be diluted 30 or 100 times before starting the analysis, multiply the obtained results by the dilution factor.

Measured liquid	Experimental	Sample calibration	empty
Diacetyl monooxime	1.0 ml	1.0 ml	1.0 ml
Biological fluid	-	0.01 ml	-
Calibration solution of urea	-	0.01 ml	-
Physiological solution	-	-	0.01 ml
Thiosemicurea solution	1.0 ml	1.0 ml	1.0 ml

The test tubes are covered with foil, the contents are mixed and simultaneously placed in a boiling water bath for exactly 10 minutes. Then the test tubes are cooled under a stream of cold water. Then colorimetry is performed on a photoelectrocolorimeter.

The concentration of urea is calculated according to the formula:

Ex.

C = ---------- 8.32 mmol/l, where

Ekal

C - concentration of urea; Ex. - optical density of the test sample; Ekal - optical density of the calibration sample.

Norm: blood - 2.5-8.3 mmol/l, urine - 330-580 mmol/l.

Clinical and diagnostic value of the method

The content of urea in the blood serum of healthy people is 3.3-8.3 mmol/l (20-50 mg%). A decrease in this indicator is observed in parenchymal hepatitis, cirrhosis and liver dystrophy, which are accompanied by a sharp decrease in urea biosynthesis, as well as during pregnancy and eclampsia.

An increase in the content of urea in the blood serum is one of the main signs of nephritis and tuberculosis of the kidneys, but it is also observed with increased breakdown of proteins in the body, with loss of fluid (dehydration, vomiting, diarrhea), with sepsis, fever, and excess protein nutrition.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Test tasks.

How is ammonia neutralized in the body?

A - is partially used to neutralize acids;

B - by synthesis of urea;

C - in the form of amides;

D - goes to the synthesis of ammonium salts;

E* - in all the indicated ways.

How much urea is formed per day in an adult?

A* - 25-35 g (depending on the amount of proteins in the diet);

B - 10-35 g;

C - 35-50 g;

D - 50-75 g;

E - 2-5 g.

Ammonia is a very poisonous substance, especially for the nervous system. Which compound is particularly active in neutralizing ammonia in brain tissues?

A. Lysine.

B. Glutamic acid

C. Proline.

D. Histidine

E.* Alanine

Citrulline and a high level of ammonia are determined in the urine of newborns. The formation of which substance is most likely disturbed?

A. Ammonia.

B*. Uric acid.

C. Urea.

D. Creatinine.

E. Creatine

The patient has disturbed sleep, there is a weakening of the activity of inhibitory processes in the central nervous system, which is associated with a violation of the formation of gamma-aminobutyric acid. What substance is the precursor of GABA?

A Histidine

B Tryptophan

C Methionine

D Valin

E Glutamate

When forming the tertiary structure of most proteins, nonpolar amino acid residues form the inner hydrophobic part of the globule. Name one of these hydrophobic amino acids.

A valine
B lysine
C arginine
D glutamic acid
E aspartic acid

The hormone of local action, histamine, is produced in the lungs, digestive system, and skin. He is vasodilator. Indicate which compound it is as a result of decarboxylation is formed:

A Histidine
B Valina
C Alanine
D Serena
E Threonine

In the process of decarboxylation of 5-hydroxytryptophan, a biogenic amine is formed, which has vasoconstrictor effect. Name this biogenic amine.

A serotonin
B histamine
C gamma-aminobutyric acid
D putrescine
E cadaverine

In a man who suffers from chronic intestinal obstruction, the decay of proteins increases in the large intestine. What toxic substance is formed in this case with tryptophan:

A Indole
B Bilirubin
C Lactate
D Creatine
E Glucose

The patient warned that the use of painkillers can cause allergic shock. An increase in the amount of which biogenic amine in the blood can be the cause such a state?

A Histamine;
B GABA;
C Cadaverine;
D Dopamine;
E Putrescin

L-DOPA and its derivatives are used to treat Parkinson's disease. From which Amino acids form this substance?

A Tyrosine
B Asparagine
C Glutamate
D Tryptophan
E Arginine

In the course of histidine catabolism, a biogenic amine is formed, which has a significant vasodilating effect. Specify this substance.

A Histamine
B Serotonin
C DOFA
D Thyroxine

E Dopamine

The patient has pronounced allergic symptoms: rashes on the body, swelling of the face, itching. From the increase in the formation of which biogenic amine is this due to?

A Histamine
B Serotonin
C adrenaline
D Norepinephrine
E to Holin

The structure of the lateral radical is the basis of the structural classification of amino acids. Which of the listed amino acids belongs to diaminomonocarbonic ones?

A Lysine
B Proline
C Valin
D Leucine
E Methionine

4. Summary.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
2. Lunyova H.G. Clinical biochemistry. – Magnolia, 2021. – 400 p.
3. Human biochemistry: a textbook / Ya.I. Gonskyi, T.P. Maksymchuk; under the editorship Ya.I. Gonsky – Ternopil: TDMU, 2019. – 732 p.
4. William Marshall, Martha Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432
5. Medical Biochemistry/ Baynes J., Dominiczak M.. - Saunders, Elsevier, 2018. - 712 p.
6. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. - Philadelphia: Wolters Kluwer, 2017. - 560 p.

Auxiliary

1. Biological chemistry: textbook / O.Ya. Sklyarov, N.V. Apron, T.I. Bondarchuk. – Ternopil: TDMU, 2020. – 706 p.
2. Functional biochemistry/ edited by N. O. Sibirnoi. - LNU, 2018. - 644 p.
3. Popova L. Biochemistry / Popova L., Polikarpova A. – Kharkiv: KNMU, 2012. - 540 p.
4. Harper's Illustrated Biochemistry / VW Rodwell, DA Bender, KM Botham et al. - McGraw Hill Education, 2015. - 817 p.
5. Molecular Cell Biology / H. Lodish et al. - WH Freeman and Company, N. York. - 2016. - 1170 p.
6. Clinical biochemistry (textbook) / edited by Prof. O. Ya. Sklyarova - K.: Medicine, 2006. - 432 p.
7. Clinical biochemistry: teaching. manual / edited by O.P. Tymoshenko. - K.: VD "Professional", 2005. - 288 p.
8. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
9. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
10. Storchylo OV (2019) Mechanisms of radioprotective and radiocorrective effects of dietary

phytoadditive of milk thistle fruits. Environment&Health 2019, No. 1 (90). - P. 33-37.doi.org/10.32402/dovkil2019.01.033.
11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.
12. G.F. Stepanov, O.O. Mardashko, A.A. Kostina Epigenetic changes of enzyme proteins in animal tissues after ionizing radiation // Advances in biology and medicine No. 2(34). – 2019. – P.26-30.
13. Stepanov G.F., Kostina A.A., Mardashko O.O. Metabolism of amino acids in the offspring of irradiated animals // Advances in biology and medicine. - No. 1(29). - 2017. - P. 26-32. 15. Mardashko O.O., Stepanov G.F., Kostina A.A. Hematological indicators in the dynamics of extreme injuries / Actual problems of transport medicine. - No. 3 (49). - 2017 - p. 109-114.

Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files
2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 6

Topic: <u>Clinical biochemistry of the endocrine system</u>.

Goal: To study and be able to characterize the hormones of the hypothalamic-pituitary system according to the following plan: 1) the name of the hormone; 2) place of synthesis; 3) features of the structure; 4) mechanism of action, biological role; 5) violation of synthesis.

Basic concepts:hormones, the mechanism of action of hormones depends on their nature, insulin, regulation. Based's disease.

Equipment: Laboratory of the department

Plan:

1. Organizational measures (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:

- hormones of the anterior lobe of the pituitary gland. pathological processes associated with a violation of their synthesis.
- thyroid hormones: iodothyronine and calcitonin. the main types of dysfunction of the thyroid gland.
- parathyroid hormones. the connection of parathyrin with calcitonin in the regulation of phosphorus-calcium metabolism. signs of dysfunction of the parathyroid glands.
- adrenal cortex hormones
- glucocorticoids
- Isenko-Cushing syndrome
- the role of aldosterone in the regulation of water-salt metabolism; aldosteronism
- female sex hormones: estrogens - estradiol, progesterone physiological and biochemical effects, regulation of synthesis and secretion
- male sex hormones (androgens) – testosterone, dihydrotestosterone, regulation of synthesis and secretion
- mechanisms of influence of insulin and glucagon on metabolism

The student should be able to:

- determine the type of diabetes
- determine hypothyroidism and thyroiditis
- be able to explain the work of the insulin receptor
- be able to explain the types of diabetes

Questions to check basic knowledge on the topic of the lesson:

- general characteristics of hormones, the role of hormones in the system of intercellular integration of human body functions.
- methods of hormone research.
- properties of hormones and features of the functioning of the endocrine system.
- classification of hormones by the city of synthesis, chemical nature, provision and maintenance of homeostasis.
- name groups of hormones and representatives of each of them.
- mechanisms of action of hormones of protein-peptide nature and derivatives of amino acids.
- biochemical systems of intracellular transmission of hormonal signals: g-proteins, secondary messengers (tsamph, tsgmph, ca2+/calmodulin, if3, dag).
- adenylate cyclase messenger system. structure of ATP and cyclic 3',5'-amp.

- hypothalamic hormones - liberins and statins. their structure and role in neurohumoral regulation.

- hormones of the anterior lobe of the pituitary gland. pathological processes associated with a violation of their synthesis.

- group "growth hormone (somatotropin) - prolactin - chorionic somatomammotropin"; pathological processes associated with a violation of their functions.

- a group of glycoproteins - tropic hormones of the pituitary gland (thyrotropin, gonadotropins).

- vasopressin and oxytocin: structure, biological functions. a pathology associated with a violation of vasopressin production.

- violation of the synthesis of thyroid hormones

- dysfunction of the thyroid gland

- parathyroid hormones

- insulin: structure,

- biosynthesis and secretion of pancreatic hormones

- influence on the metabolism of carbohydrates, lipids, proteins.

- growth-stimulating effects of insulin.

3. Formation of professional skills:

3.1 Demonstration and practical work:

Demonstration and practical work "Iodine determination in the thyroid gland".

Recommendations for completing tasks:

The method is based on the separation during acid hydrolysis of thyroid hormones (iodothyronines) of iodide acid, which reacts with potassium iodate to release free iodine:

$5NH + KJO3 + HNO3 \rightarrow 3J2 + KNO3 + 3H2O$

In chloroform, iodine has a purple color.

Progress. Place several crystals of thyroidin in a test tube, add 10 drops of concentrated nitric acid and heat for 3-5 minutes in a water bath. Then add 20 drops of 10% potassium iodate solution. Mix the contents and cool. Add 15 drops of chloroform to the test tube, mix by shaking. Color development is observed.

Designing the work: fill in the table

Hormones	**Place of synthesis**	**Chemical structure**	**Qualitative response**	**Reaction mechanism**	**Color**
Insulin					
Iodothyronine					

In clinical and biological laboratories, methods of qualitative and quantitative analysis are widely used to determine hormones in biological material for the purpose of diagnosis and prognosis of various endocrine diseases.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Test tasks.

What hormone stimulates the activity of the enzyme adenylate cyclase?

A. Adrenaline

B. Aldosterone

S. Testosterone

D. Progesterone

E. Calcitriol

In which glands are steroid hormones synthesized?

A. Shield-like

V. Pidzhudzkova

S. Adrenal cortex

D. The cerebral part of the adrenal glands

What hormone regulates the function of the thyroid gland?

A. Tyroliberin

V. Transkortin

S. Cortisol

D. Somatoliberin

E. Somatotropin

What hormone regulates water balance and osmotic pressure of blood plasma, stimulates contraction of smooth muscles?

A. Prolactin

B. Somatostatin

S. Corticoliberin

D. Vasopressin

E. Glucagon

For the purpose of analgesia, a substance that imitates the effects of morphine, but is synthesized in the central nervous system, can be used. Name this substance.

A. Somatoliberin

B. Oxytocin

S. Vasopressin

D. Calcitonin

E. Endorphin

The patient has a headache, changes in appearance (increasing the size of the limbs, brow ridges, nose, tongue), hoarse voice, memory impairment. The disease started about three years ago. The reason for this condition can be:

A. Aldosterone deficiency

B. Glucagon deficiency

S. Thyroxine deficiency

D. Hyperproduction of somatotropin

E. Hyperproduction of corticosteroids

Products of hydrolysis and modification of some proteins are biologically active substances - hormones. Lipotropin, corticotropin, melanotropin and endorphins are formed from which protein in the pituitary gland?

A. Proopiomelanocortin

B. Neuroalbumin

S. Neurostromin

D. Neuroglobulin

E. Thyroglobulin

Products of hydrolysis and modification of some proteins are biologically active substances - hormones. Lipotropin, corticotropin, melanotropin and endorphins are formed from which protein in the pituitary gland?

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B. Neuroalbumin

S. Neurostromin

D. Neuroglobulin

E. Thyroglobulin

Ca2+ ions play the role of secondary mediators in cells. They are activators of a number of processes if they interact with:

A. Calcitonin

V. Calmodulin
S. Calciferol
D. Myosin kinase
E. Phosphorylase S

After a cerebral hemorrhage with damage to the hypothalamic nuclei, the patient developed diabetes insipidus, which is accompanied by polyuria as a result of:

A. Hypoglycemia
B. Reduction of reabsorption of potassium ions
C. Acceleration of glomerular filtration
D. Hyperglycemia E. Reduction of water reabsorption

Which of the listed hormones is hydrophilic and does not require a special transport protein:

A. Dihydrotestosterone
B. Progesterone
S. Paratyrin
D. Aldosterone
E. Estradiol

The husband was diagnosed with angina pectoris. A phosphodiesterase inhibitor is included in the complex of drugs prescribed to the patient. The concentration of which substance in the heart muscle will increase?

A. AMF
V. GMF
S. cAMP
D. ADP
E. ATP

The patient turned to the doctor with complaints of frequent and excessive urination, thirst. Urinalysis revealed: daily urine output – 19 L, urine density – 1.001. For which disease are these indicators characteristic?

A. Steroid diabetes
B. Diabetes mellitus
S. Thyrotoxicosis
D. Diabetes insipidus
E. Addison's disease

The boy is being examined in the hospital for short stature. Over the past two years, it has grown by only 3 cm. This condition is caused by the lack of which hormone?

A. Somatotropin
B. Corticotropin
S. Gonadotropin
D. Thyrotropin
E. Parathyroid hormone

What hormones regulate the content of calcium and phosphorus in the blood?

A. Parathyroid hormone
B. Calcitonin
S. Adrenocorticotropin
D. Progesterone
E. Testosterone

What hormone stimulates glycogen biosynthesis and enhances anabolic processes?

A. Adrenaline
B. Norepinephrine
S. Cholecystokinin

Violation of hormone synthesis in the body leads to various pathological conditions. What hormone is synthesized in an insufficient amount in the body when growth stops in childhood, but at the same time mental activity is not disturbed?

A. Thyroxine
B. Prolactin
S. Somatotropin
D. Adrenaline
E. Gonadotropin

A 9-year-old boy had multiple fractures of his limbs due to the fragility of his bones. The function of which endocrine organ is impaired?

A. Parathyroid glands
B. Thyroid gland
S. Epiphysis of the adrenal glands
E. Pancreas

Some substances contribute to the uncoupling of respiration and phosphorylation processes, thereby causing the activation of Na+, K+-ATP-ase. Name this substance.

A. Vasopressin
B. Insulin
S. Oxytocin
D. Adrenaline
E. Thyroxine
D. Insulin
E. Thyroxine

3. The patient has tachycardia, increased body temperature, weight loss, irritability. An increase in the content of which hormone in the blood can lead to such a condition?

A. Thyroxine
B. Vasopressin
S. Somatotropin
D. Insulin
E. Adrenocorticotropin

It is known that endemic goiter is widespread in some biogeochemical zones. Deficiency of which biogenic element is the cause of this disease.

A. Zaliza
V. Yodu
S. Tsink
D. Midi
E. Cobalt

The patient's blood shows hypercalcemia, hypophosphatemia, and hyperphosphaturia in the urine. What is the possible cause of this condition?

A. Enhanced secretion of parathyroid hormone
B. Inhibition of parathyroid hormone secretion
S. Enhanced secretion of calcitonin
D. Inhibition of calcitonin secretion
E. Increased secretion of thyroxine

A patient living in a specific geochemical area has been diagnosed with endemic goiter. What type of post-translational modification of thyroglobulin is disturbed in the patient's body?

A. Methylation
B. Acetylation
S. Phosphorylation
D. Glycosylation
E. Iodination

With hyperfunction of the thyroid gland, there is a decrease in weight and an increase in body temperature. What biochemical processes are activated at the same time?

A. Anabolism
B. Catabolism

S. Gluconeogenesis
D. Lipogenesis
E. Steroidogenesis

Parathyroid glands were mistakenly removed during thyroid surgery in a patient with diffuse toxic goiter. Convulsions, tetany occurred. The exchange of which bioelement is disturbed?

A. Calcium
B. Magnesium
S. Kaliya
D. Iron
E. Sodium

What hormone stimulates glycogen biosynthesis and enhances anabolic processes?

A. Adrenaline
B. Norepinephrine
S. Cholecystokinin
D. Insulin
E. Thyroxine

Glucose is used by its transport from the extracellular space through the plasma membrane into cells. This process is stimulated by the hormone:

A. Insulin
B. Glucagon
S. Thyroxine
D. Aldosterone
E. Adrenaline

The patient is in a state of hypoglycemic coma. An overdose of which hormone can lead to such a situation?

A. Insulin
B. Cortisol
S. Somatotropin
D. Progesterone
E. Corticotropin

The parents of a five-year-old child turned to the hospital. During the examination, it was found: retardation in mental development and growth, the child is sedentary. General exchange is reduced. What disease does the child have?

A. Cretinism
B. Lesch-Nyhan syndrome
S. Phenylketonuria
D. Hyperparathyroidism
E. Endemic goiter

Insulin, like other hormones of a protein-peptide nature, has receptors on the surface of the cytoplasmic membrane. Name the mechanism of realization of the effect of insulin in target cells?

A. Adenylate cyclase messenger system
B. Guanylate cyclase messenger system
C. Protein kinase cascade
D. Phosphoinositide messenger system
F. All answers are correct

The patient mistakenly took an excess dose of thyroxine. What changes in the secretion of thyroliberin and thyrotropin will this lead to?

A. The secretion of hormones will increase
A. There will be no change in secretion
C. Secretion of thyroliberin will increase, thyrotropin will decrease
D. Secretion of thyrotropin will increase, and thyroliberin will decrease
F. Hormone secretion will decrease

4. Summary.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
2. Lunyova H.G. Clinical biochemistry. – Magnolia, 2021. – 400 p.
3. Human biochemistry: a textbook / Ya.I. Gonskyi, T.P. Maksymchuk; under the editorship Ya.I. Gonsky – Ternopil: TDMU, 2019. – 732 p.
4. William Marshall, Martha Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432
5. Medical Biochemistry/ Baynes J., Dominiczak M.. - Saunders, Elsevier, 2018. - 712 p.
6. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. - Philadelphia: Wolters Kluwer, 2017. - 560 p.

Auxiliary

1. Biological chemistry: textbook / O.Ya. Sklyarov, N.V. Apron, T.I. Bondarchuk. – Ternopil: TDMU, 2020. – 706 p.
2. Functional biochemistry/ edited by N. O. Sibirnoi. - LNU, 2018. - 644 p.
3. Popova L. Biochemistry / Popova L., Polikarpova A. – Kharkiv: KNMU, 2012. - 540 p.
4. Harper's Illustrated Biochemistry / VW Rodwell, DA Bender, KM Botham et al. - McGraw Hill Education, 2015. - 817 p.
5. Molecular Cell Biology / H. Lodish et al. - WH Freeman and Company, N. York. - 2016. - 1170 p.
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7. Clinical biochemistry: teaching. manual / edited by O.P. Tymoshenko. - K.: VD "Professional", 2005. - 288 p.
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9. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
10. Storchylo OV (2019) Mechanisms of radioprotective and radiocorrective effects of dietary phytoadditive of milk thistle fruits. Environment&Health 2019, No. 1 (90). - P. 33-37.doi.org/10.32402/dovkil2019.01.033.
11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.
12. G.F. Stepanov, O.O. Mardashko, A.A. Kostina Epigenetic changes of enzyme proteins in animal tissues after ionizing radiation // Advances in biology and medicine No. 2(34). – 2019. – P.26-30.
13. Stepanov G.F., Kostina A.A., Mardashko O.O. Metabolism of amino acids in the offspring of irradiated animals // Advances in biology and medicine. - No. 1(29). - 2017. - P. 26-32. 15. Mardashko O.O., Stepanov G.F., Kostina A.A. Hematological indicators in the dynamics of extreme injuries / Actual problems of transport medicine. - No. 3 (49). - 2017 - p. 109-114.

Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files
2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 7

Topic: Clinical biochemistry of vitamins.

Goal: Study of the mechanism of action and biological role of this group of vitamins. Show the possibility of using them in practical medicine. Studybiochemical bases of vitamin interventions in correcting the functioning of the methionine cycle
To teach students the quantitative determination of vitamin C in plant objects
To teach students to carry out qualitative determination of vitamins B1, B2, B6, RR.
Study of coenzyme forms of vitamins and their role in the catalytic activity of enzymes.
Basic concepts: *vitamins, coenzymes, prosthetic group*
Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
–what vitamins are, their biological role for the body
–distribution and daily requirement of water-soluble vitamins.
–peculiarities of absorption, transportation and chemical modifications of water-soluble vitamins in the human body.
–chemical composition and structure of vitamins;
–Symptoms and consequences of hypovitaminosis due to water-soluble vitamins.

The student should be able to:
–to determine the amount of vitamin C in a plant object.
–to interpret the biochemical bases of vitamin interventions in correcting the functioning of the methionine cycle.
–to explain the experimental contradictions of the use of vitamin preparations.

Questions to check basic knowledge on the topic of the lesson:
– Coenzyme function of vitamins
– What are the groups of coenzymes?
– Differences of coenzymes from prosthetic groups
– The role of coenzymes in catalysis
– The structure of the most common coenzymes
–Causes of hypovitaminosis B1, B2, B6, PP.
– Symptoms of hypovitaminosis B1, B2, B6, PP and their consequences for the body.

– Which water-soluble vitamins are coenzymes?
– Sources of vitamin C, daily requirement. What does vitamin C cause?
– Nucleotide coenzymes.
– Coenzymes-phosphorus esters of vitamins.

3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «*Qualitative reactions to vitamins B1, B2, B6, PP". Recommendations for performing tasks.*

A. Qualitative determination of thiamine

The principle of the method: during oxidation, thiamine turns into thiochrome, which has the ability to fluoresce blue in ultraviolet light.

Work progress: 1. Oxidation of thiamine to thiochrome:

Pour 0.5 ml of 5% thiamine solution into the test tube, then 1.0 ml of 5% ferric cyanide and 2.0 ml of 10% NaOH solution. Mix thoroughly and leave for 10 minutes.

2. Extraction of thiochrome:

After 10 minutes, 1.0 ml of isobutyl alcohol is added to the test tube, shaken and allowed to settle for 5 minutes.

3. Registration of indicators and conclusion:

The test tube is brought to the source of ultraviolet light. A solution of thiochrome in isobutyl alcohol fluoresces blue.

B. Qualitative determination of riboflavin

Principle of the method:

In ultraviolet light, riboflavin is able to fluoresce in a yellow-green color. When it is reduced with sodium hyposulfite, it loses this property.

The main stages of work performance.

1. Preparation of material for research:

Take 2 test tubes and label them "experiment" and "control". Pour 1.0 ml of 0.02% riboflavin solution into both test tubes.

2. Restoration of riboflavin:

A few crystals of sodium hyposulfite are added to the test tube marked "experiment". The solution turns from bright yellow to pale yellow.

3. Comparative fluorometry:

Both test tubes are raised to the source of ultraviolet light. Reconstituted riboflavin in a test tube does not fluoresce under ultraviolet light.

B. Qualitative determination of pyridoxine

Principle of the method:

If iron chloride is added to the pyridoxine solution, a red color of the complex salt appears, similar to red iron phenolate.

The main stages of work performance.

1. Preparation of material for research:

Pour 0.5 ml of 5% pyridoxine solution into the test tube.

2. Carrying out the reaction:

Pour 0.5 ml of 5% ferric chloride solution into the test tube and shake it. The mixture turns red.

G. Qualitative determination of vitamin RR

Principle of the method:

Nicotinic acid, when heated with a solution of copper acetic acid, forms a blue soluble precipitate of the copper salt of nicotinic acid.

The main stages of work performance.

1. Preparation of material for research:

Pour 1.0 ml of 1% nicotinic acid solution into the test tube.

2. Formation of the copper salt of nicotinic acid:

Add 1.0 ml of 5% copper acetic acid solution to the nicotinic acid solution. They stir. They heat up. A poorly soluble blue precipitate of the copper salt of nicotinic acid is formed.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.2. Demonstration and practical work "Quantitative determination of vitamin C in products according to the Tillmans method."

Recommendations for performing tasks.

Principle of the method: Determination of the content of vitamin C (ascorbic acid) is based on its reaction with 2,6-dichlorophenolindophenol. Using the change in color, based on the amount of the reagent spent on the oxidation of vitamin C, it is possible to determine its amount in the object under study.

Progress:

1. Preparation of material for research.

Take 1.0 g of rose hips or needles, grind it in a porcelain mortar, then add 10.0 ml of 2% hydrochloric acid. Quickly filter the hood to a dry flask.

2. Determination of content by titration.

Measure 3.0 ml of the filtrate into a conical flask and titrate with a 0.001 N solution of the sodium salt of 2,6-dichlorophenolindophenol to a pale pink color that does not disappear within 30 seconds.

The calculation is carried out according to the following formula:

$$C = \text{, where} \frac{М \cdot 0{,}088 \cdot 10}{А \cdot Б}$$

C is the concentration of vitamin C in the solution;

M is the amount of 2,6-dichlorophenolindophenol used for titration;

0.088 – the amount of vitamin C that binds 1 ml of 2,6-dichlorophenolindophenol;

10 – the number of hoods;

A is the amount of extract taken for titration;

B is the amount of researched material in

Conclusion: with the help of the described method, it is possible to determine the content of vitamin C in plant objects.

Requirements for work results.

Enter the obtained data into the workbook.

Make medical and biological conclusions.

3.3 Demonstration and practical work "*Qualitative reactions to fat-soluble vitamins A, D, E, K (Vikasol)*".

Recommendations for performing tasks.

A. Qualitative determination of vitamin A

Principle of the method: If chloroform and concentrated sulfuric acid are added to fish oil containing vitamin A, a purple ring forms at the interface between the two liquids.

The main stages of work performance.

1. Preparation of the hood:

2 drops of fish oil are dripped into the test tube, and then 5 drops of chloroform. They shake

2. Formation of a colored complex:

Add 0.5 ml of concentrated sulfuric acid to the obtained extract. Mix carefully. A purple ring appears at the interface between the two liquids, which then turns brown. The appearance of such a ring indicates that the solution contains vitamin A.

B. Qualitative determination of vitamin D

Principle of the method: When vitamin D interacts with hydrochloric acid aniline, a red color is observed.

The main stages of work performance.

1. Preparation of the reaction mixture:

Pour 0.5 ml of fish oil into a dry test tube, then add 1.0 ml of aniline hydrochloric acid solution.

2. Boiling:

The contents of the test tube are heated to boiling with constant stirring and boiled for 30 seconds. The yellow emulsion first acquires a dirty-green, and then a brown-red color. This indicates that the solution contains vitamin D.

B. Qualitative determination of vitamin E

Principle of the method: When an alcoholic solution of tocopherol reacts with concentrated nitric acid, the reaction mixture turns red.

The main stages of work performance.

Pour 0.5 ml of an alcoholic tocopherol solution into a dry test tube and add 1.0 ml of concentrated nitric acid. As a result of the reaction, a product of quinoid nature is formed, which gives a red color. This color indicates the presence of vitamin E in the solution.

D. Qualitative determination of vitamin K

Principle of the method: If cysteine and NaOH are added to a solution containing vitamin K, the solution will acquire a lemon-yellow color.

The main stages of work performance.

Pour 0.5 ml of Vikasol into the test tube, then add 0.5 ml of cysteine and one drop of 10% NaOH solution.

In the presence of cysteine, the Vikasol solution in an alkaline environment acquires a lemon-yellow color.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Control materials for the final stage of the lesson.

Questions to check the final level of knowledge:

1. Distribution and daily requirement of water-soluble vitamins.
2. Features of absorption, transportation and chemical modifications of water-soluble vitamins in the human body.

3. Biochemical bases of vitamin interventions in correcting the functioning of the methionine cycle.
4. Experimental contradictions in the use of vitamin preparations.
5. Distribution and daily need of fat-soluble vitamins.
6. Features of absorption, transportation and chemical modifications of fat-soluble vitamins in the human body.
7. Violation of the balance of vitamins in the body
8. Pathology of vitamin metabolism

Test tasks

1The doctor recommends the patient to take Vikasol under conditions of increased risk of bleeding. What vitamin is this drug an analogue of?

A *Vitamin K
B Vitamin A
C Vitamin B5
D Vitamin B12
E Vitamin B6

2. Administration of dicoumarol into the body causes a sharp decrease in blood clotting factors. Dicoumarol is an antivitamin of which vitamin?

A *Vitamin K
B Vitamin C
C Vitamin B2
D Vitamin E
E Vitamin R

3. The patient suffers from thrombophlebitis. Which of the vitamins that enhances the synthesis of blood coagulation factors can provoke an exacerbation of this disease?

A * vitamin K
B vitamin E
C vitamin B2
D vitamin D
E vitamin B1

1. In the large intestine, microorganisms synthesize vitamins that participate in biochemical processes of the body. What vitamins are mainly synthesized by microflora?

A *K, B12
B A, S
C E, RR
D B1, B2
E B6, E

2. A patient with chronic hepatitis has bleeding gums, hemorrhages in the skin even with a minor injury. These manifestations are most likely associated with a violation of the metabolism of which vitamin?

A *K
B D
C IS
D RR
E IN

3. Vitamin D is necessary for the formation of the bone system of the fetus during

intrauterine development. This vitamin is a derivative of which chemical compound?

A Cholesterol;
B Glycerol;
C Sphingosine;
D Inositol;
E Ethanol.

4. Some vitamins ensure the stability of biological membranes. Name one of the vitamins that has this effect.

A * tocopherol
B naphthoquinone
C cholecalciferol
D pantothenic acid
E riboflavin

5. Vitamin A quickly oxidizes in the air, which leads to the loss of biological activity. Which component of food products mainly prevents oxidation of the vitamin?

A *tocopherol
B nicotinic acid
C Table salt
D White
E Fat

6. Deficiency of which vitamin will most likely cause activation of lipid peroxidation processes?

A *Vitamin E
B Vitamin D
C Vitamin K
D Vitamin B12
E Vitamin B6

7. An elderly woman complains of impaired vision at dusk. Which of the listed vitamins should be prescribed in this case?

A *AND
B WITH
C IS
D D
E RR

8. The patient was hospitalized with intestinal bleeding. What drug should be included in the treatment regimen?

A Vikasol
B Sulfanilamide
C Cocarboxylase
D Aspirin
E Riboflavin

9. The state of the patient's antioxidant system was assessed based on the determination of the content of one of the endogenous antioxidants. Which one exactly?

A *Alpha-tocopherol
B Trivalent Ferum
C Ornithine

D Hydrogen peroxide
E Cholecalciferol

10. The ophthalmologist found that the patient had an increase in the time it took for the eye to get used to the dark. The lack of which vitamin can be the cause of such a symptom?
A * vitamin A
B vitamin C
C vitamin K
D vitamin B1
E vitamin B6

11. 20 minutes after the skin cut, the woman noticed that the wound did not stop bleeding. Deficiency of which vitamin causes this condition?
A * vitamin K;
B vitamin A;
C vitamin D;
D vitamin E;
E vitamin B12.

12. A woman contacted a pediatrician about the ill health of her 8-month-old child: sweating, increased size of the relative, delay in teething. Which drug should be prescribed first?
A *Cholecalciferol;
B Cyanocobalamin;
C Calcium gluconate;
D Thiamine bromide;
E Calcium pangamate

13. The child did not receive vitamin D in a timely manner. After a while, everyone appeared
symptoms of rickets. A decrease in the activity of which blood enzyme is observed in this case?
A *Alkaline phosphatase;
B Acid phosphatase;
C Alpha amylases;
D Choline esterase;
E Creatine kinases.

14. During the examination of a one-year-old child, the doctor paid attention to the late eruption of teeth, their incorrect location. The lack of which vitamin can cause such a condition?
A *Vitamin A;
B Vitamin C;
C Vitamin E;
D Vitamin D;
E vitamin B2.

15. During the examination of the patient's oral cavity, the dentist determined dryness mucous membrane, numerous erosions. The lack of which vitamin caused these phenomena?
A *Vitamin A;
B Vitamin K;
C Vitamin P;
D Vitamin H;
E Vitamin PP.

19. In the last month of pregnancy, the doctor recommends that women take Vikasol according to the scheme. Which vitamin is it an analogue of?

A *Vitamin K
B Vitamin B12
C Vitamin B5
D Vitamin B6
E Vitamin A

20. Vitamins are the amines of life. What vitamin in the body is formed from provitamin beta-carotene?

A *A1
B B1
C B12
D WITH
E D

21. With long-term use of the sulfonamide drug, the patient's microbial flora in the intestine was disturbed. During the examination in the polyclinic, small point hemorrhages were found on the skin. Their reason is most likely:

A *Deficiency of vitamin K in the body
B Lack of vitamin C in the body
C Enterocolitis (inflammation of the mucous membrane of the small and large intestine)
D Liver disease
E Hereditary defect of blood coagulation factors

22. A patient with cirrhosis of the liver is noted to have impaired vision at dusk. Which of the following is the most likely cause?

A * Violation of absorption of vitamin A in the intestines
B Insufficient supply of vitamin A with food products
C Excessive intake of vitamin A with food products
D Violation of trans-retinal conversion into cis-retinal
E Violation of rhodopsin synthesis

23.Insufficiency of which vitamin leads to the development of hypercoagulation syndrome?

A *S
In B12
S A
D B6
E D2

24. The doctor diagnosed the patient with scurvy. This disease was a manifestation of what pathological condition associated with improper nutrition?

A * Nutritional imbalance
In Malnutrition
C Overeating
D Stomach ulcer
E Helminthosis

25. The mechanism of antimicrobial action of sulfonamide drugs is based on their structural similarity with:

A * Para-aminobenzoic acid
In Glutamic acid
With folic acid

D Nucleic acid
E Antibiotics

26. In the process of biotransformation of the anesthetic drug novocaine, para-aminobenzoic acid is formed. Therefore, with the combined use of novocaine and sulfonamides, the following is most likely to occur:
A *Decreasing the antimicrobial effect of sulfonamides
In Strengthening the antimicrobial action of sulfonamides
C Reduction of the anesthetic effect of novocaine
D Strengthening of the anesthetic effect of novocaine
E Decrease in the pharmacological activity of both drugs

27. Lack and absence of ascorbic acid in food cause various diseases. Name the main one of them.
A Scurvy
B Rickets
C Beri-Beri
D Pellagra
E Gout

28. Complex proteins in the human body perform various functions. Which glycoprotein contained in raw egg white disrupts the absorption of vitamin H and can lead to acute biotin deficiency?
A Avidin
B Fibrinogen
C Hemoglobin
D Interferon
E Caseinogen

29. The formation of collagen in the human body requires the hydroxylation of proline, which occurs with the participation of prolyl hydroxylase. What substance activates this process:
A Ascorbic acid
B OVER
C FAD
D Biotin
E Pyridoxine phosphate

30. The patient was diagnosed with pernicious anemia. Indicate which vitamin deficiency this may be due to.
A B12
B B3
C B2
D WITH
E IS

31. Vitamins, when used simultaneously, can enhance each other's effects. Which of the vitamins potentiates the antihyaluronidase activity of vitamin P?
A *Vitamin C
B Vitamin B1
C Vitamin D
D Vitamin A
E Vitamin B2

32. Some conditions are necessary for the assimilation of vitamins by organisms. For the absorption of which vitamin, the presence of Castle's factor (a glycoprotein produced by the lining cells of the gastric mucosa) is necessary?

A *Vitamin B12
B Vitamin C
C Vitamin B5
D Vitamin E
E Vitamin B6

33. A patient with angina was prescribed a sulfonamide drug, the antimicrobial action of which is due to a violation of the synthesis of folic acid. With which substance do sulfonamides compete for the active center of the enzyme?

A * Para-aminobenzoic acid
B Ubiquinone
C Succinate
D Glutamic acid
E Citric acid

34. Bacteriostatic sulfonamides suppress the synthesis of nucleotides, nucleic acids and proteins in microbial cells, but in pharmacological doses they do not affect the synthesis of these substances in the human body. This difference is due to the fact that eukaryotic cells:

A *Folic acid is not synthesized
B Para-aminobenzoic acid is not synthesized
C Nucleotides are not synthesized
D Impermeable to sulfonamides
E Very quickly inactivate sulfonamides

35. Antimicrobial sulfonamide drugs are metabolized in the body by acetylation. At the same time, their bacteriostatic action:

A *Lost
B is growing
C Does not change
D It changes to toxic in the human body
E Intensifies

36. The patient has megaloblastic anemia (Addison-Birmer's disease). It is advisable to treat with vitamin B12 in combination with the following drug:

A *Folic acid
B Lipoic acid
C Ascorbic acid
D Nicotinic acid
E Pangamic acid

37. The patient consumes several raw eggs daily, which contain the anti-vitamin of biotin - avidin. What disorders in lipid metabolism can occur in this case?

A *Biosynthesis of fatty acids
B Cholesterol biosynthesis
C Oxidation of glycerol
D Absorption of lipids
E Transport of lipids in the blood

38. Bacterial cells use folic acid to synthesize a certain vitamin, the derivatives of which are coenzymes of a number of important bacterial enzymes. Sulfanilamide drugs block the formation of these coenzymes, as they are antivitamins:

A * Para-aminobenzoic acid
B Pyridoxine
C Nicotinic acid
D Riboflavin
E to Holin

39. In a patient with complaints of pain in the stomach, a decrease in the secretory function of the stomach, which was accompanied by anemia, was established during the biochemical examination. Indicate which of the vitamins has an anti-anemic effect:

A * Cobalamin
B Tocopherol
C Retinol
D Thiamine
E Nicotinic acid

40. Some vitamins inhibit the formation of lipid peroxides in cells membranes and ensure the stability of biological membranes. Specify one of vitamins that have this effect.

A * ascorbic acid
B naphthoquinone
C cholecalciferol
D pantothenic acid
E folacin

41. In a patient with frequent bleeding in the internal organs and mucous membranes in the composition proline and lysine were found in collagen fibers. Lack of which vitamin leads to violation of their hydroxylation.

A *Vitamin C
B Vitamin E
C Vitamin K
D Vitamin A
E Vitamin B1

42. The parents of a 10-year-old boy turned to the doctor with a complaint about stunted growth. During the examination, the doctor found changes in the mucous membranes and suspicion of malignant anemia. He suggested that this disease is associated with vitamin deficiency. Indicate which vitamin deficiency can lead to the development of such a condition?

A * Folic acid
B Nicotinic acid
C Orotic acid
D to Holin
E Arachidonic acid

43. The result of a violation of which biochemical reaction is the appearance of hemorrhages at scurvy disease.

A *hydroxylation of proline
B glucose phosphorylation

C dehydrogenation of isocitric acid
D isomerization of phosphodioxyacetone
E deamination of glutamic acid

44. A tuberculosis patient was treated with isoniazid (tuberculostatic drug). Later, he developed signs of dermatitis, diarrhea, and damage to the central nervous system. Which vitamin should be prescribed for this patient?

A *vitamin RR
B vitamin C
C lipoic acid
D vitamin A
E vitamin B1.

45. In medical practice, sulfonamide drugs are used, which are antimetabolites of paraaminobenzoic acid, which is synthesized by microorganisms. Indicate the synthesis of which vitamin is blocked.

A * Folic acid
B Pangamic acid
C Orotic acid
D Nicotinic acid
E Ascorbic acid

4. Summary.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
2. Lunyova H.G. Clinical biochemistry. – Magnolia, 2021. – 400 p.
3. Human biochemistry: a textbook / Ya.I. Gonskyi, T.P. Maksymchuk; under the editorship Ya.I. Gonsky – Ternopil: TDMU, 2019. – 732 p.
4. William Marshall, Martha Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432
5. Medical Biochemistry/ Baynes J., Dominiczak M.. - Saunders, Elsevier, 2018. - 712 p.
6. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. - Philadelphia: Wolters Kluwer, 2017. - 560 p.

Auxiliary

1. Biological chemistry: textbook / O.Ya. Sklyarov, N.V. Apron, T.I. Bondarchuk. – Ternopil: TDMU, 2020. – 706 p.
2. Functional biochemistry/ edited by N. O. Sibirnoi. - LNU, 2018. - 644 p.
3. Popova L. Biochemistry / Popova L., Polikarpova A. – Kharkiv: KNMU, 2012. - 540 p.
4. Harper's Illustrated Biochemistry / VW Rodwell, DA Bender, KM Botham et al. - McGraw Hill Education, 2015. - 817 p.
5. Molecular Cell Biology / H. Lodish et al. - WH Freeman and Company, N. York. - 2016. - 1170 p.
6. Clinical biochemistry (textbook) / edited by Prof. O. Ya. Sklyarova - K.: Medicine, 2006. - 432 p.
7. Clinical biochemistry: teaching. manual / edited by O.P. Tymoshenko. - K.: VD "Professional", 2005. - 288 p.

8. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
9. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
10. Storchylo OV (2019) Mechanisms of radioprotective and radiocorrective effects of dietary phytoadditive of milk thistle fruits. Environment&Health 2019, No. 1 (90). - P. 33-37.doi.org/10.32402/dovkil2019.01.033.
11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.
12. G.F. Stepanov, O.O. Mardashko, A.A. Kostina Epigenetic changes of enzyme proteins in animal tissues after ionizing radiation // Advances in biology and medicine No. 2(34). – 2019. – P.26-30.
13. Stepanov G.F., Kostina A.A., Mardashko O.O. Metabolism of amino acids in the offspring of irradiated animals // Advances in biology and medicine. - No. 1(29). - 2017. - P. 26-32. 15. Mardashko O.O., Stepanov G.F., Kostina A.A. Hematological indicators in the dynamics of extreme injuries / Actual problems of transport medicine. - No. 3 (49). - 2017 - p. 109-114.

Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files
2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 8

Topic: <u>Hormonal regulation of water-salt and phosphorus-calcium metabolism. Violation of water-salt exchange.</u>

Goal: To study and be able to characterizepathochemistry of water-electrolyte exchange and the basis of braids.

Basic concepts:hormones, the mechanism of action of hormones depends on their nature, insulin, regulation. Based's disease.

Equipment: Laboratory of the department

Plan:

1. Organizational measures (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:

- water balance and its regulation in normal and pathological conditions.
- biochemical mechanisms of phosphorus-calcium exchange regulation,
- disorders in pathology. biochemical characteristics of the pathogenesis of rickets.
- regulation of water-salt exchange.
- structure and functions of aldosterone, vasopressin, atrial natriuretic factor.
- renin-angiotensin-aldosterone system.
- the role of hormones in the regulation of calcium and phosphate metabolism (parathyroid hormone, calcitonin and calcitriol).
- structure, biosynthesis and mechanism of action of calcitriol

The student should be able to:

- be able to explainbiochemical mechanisms of renal hypertension, edema, xerostomia
- be able to explaindisturbance of electrolyte exchange
- be able to explainacidic - the main state in normal and pathological conditions

Questions to check basic knowledge on the topic of the lesson:

- a group of glycoproteins - tropic hormones of the pituitary gland (thyrotropin, gonadotropins).
- vasopressin and oxytocin: structure, biological functions. a pathology associated with a violation of vasopressin production.
- parathyroid hormones
- atrial sodium-uretic hormone
- renin-angiotensin system

3. Formation of professional skills:

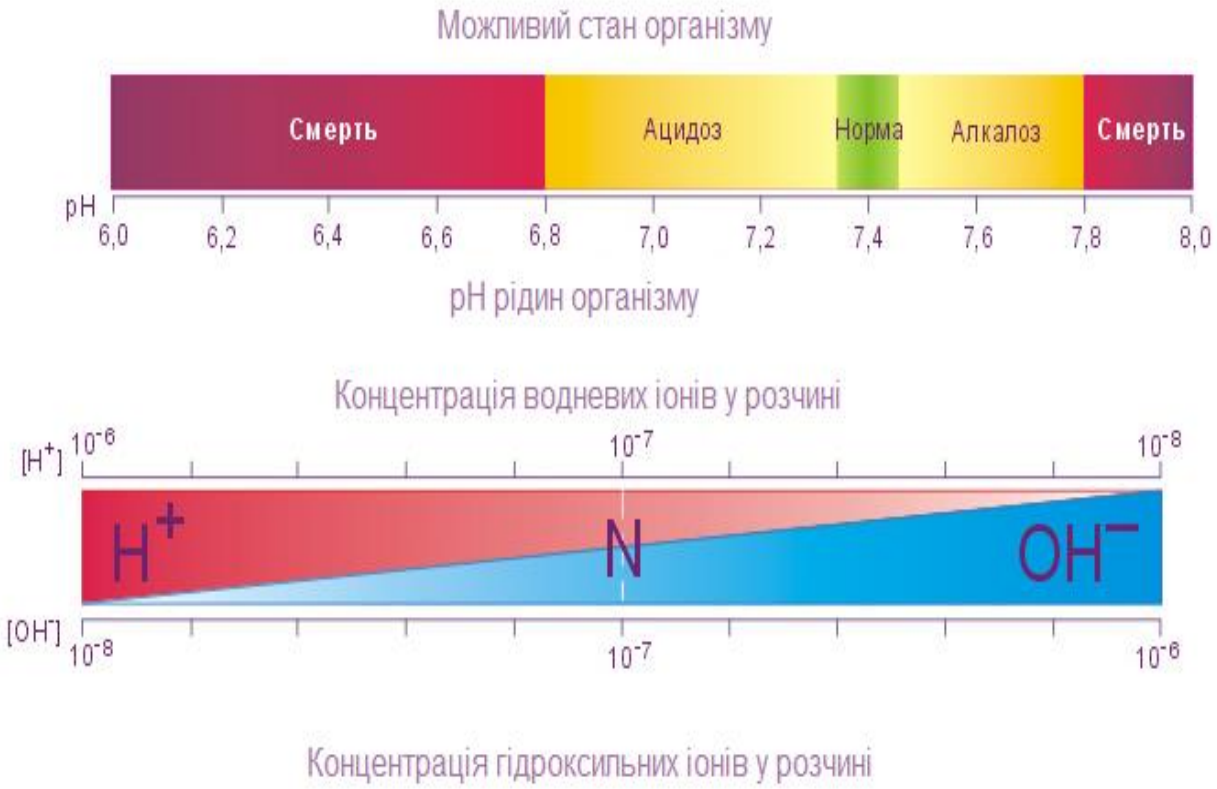
3.1 Demonstration and practical work:

Demonstration work "Graph-logic schemes".

Recommendations for completing tasks:

Scheme. Possible conditions caused by different ratios of the concentration values of hydrogen cations and hydroxyl anions in body fluids.

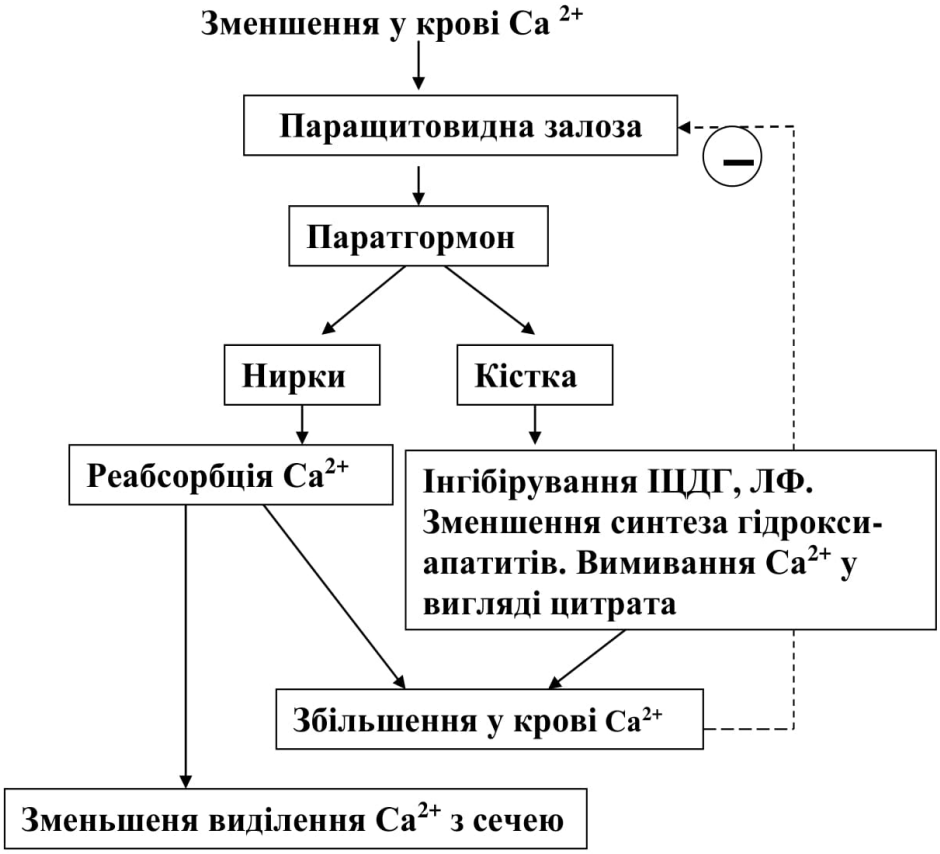
Notation: N is a neutral solution, the balance between the degree of acidity and the degree of alkalinity of the solution, the value of the concentration of hydrogen ions [H+] is equal to the value of the concentration of hydroxyl ions [OH–] = 10–7, or pH = pOH = 7.0.



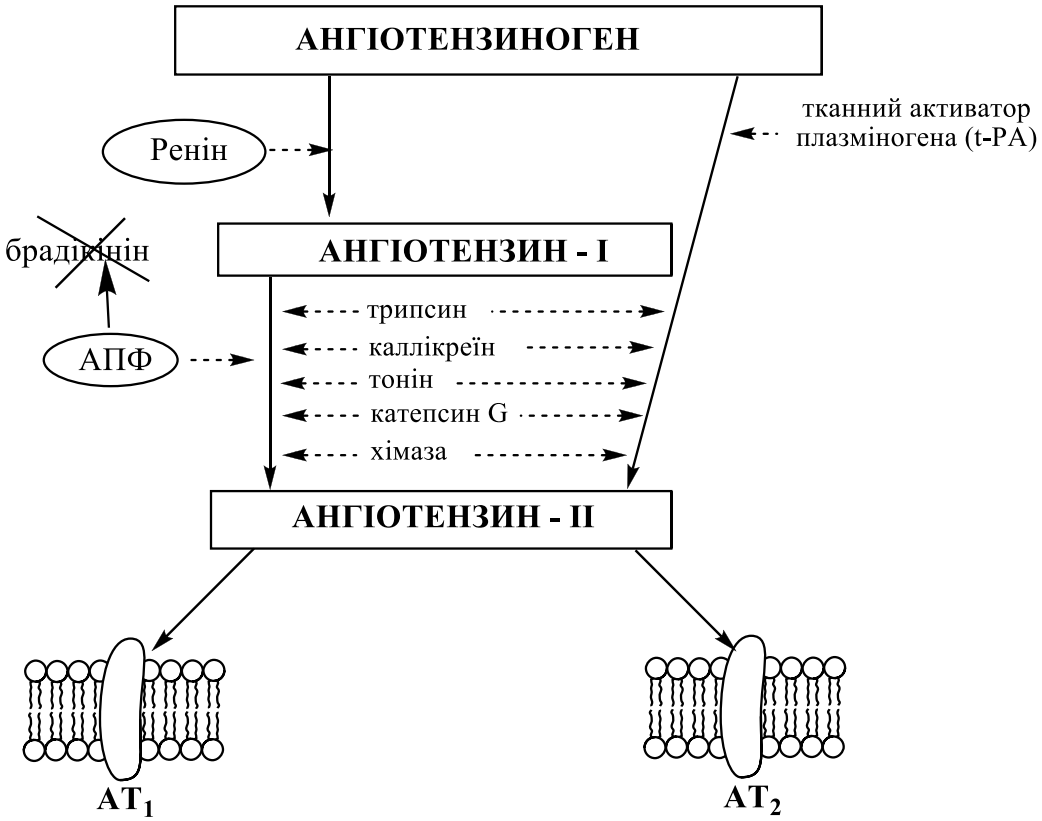
Спрямованість дії вазопресину

Рецептори	Локалізація дії	Механизм дії	Ефекти
V2	Нирки (дистал. частина нефрона)	Посилення реабсорбції H_2O	Антидиуретична дія
V2	Система зсідання крові	Підвищення вмісту у крові антигемофільного глобуліна А	Гемостатична дія
V1	Тромбоцити	Стимуляція агрегації і дегрануляції тромбоцитів	Стимуляція тромбоутворення
V1A	Артеріальні судини	Підвищення тонуса гладких м′язів судин	Вазопресорн дія
V1B	Передня доля гіпофіза	Стимуляція вивільнення кортикотропіна	Стимуляція вивільнення гідрокортизона

Дія паратгормона, його регуляція



РЕНІН-АНГІОТЕНЗИНОВА СИСТЕМА



Test tasks.

Arachidonic acid as an irreplaceable component of food is a precursor of biologically active substances. What compounds are synthesized from it?

A. Ethanolamine
V. Kholin
S. Norepinephrine
D. Prostaglandin E1
E. Triiodothyronine

A patient complained of constant thirst to the doctor. Hyperglycemia, polyuria, and increased content of 17-ketosteroids in urine were established. What disease is possible?

A. Steroid diabetes
B. Non-insulin-dependent diabetes
S. Myksedema
D. Glycogenosis of type I
E. Addison's disease

Hyperglycemia occurs in Itsenko-Cushing's disease. What process is stimulated in this case?

A. Glycolysis
B. Phosphorolysis of glycogen
S. Krebs cycle
D. Pentose phosphate pathway of glucose oxidation
E. Gluconeogenesis

What hormone stimulates the synthesis of corticosteroids?

A. Parathyroid hormone
B. Thyrotropin
S. Corticoliberin
D. Calcitonin
E. Corticosterone

The patient was diagnosed with hypernatremia, hypervolemia, and hypokalemia. What is the possible cause of this condition?

A. Hyperaldosteronism
B. Hypoaldosteronism
S. Addison's disease
D. Based's disease
E. Diabetes

Taking oral contraceptives containing sex hormones inhibits the secretion of pituitary hormones. The secretion of which of the following hormones is inhibited at the same time?

A. Vasopressin
B. Somatotropin
S. Oxytocin
D. Follitropin
E. Corticotropin

Testosterone and its analogues increase the mass of skeletal muscles, which allows them to be used for the treatment of dystrophies. This action of the hormone is determined by the interaction with which cell substrate?

A. Membrane receptors
B. Ribosomes
S. Nuclear receptors
D. Transcription activator proteins
E. Chromatin

The patient, who has been taking glucocorticoids for a long time, had an exacerbation of the disease, a decrease in blood pressure, and weakness as a result of the withdrawal of the drug. What explains this?

A. Occurrence of adrenal insufficiency

B. Cumulation

C. Addiction to the drug

D. Hyperproduction of ACTH

E. Sensitization

The patient has been taking glucocorticoids for a long time. After abrupt discontinuation of the drug, he complains of myalgia, increased fatigue, emotional instability, and headache. Glucocorticoid withdrawal syndrome developed. What drugs are prescribed to correct this condition?

A. AKTG

B. Glucocorticoids

S. Mineralocorticoids

D. Adrenaline

E. Corticosteroids

A patient with Itsenko-Cushing syndrome has an increased cortisol content in the blood. Which endocrine gland pathology is this related to?

A. The cortical part of the adrenal glands

B. The cerebral part of the adrenal glands

S. Pancreas

D. Hypophysis

E. Thyroid gland

A man who has been in a state of stress for a long time has a significantly increased content of 17-ketosteroids in his urine, which primarily indicates increased secretion:

A. Estradiol

B. Aldosterone

S. Adrenaline

D. Cortisol

E. Progesterone

The woman showed signs of virilism (hair growth on the body, irregular menstrual cycle). Hyperproduction of which hormone can cause such a condition?

A. Estriola

B. Testosterone

S. Relaxin

D. Oxytocin

E. Prolactin

The woman has a "moon-shaped" face, obesity of the upper part of the body, stretch marks on the front abdominal wall, hirsutism. The urine has an elevated level of 17-oxyketosteroids. Such manifestations are characteristic of:

A. Pheochromocytomas

B. Kon's syndrome

S. Itsenko-Cushing syndrome

D. Primary hypoaldosteronism

E. Secondary hyperaldosteronism

A patient suffering from Itsenko-Cushing's disease was consulted about excess body weight. The survey revealed that the energy value of the consumed food is 1700-1900 kcal/day. What is the leading cause of obesity in this case?

A. Hypodynamia

B. Insufficiency of insulin

C. Excess insulin

D. Insufficiency of glucocorticoids

E. An excess of glucocorticoids

Glucocorticoids and nonsteroidal anti-inflammatory drugs are widely used in practical medicine. One of the negative consequences of long-term glucocorticoid therapy is:

A. Polyuria
B. Hyponatremia
S. Hyperkalemia
D. Osteoporosis
E. Hypotension

4. Summary.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
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5. Medical Biochemistry/ Baynes J., Dominiczak M.. - Saunders, Elsevier, 2018. - 712 p.
6. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. - Philadelphia: Wolters Kluwer, 2017. - 560 p.

Auxiliary

1. Biological chemistry: textbook / O.Ya. Sklyarov, N.V. Apron, T.I. Bondarchuk. – Ternopil: TDMU, 2020. – 706 p.
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6. Clinical biochemistry (textbook) / edited by Prof. O. Ya. Sklyarova - K.: Medicine, 2006. - 432 p.
7. Clinical biochemistry: teaching. manual / edited by O.P. Tymoshenko. - K.: VD "Professional", 2005. - 288 p.
8. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
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10. Storchylo OV (2019) Mechanisms of radioprotective and radiocorrective effects of dietary phytoadditive of milk thistle fruits. Environment&Health 2019, No. 1 (90). - P. 33-37.doi.org/10.32402/dovkil2019.01.033.
11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.

12. G.F. Stepanov, O.O. Mardashko, A.A. Kostina Epigenetic changes of enzyme proteins in animal tissues after ionizing radiation // Advances in biology and medicine No. 2(34). – 2019. – P.26-30.
13. Stepanov G.F., Kostina A.A., Mardashko O.O. Metabolism of amino acids in the offspring of irradiated animals // Advances in biology and medicine. - No. 1(29). - 2017. - P. 26-32. 15. Mardashko O.O., Stepanov G.F., Kostina A.A. Hematological indicators in the dynamics of extreme injuries / Actual problems of transport medicine. - No. 3 (49). - 2017 - p. 109-114.

Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files
2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 9

Topic:Clinical biochemistry of blood. Biochemistry of the system of hemostasis and fibrinolysis.

Goal: to study the mechanisms of blood coagulation and anticoagulation, disorders in the functioning of these processes. evaluate the molecular structure of coagulants and anticoagulants, the mechanisms of hemophilia of various genesis

Basic concepts:*blood coagulation system, external coagulation pathway, internal coagulation pathway, anticoagulation system of blood, fibrinolytic system of blood, anticoagulants, hemophilia, CVD syndrome*

Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:

– molecular mechanisms of blood coagulation and anticoagulation systems, the role of the liver in this process.

– molecular structure of coagulants and anticoagulants, mechanisms of hemophilia of various genesis.

The student should be able to:

– determine biochemical indicators of the state of the coagulation system and give them a medical and biological assessment.

Questions to check basic knowledge on the topic of the lesson:

1. Composition and properties of erythrocytes and platelets:
2. Chemical composition of blood plasma;
3. Physico-chemical properties of proteins;
4. Glycosaminoglycans. Their structure and functions;

5. Blood plasma enzymes.

3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «Determination of the amount of fibrinogen in blood plasma".

Recommendations for performing tasks.

Progress. 0.1 ml of 5% calcium chloride solution is added to 1 ml of clear plasma. Fibrin is wound on a stick, dried with filter paper and weighed. The weight of fibrin is multiplied by a factor of 22.2 and expressed in mg%. Normally, the amount of fibrinogen in blood plasma is 200-400 mg%.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.2 Demonstration and practical work "Determination of prothrombin time".

Recommendations for performing tasks.

The principle of the method. With excess thromboplastin and optimal calcium content, the time of clot formation in plasma depends on the activity of II, VII, IX, X factors.

Progress. Add 0.1 ml of 1% thrombolastin solution to 0.1 ml of plasma, incubate for 1 minute and add 0.1 ml of 0.025 M calcium chloride solution, turn on the stopwatch until a dense clot forms. A dense clot is formed. Time is expressed in seconds.

$$\text{PAK} = \frac{\text{A}}{\text{B}} x100\%$$

A - the time of a healthy person (20 seconds)

In - the time of a sick person

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.3 Demonstration and practical work "Definition of plasma recalcification".

Recommendations for performing tasks.

Progress. Blood is collected in a centrifuge tube with 1.34% sodium oxalate in a ratio of 9:1 and centrifuged for 10 minutes. at 1500 rpm. 0.2 ml of 0.025 M calcium chloride and 0.1 ml of physiological solution are mixed in a test tube and placed in a water bath. Then add 0.1 ml of plasma and start the stopwatch. Clotting is complete if blood does not flow when the tube is inverted. Normally, the recalcification time is 60-120 seconds. when fibrin threads appear.

Medical and biological evaluation of the obtained results

Violations of coagulation hemostasis can be genetically determined and acquired. Plasma recalcification time increases in hemophilia A, Hagemann's defect, factor VII deficiency. Is prothrombin activity reduced in hemophilia B, factor VII deficiency? V, X. With hypofibrinogenemia, all coagulation tests are sharply increased. In case of enteropathy and damaged liver, hypovitaminosis of vitamin K, deficiency of factors I, II, IX, X, XI, XII is possible.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Questions to check the final level of knowledge:

1. What are the phases of blood coagulation?
2. Where are blood coagulation factors located and how are they affected?
3. How many blood clotting factors found in plasma and erythrocytes have been studied?
4. What is the process of autocatalysis on the example of activation of coagulation factors?

5. What factors of plasma and platelets take part in the 1st phase of blood coagulation?
6. What factors of plasma and platelets take part in the II phase of blood coagulation?
7. What factors of plasma and platelets take part in the III phase of blood coagulation?
8. The absence of which factors causes hemophilia A and which stages of coagulation are disrupted?
9. The absence of which factors causes hemophilia B and which stages of coagulation are disrupted?
10. Why is Vikasol administered to patients with bleeding?
11. What systems make up the anti-coagulation system?
12. What is the mechanism of action of heparin?
13. How is the liquid state of the blood in the vessels ensured?
14. What antivitamins are used to strengthen the anticoagulation system and their mechanism of action?
15. Medicines affecting fibrinolysis processes.

Test tasks.

A patient with thrombophlebitis is prescribed complex therapy, which affects various stages of thrombus formation. Which of the mentioned means helps restoration of vascular patency?

A. Neodicumarin
B. Fibrinolysin
C. Acetylsalicylic acid
D. Dipyridamole
E. Heparin

A patient suffering from a streptococcal infection developed hemorrhagic diathesis. What is the cause of increased bleeding?

A Increased fibrinolysis
Lack of vitamin A
C Increase in the amount of kallikrein in the blood plasma
D Increase in the amount of heparin in the blood plasma
E Lack of vitamin C

Heparin is used to prevent blood clotting. What class of complex proteins does it belong to?

A Glycoprotein
In Metalloprotein
C Hemoprotein
D Lipoprotein
E Phosphoprotein

A patient with a streptococcal infection had diffuse bleeding after tooth extraction, which is a consequence of:

A Activation of fibrinolysis
In Violation of the coagulation system
With hypovitaminosis of vitamin K
D Insufficiency of anticoagulants
E Violation of calcium metabolism

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

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Electronic information resources

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2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php

4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 10

Topic:Biochemical study of blood plasma proteins and residual nitrogen. Clinical value of biochemical blood analysis.

Goal: To study fractions of plasma and serum proteins, classification of enzymes and their value for differential diagnosis of pathology, proteins of the acute phase and the value of their determination in clinical diagnosis. Be able to determine the total protein in blood serum by the biuret method and explain the diagnostic value of quantitative determination of protein in blood serum.

Basic concepts:*albumins, globulins, fibrinogen, lipoproteins, residual nitrogen, blood buffer systems*

Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
–functions and composition of blood;
–components of residual blood nitrogen;
–structure and function of lipoproteins;
–the role of lipoproteins in the development of atherosclerosis;
– mechanisms of regulation of the acid-base state with the participation of individual organs and types of violations and mechanisms of compensation of the acid-base state.

The student should be able to:
– evaluate the main biochemical indicators of blood composition in healthy people and in a number of diseases;
– to quantitatively determine the total protein of the blood plasma, individual fractions of proteins and to know their biochemical characteristics and biological significance for the body.

Questions to check basic knowledge on the topic of the lesson:
1. Comparative characteristics of the chemical composition of plasma and blood serum in the norm.
2. Biochemical functions of blood proteins. Characteristics of the main fractions of blood plasma proteins (albumin, α-, β-, γ-globulins). The concept of hypo-, hyper-, para- and dysproteinemia. Dyslipoproteinemia.
3. Clinical and biochemical characteristics of proteins of the acute phase of inflammation.
4. Classification of blood plasma enzymes, their use in the diagnosis of diseases.
5. Blood buffer systems. Violation of acid-base balance: types of acidosis and alkalosis, mechanisms of their occurrence.
6. The main organic non-protein nitrogen-containing and nitrogen-free components of plasma, characteristics and significance of determination in pathology.

7. General ideas about the mineral composition of blood plasma in normal and pathological conditions.

3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «Quantitative determination of blood proteins by the biuret method".

Recommendations for performing tasks.

The principle of the method is that alkaline solutions of proteins and peptides, thanks to peptide bonds, become colored like biuret when a solution of copper sulfate is added.

Progress. To 0.1 ml of serum, add 8 ml of a 4.8% solution of lye, 3 ml of a 20% solution of copper sulfate. Centrifuge at 3000 rpm. 5 minutes. Colorimeter on FEK with a green light filter against the mixture in which the serum is replaced by water.

A red-violet color appears, the intensity of which is directly proportional to the amount of protein. Multiply the optical density by 12 to find a quantitative representation of the protein content (%).

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.2 Demonstration and practical work "Refractometric determination of protein in serum".

Recommendations for performing tasks.

The principle of the method consists in the protein's ability to increase the refractive index of light passing through the solution.

Progress. Place 2-3 drops of water between the prisms and install a zero shunt on the 1.322 section of the light refraction scale. Place 2-3 drops of serum instead of the eyepiece, move the handle of the eyepiece along the scale until the viewing scale aligns with the boundary between the dark and light parts of the field of vision. According to the table The flight determines the appropriate amount of protein.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.3 Demonstration and practical work "Fractionation of blood serum proteins by the method of salting out".

Recommendations for performing tasks.

The principle of the method is the ability of proteins to coagulate at different concentrations of salts, depending on the molecular weight of the proteins.

Progress. Add an equal volume of saturated ammonium sulfate solution to 3 ml of serum. A precipitate of globulins falls out. They filter. Ammonium sulfate is added to the filtrate until saturation. A precipitate of albumin falls out. The precipitate of albumins and globulins is dissolved in 4 ml of water, a biuret reaction is carried out and the content of globulins and albumins is determined.

Medical and biological evaluation of the obtained results

Hypoproteinemia can be caused by a lack of protein in the diet, a violation of the processes of digestion and absorption of proteins, a violation of protein synthesis (for example, when the liver is damaged), protein loss during acute and chronic bleeding, kidney damage.

Hyperproteinemia can be absolute - with an increase in the protein content in the blood plasma - for example, an increase in the number of γ-globulins in infectious diseases, the appearance of abnormal proteins in the blood in myeloma, in macroglobulinemia. Loss of water in the body (diarrhea, vomiting, extensive burns) can lead to an increase in plasma protein, that is, to relative hyperproteinemia.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.4. Demonstration and practical work «Determination of osmotic resistance of erythrocytes".

Recommendations for performing tasks.

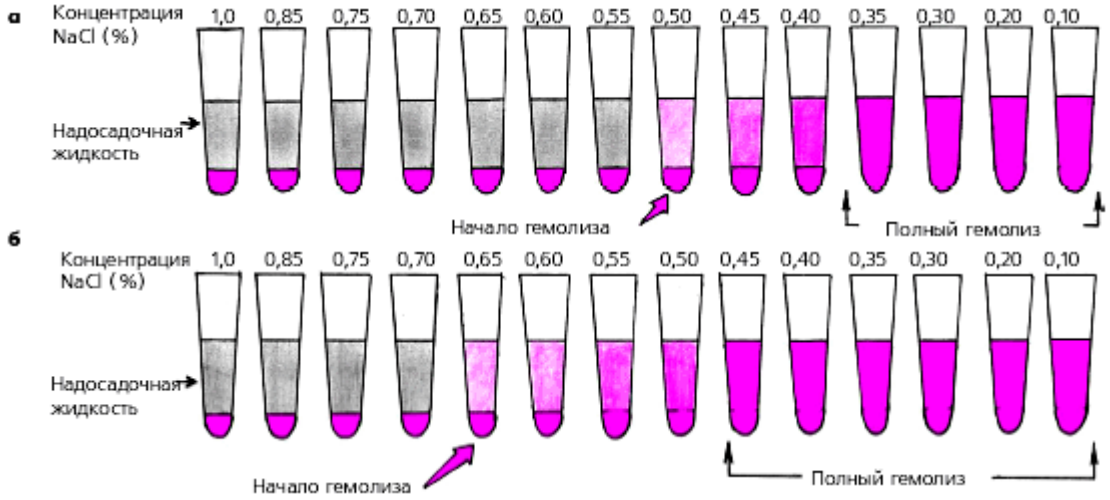
The principle of the method is based on the quantitative determination of the degree of hemolysis in hypotonic solutions of sodium chloride, in which swelling and hemolysis of erythrocytes are known to occur

Progress. Pre-prepared working solutions of sodium chloride of different concentrations: 1%; 0.85%; 0.75%; 0.70%; 0.65%; 0.60%; 0.55%: 0.50%); 0.45%; 0.40%; 0.35%; 0.30%; 0.20% and 0.10%. Working solutions of sodium chloride are poured into 14 centrifuge tubes (5.0 mol each).

Take 1.5 ml of venous blood in a sterile test tube with heparin, mix and add 0.02 ml of heparinized blood to each of 14 centrifuge tubes with sodium chloride working solutions. The tubes are left for 1 h at room temperature, and then centrifuged (5 min at 2000 rpm). The supernatant from each test tube is examined on a photoelectrocolorimeter. The supernatant liquid from the test tube containing 1% sodium chloride solution is used as a blank sample. Determine the percentage (degree) of hemolysis, assuming 100% hemolysis in a test tube with 0.1% sodium chloride solution.

Hemolysis can also be determined visually by the color of the supernatant. In the case of complete hemolysis of erythrocytes, intense red-lacquer staining of the supernatant liquid is noticeable, while the beginning of hemolysis (its minimum degree) is determined by a light pink color (when hemolysis is visually determined, the amount of working solution in the test tube should be less than 1.0 ml).

Normally, the beginning of hemolysis is noted at a concentration of 0.50–0.45%, and complete hemolysis — at a 0.40–0.35% sodium chloride solution.



Medical and biological evaluation of the obtained results

In some hemolytic anemias (congenital microspherocytic, autoimmune hemolytic, etc.), a decrease in osmotic resistance is observed: hemolysis begins at a concentration of sodium chloride solution of 0.55–0.70% and ends at a concentration of 0.40–0.45% (Fig. 7.17 , b).

An increase in the osmotic resistance of erythrocytes occurs in mechanical jaundice, thalassemia, and hemoglobinosis.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Control materials for the final stage of the lesson.

Questions to check the final level of knowledge:

1. List and explain the main functions of blood.
2. Chemical composition of blood plasma.
3. What is the difference between plasma and blood serum? Methods of obtaining them.
4. Specify the structure of the protein fractions of the blood and their role in the vital activity of the body.
5. Pathological conditions associated with quantitative and qualitative changes in blood plasma proteins.
6. Blood plasma enzymes. Diagnostic value of determination of blood plasma enzymes.
7. Non-protein organic blood compounds.
8. Nitrogen-containing compounds. Residual (rest-nitrogen) blood plasma. Its components.
9. Methods of determining the level of residual blood nitrogen.
10. Hyperazotemia. Types and causes of occurrence.
11. Nitrogen-free compounds.
12. Inorganic components of blood plasma.

Test tasks.

Plasma includes mineral salts. What physical and chemical properties of blood are due to their presence?

And osmotic pressure
In oncotic pressure
With an active blood reaction
D blood viscosity
E SHOE

The buffer systems of the blood support the constancy of its acid-alkaline balance. Which substances of one of the buffer systems have amphoteric properties?

And plasma proteins
In the bicarbonate system
C hemoglobin
D phosphate system
E electrolytes

Cyanides are strong poisons for the human body. Indicate which compound will be the best to connect them?

A Methemoglobin
B Carboxyhemoglobin
C Carbhemoglobin
D Oxyhemoglobin
E Hem

A diabetic patient has a hyperglycemic coma as a result of long-term elevated blood glucose. What is the most likely mechanism for the development of such a condition?

And * Ketonemia. A change in blood pH and, as a result, a decrease in the affinity of Hb to O2.
B Increased BBB to glucose.
Coma due to high glucose content in brain neurons
D Decrease in neurocirculation
E Acidosis. Methemoglobinemia due to a change in the valence of Fe under the influence of a high concentration of glucose and the formation of a stable compound Hb with O2.

Liver diseases (hepatitis, cirrhosis, tumor) lead to all the following disorders of protein metabolism except:

A * Hyper-alpha2-globulinemia
In hypoalbuminemia
With Hemorrhage
D Hyperaminoacidemia
E of Azotemia

A number of biochemical tests (samples) are used to diagnose liver diseases. Which of the following pathological conditions is most likely indicated by an increase in the concentration of alpha-fetoprotein in the blood plasma.

A * Liver cancer
In Cirrhosis of the liver
C Viral hepatitis
D Cholestasis
E Fatty infiltration of the liver

Which of the following conditions develops when a large volume of 5\% glucose solution is introduced.

A * Hypoosmolar hyperhydration
B. Hypoosmolar dehydration
C Isoosmolar dehydration
D. Hyperosmolar dehydration
E Hyperosmolar hyperhydration

All of the pathological conditions listed below can be accompanied by hyperosmolar dehydration except:

A *Burns
In Hyperaldosteronism
C Heart failure
D Jade
E Diabetes

The formation of carbonic acid from CO2 occurs in the presence of the enzyme carbonic anhydrase. Where does this process take place?

And in erythrocytes
In leukocytes
C in plasma proteins
D in platelets
E in plasma

For the prevention and therapy of radiation sickness, among various radioprotectors, sodium nitrite is used, which causes the development of hypoxia. What is the mechanism of its hypoxic action:

A * Stimulates the formation of methemoglobin
Stimulates the breakdown of hemoglobin
C Inhibits the dissociation of oxyhemoglobin
D Inhibits the activity of tissue respiration enzymes
E Activates lipid peroxidation

3. Summing up.

4. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
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7. Clinical biochemistry: teaching. manual / edited by O.P. Tymoshenko. - K.: VD "Professional", 2005. - 288 p.
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9. Storchylo Olha V. (2018) Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own data J Gastrointest Dig Syst DOI: 10.4172/2161-069X-C1-064
10. Storchylo OV (2019) Mechanisms of radioprotective and radiocorrective effects of dietary phytoadditive of milk thistle fruits. Environment&Health 2019, No. 1 (90). - P. 33-37.doi.org/10.32402/dovkil2019.01.033.
11. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. Seventh International Conference on Radiation in Various Fields of Research (RAD 2019): June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.radconference.org. – P.452.
12. G.F. Stepanov, O.O. Mardashko, A.A. Kostina Epigenetic changes of enzyme proteins in animal tissues after ionizing radiation // Advances in biology and medicine No. 2(34). – 2019. – P.26-30.
13. Stepanov G.F., Kostina A.A., Mardashko O.O. Metabolism of amino acids in the offspring of irradiated animals // Advances in biology and medicine. - No. 1(29). - 2017. - P. 26-32. 15. Mardashko O.O., Stepanov G.F., Kostina A.A. Hematological indicators in the dynamics of extreme injuries / Actual problems of transport medicine. - No. 3 (49). - 2017 - p. 109-114.

Electronic information resources

1. http://info.odmu.edu.ua/chair/medicinal_chemistry/files

2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 11

Topic:The exchange of porphyrins is normal and conditional. pathologies

Goal: to study the main biochemical functions of the liver, its role in the exchange of proteins, carbohydrates, and lipids; learn the main stages of the breakdown of hemoglobin in the body with the formation of bile pigments, be able to perform a quantitative and qualitative determination of bilirubin in serum and give it a medical and biological assessment.

Basic concepts:*total bilirubin, conjugated bilirubin, unconjugated bilirubin, UDF-glucuronyltransferase, hemolytic jaundice, parenchymal jaundice, obstructive jaundice*

Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:

– the main biochemical functions of the liver, its role in the exchange of proteins, carbohydrates, and lipids;

– the main stages of the breakdown of hemoglobin in the body with the formation of bile pigments;

– the main types of jaundice.

The student should be able to:

– carry out quantitative and qualitative determination of bilirubin in serum and give it a medical and biological assessment.

Questions to check basic knowledge on the topic of the lesson:

1. The main ways of metabolism of carbohydrates, lipids and proteins;
2. Structural and functional features of erythrocytes;
3. List the metabolic features of erythrocytes;
4. The structure of hemoglobin and its synthesis in the human body. Abnormal types of hemoglobin.

3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «Determination of total, direct and indirect bilirubin in blood serum.

Recommendations for performing tasks.

The principle of the method is that the direct bilirubin of the blood serum gives a pink color when the diazo reagent is added; indirect bilirubin reacts with the diazo reagent only after adding caffeine. The color intensity is proportional to the amount of bilirubin.

Progress. a) determination of total bilirubin: add 3.5 ml of caffeine reagent and 0.5 ml of diazo reagent to 1 ml of serum - a pink color appears, after 5 minutes the resulting mixture is placed in a SF cuvette with a layer thickness of 1 cm with a green light filter against the compensation solution , containing 1 ml of serum, 3.5 ml of caffeine solution and 0.5 ml of water.

Calculation: C = 6.34xE - 0.05 (C - bilirubin concentration)

b) determination of direct bilirubin: to 1 ml of serum add 3.5 ml of physiological solution and 0.5 ml of diazo reagent and 0.5 ml of diazo reagent - a pink color appears, the following stages are similar to point a)

c) the concentration of indirect bilirubin is determined by the difference between total and direct bilirubin.

Medical and biological evaluation of the obtained results

An increase in indirect bilirubin in the blood is observed with hepatic jaundice - hemolytic anemias of various etiologies, as well as posthepatic hyperbilirubinemia, jaundice of newborns.

With mechanical jaundice, direct bilirubin is increased in the blood. In parenchymal jaundice, an increase in both direct and indirect bilirubin is observed.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Questions to check the final level of knowledge:

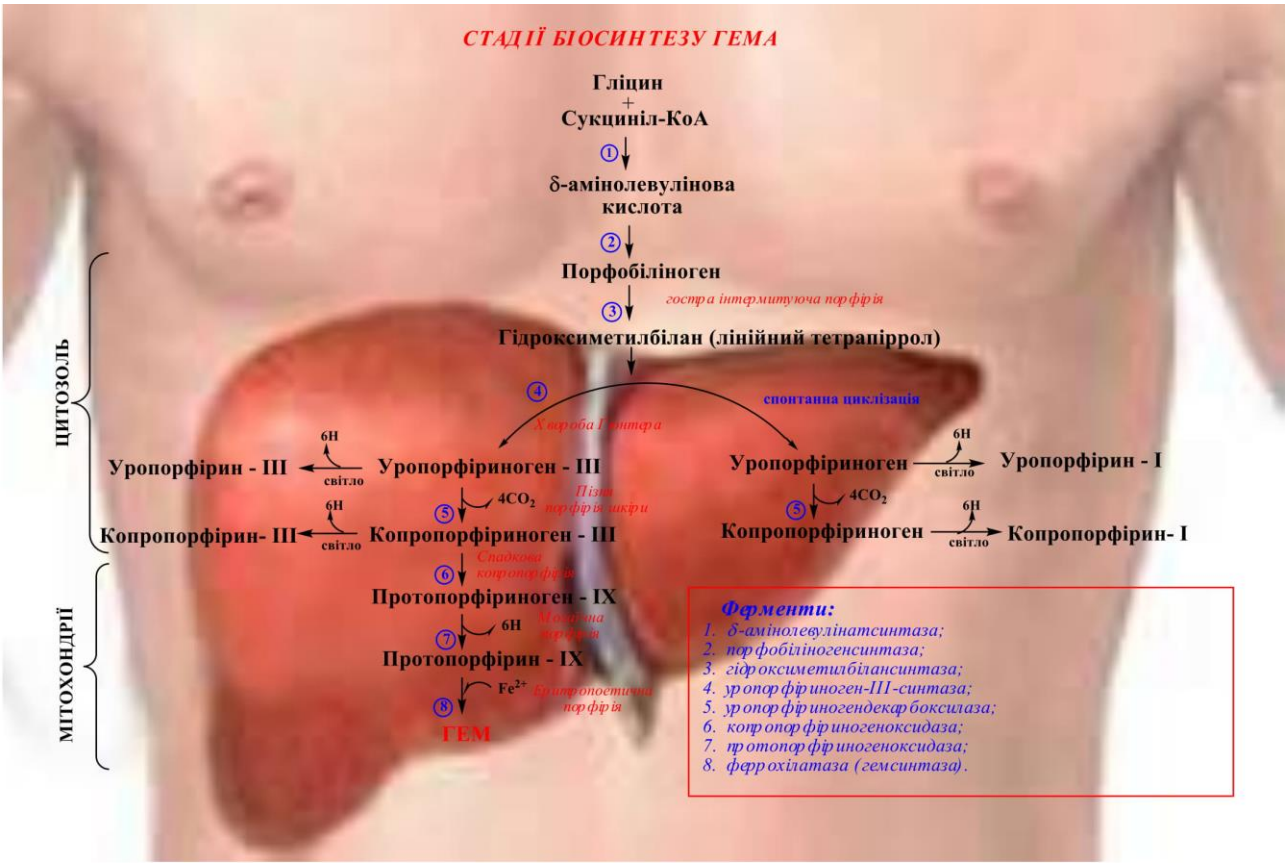
1. List and explain the main functions of the liver.
2. What role does the liver play in carbohydrate metabolism?
3. What role does the liver play in lipid metabolism?
4. What role does the liver play in protein metabolism?
5. What are the main stages of hemoglobin breakdown?
6. What forms of bilirubin are formed when hemoglobin breaks down?
7. What indicators of pigment metabolism change:

a) with hemolytic jaundice?

b) with parenchymal jaundice?

c) with obstructive jaundice?

8. What are Gelber, Dubin-Johnson and Crigler-Nayar syndromes related to?
9. Diagnostic value of determination of bound and free bilirubin in jaundice of various etiology.



Test tasks.

1. A patient with signs of acute poisoning was admitted to the hospital. A high content of methemoglobin was found in the blood. Which of the following compounds led to this:

A. - Lead salts
B. - Alkaloids
C. - Tetrachloromethane
+D. - Nitrates
E. - Radionuclides

2. A child born prematurely has hypoglycemia in the first days due to:

+A. - Deficiency of gluconeogenesis enzymes
B. - Violation of glycogen synthesis
C. - Violation of glycolysis
D. - Hyperinsulinemia
E. - Uncoupling of tissue respiration and oxidative phosphorylation

3. A 56-year-old patient complains of general weakness, nausea, and poor appetite. Yellowish skin, hyperbilirubinemia (direct bilirubin), light, foamy urine, acholic stools are noted. For which condition are these changes most characteristic?

A. - Dubin-Johnson syndrome
B. - Parenchymal jaundice
+C. - Obstructive jaundice
D. - Hemolytic jaundice
E. - Gilbert's disease

4. Patient F., 44 years old, notes pain in the right hypochondrium after minor physical exertion, sometimes at rest, periodic nausea, loss of appetite, swelling of the legs and trunk. During the

biochemical examination of blood: total bilirubin 88.4 μM/l, indirect 58 μM/l, direct 30.4 μM/l, AlAT - 22.4 μmol/h-/ml, AsAT-14.7 μmol/h/ml , total protein 35 g/l, albumins 15 g/l, globulins 20 g/l, K-2.2 mM/l, Na-1-8 mM/l. The patient probably has:

A. - Hepatic jaundice
+B. - Cirrhosis
C. - Obstructive jaundice
D. - Chronic pancreatitis
E. - Chronic cholecystitis

5. A patient was admitted to the infectious department with complaints of itching, jaundice of the skin and mucous membranes. Laboratory: increased concentration of bilirubin in blood serum due to direct, acholic stool. Determining the activity of which serum enzyme will confirm the clinical signs of cholestasis in this patient?

A. - Aspartate aminotransferase
B. - Creatine phosphokinase
C. - Lactate dehydrogenase
D. - Alpha amylase
+E. - Gamma-glutamyl transpeptidase

6. The baby has an unstable light yellow color of the skin, icteric sclera. Laboratory: anemia is not determined, hyperbilirubinemia, mainly due to the fraction of unconjugated bilirubin. Diagnosis: Gilbert's syndrome. Which enzyme defect is one of the causes of this pathology?

A. - Glycogen synthases
B. - Alanylaminotransferases
C. - Glucose-6-phosphatases
+D. - UDP-glucuronyltransferase
E. – Biliverdin reductases

7. A 52-year-old female patient has been bothered by attacks of pain in the right hypochondrium for the past few days after eating fatty food. Yellowing of sclera and skin, acholic stool, "beer-colored" urine is visually determined. The presence of which substance in the patient's urine caused the dark color of the urine in obstructive jaundice?

A. - Ketone bodies
+B. - Bilirubin glucuronides
C. - Urobilin
D. - Glucose
E. – Stercobilin

8. In a patient with liver disease, there is no urobilinogen in the urine in the presence of bilirubin, this is due to a violation of:

+A. - The influx of bile into the intestines
B. - Formation of direct bioirubin
C. - Kidney function
D. - Conversion of bilirubin in the intestine
E. – Formation of stercobilin

9. Wilson-Konovalov disease (hepatocerebral degeneration) is accompanied by a decrease in the concentration of free copper in blood serum, as well as the level of:

A. - Transferrin
B. - Albumin
+C. - Ceruloplasmin
D. - C-reactive protein

E. – Fibrinogen

10. Indicate which of the following biochemical blood parameters is most important for confirming the diagnosis of liver cirrhosis?
+A. - Hypoalbuminemia
B. - Hypercholesterolemia
C. - Hyperglycemia
D. - Hypoglycemia
E. – Hyperglobulinemia

11. Yellowing of the skin is observed in a newborn. Specify the blood index, the increase of which led to such a condition:
A. - Creatine
B. - Urea
C. - Direct bilirubin
D. - Uric acid
+E. – Indirect bilirubin

12. Hyperbilirubinemia with an increase in the conjugated form was found in the patient. The thymol test is normal, a slight increase in the activity of alanine aminotransferase is noted. Choose a possible diagnosis.
A. - Viral hepatitis
+B. - Mechanical jaundice
C. - Hemolytic jaundice
D. - Acute cholecystitis
E. – Polyarthritis

13. In jaundice, the content of total bilirubin in the blood is increased due to indirect bilirubin, in the feces and urine there is a high content of stercobilin. Name the type of jaundice.
A. - Jaundice of newborns
B. - Biliary
C. - Mechanical
D. - Hemolytic
+E. - Parenchymatous

14. In which jaundice hyperbilirubinemia is not accompanied by bilirubinuria?
A. - Terminal
B. - Parenchymatous
C. - Obturational
+D. - Hemolytic
E. – Mixed

15. With hemolytic jaundice, the level of direct bilirubin:
+A. - It is growing
B. - Does not change
C. - Decreases
D. - Not determined
E. – It fluctuates

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.
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Electronic information resources

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5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 12

Topic:The role of the liver in metabolism. Destruction of xenobiotics and biotransformation of medicinal substances. Pigment exchange in normal and pathological conditions.

Goal: To interpret the mechanisms of biotransformation of xenobiotics and endogenous toxins. To study theoretical material on the biochemistry of the immune system.

Basic concepts:*microsomal oxidation, cytochrome P-450, animal indican, hippuric acid, immunoglobulins, cytokines*

Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:

– the main mechanisms of neutralization of xenobiotics and endogenous toxins;

– cellular and biochemical organization of the immune system; mediators and hormones of the immune system;

– biochemical components and mechanisms of complement system activation; biochemical mechanisms of immunodeficiency states.

The student should be able to:

– determine hippuric acid and indican in urine;

– assess the state of the body's immune system.

Questions to check basic knowledge on the topic of the lesson:

1. List and explain the main functions of the liver.
2. Microsomal oxidation: cytochrome P-450; molecular organization of the electron transport chain. Biological significance.
3. Formation of peroxides. Antioxidant systems.
4. Structure and functions of blood plasma γ-globulins.
5. Formed elements of blood. Structure and functions.
6. Anatomical and physiological features of the lymphoid system.

3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «Determination of hippuric acid and indican in urine".

Recommendations for performing tasks.

The principle of the method is that alkaline solutions of proteins and peptides, thanks to peptide bonds, become colored like biuret when a solution of copper sulfate is added.

Progress. To 0.1 ml of serum, add 8 ml of a 4.8% solution of lye, 3 ml of a 20% solution of copper sulfate. Centrifuge at 3000 rpm. 5 minutes. Colorimeter on FEK with a green light filter against the mixture in which the serum is replaced by water.

A red-violet color appears, the intensity of which is directly proportional to the amount of protein. Multiply the optical density by 12 to find a quantitative representation of the protein content (%).

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.2 Demonstration and practical work "Determination of indican in urine".

Recommendations for performing tasks.

The principle of the method consists in the transformation of indican into indoxysulphuric acid and its subsequent oxidation (with iron chloride or potassium permanganate) to blue or red indigo.

Progress. Mix 8-10 ml of urine with an equal volume of hydrochloric acid, add 1-2 ml of chloroform and 1-2 drops of potassium permanganate. Close the test tube and invert several times without shaking.

In the presence of indican, chloroform turns blue or pink.

Note: In the presence of iodide salts in the urine, chloroform also gives a pink color. In this case, a hyposulfite crystal is added. The disappearance of the pink color of chloroform indicates the presence of iodide salts. In the presence of indican, the pink color does not disappear.

Medical and biological evaluation of the obtained results

In normal urine, indican is contained in a small amount, which is not detected by ordinary quality tests. Turkey anuria occurs with intense decay of protein substances in the large intestine (colitis, colon abscess, peritonitis, constipation), as well as with increased breakdown of proteins in the body (tumor, emphysema, abscesses, pulmonary tuberculosis).

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

Questions to check the final level of knowledge:

1. List the compounds that have adverse, toxic effects on both individual cells and the higher organism as a whole.
2. Name the types of biotransformation reactions of xenobiotics and endogenous toxins.
3. What role do microsomal and peroxidation reactions play in detoxification of toxic substances?
4. What role do conjugation reactions play in the detoxification of xenobiotics?
5. Name the most common conjugation reactions?
6. Name the main classes of lymphocytes. Their structure and functions.
7. Name the main factors of the non-specific immune system.
8. Name the main classes of immunoglobulins. Their structure and functions.
9. The main classes and biological role of cytokines.
10. Molecular mechanisms of antiviral action of interferons.
11. Tumor necrosis factors, colony-stimulating factors and transforming growth factors. Their biological role.
12. Biological organization and ways of activation of the complement system.
13. Mechanisms of impaired functioning of the human immune system. Primary and secondary immunodeficiencies.

Test tasks.

Neutralization of toxic substances and inactivation of biologically active substances in hepatocytes is carried out by various reactions. Sulfonamides are converted by which of the following reactions?

A * Acetylation

In Demining

C Conjugation with glucuronic acid
D Oxidation
E Conjugation with glycine

Drug metabolism in hepatocytes is carried out mainly:
A *In the endoplasmic reticulum
In the plasma membrane
C In the core
D In mitochondria
E In lysosomes

In the process of microsomal oxidation, binding and transformation of the substrate is carried out by:
A * Cytochrome P450
In Flavoprotein
C Iron-containing non-heme protein
D NADF
E OVER

Neutralization of toxic and inactivation of biologically active substances in hepatocytes is carried out in different ways. How is benzoic acid neutralized?
A Conjugation with glycine
B Restoration
C Methylation
D Oxidation
E Acetylation

In a boy with intestinal obstruction, the urinary excretion of indican, which is formed in the liver as a result of the reaction of conjugation of indoxyl with:
A with phosphoadenosine phosphosulfate
B Glycine
C Glutathione
D Acetyl-Co A
E Taurine

Neutralization of toxic substances and inactivation of biologically active substances in hepatocytes is carried out by various reactions. Barbiturates are converted by which of the following reactions?
A Oxidation
B Deamination
C Acetylation
D Restoration
E Conjugation with glycine

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

1. Biological and bioorganic chemistry: In 2 books. — Kn. 2: Biological chemistry: Textbook for med. University of the IV R.A. — 2nd ed., ed. Approved by the Ministry of Education and Culture / Ed. Yu.I. Gubskyi, I.V. Nizhenkovskaya. — K., 2017. — 544 p.

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2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association

Practical lesson No. 13

Topic:Clinical value of biochemical analysis of urine. Collagenosis.

Goal: Learn the peculiarities of metabolism in the kidneysand the occurrence of collagenoses.

Basic concepts:*primary urine, secondary urine, urea, clearance, ACE inhibitors*

Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
–kidney function;
–peculiarities of metabolism in the kidneys;
–the role of the kidneys in maintaining acid-base balance;
–biochemical mechanisms of the urinary function of the kidneys;
–the biochemical composition of human urine in normal conditions and under the conditions of pathological processes;
–clinical and diagnostic value of urine composition analysis;
–hormones involved in the regulation of water-salt metabolism and kidney functions
–the principle of action of hypotensive drugs - angiotensin-converting enzyme inhibitors

The student should be able to:
– perform qualitative reactions to protein in urine;
– determine the amount of protein in urine;
– determine the amount of glucose in the urine.

Questions to check basic knowledge on the topic of the lesson:
1. The structure of the nephron.
2. The mechanism of urine formation: filtration, reabsorption, secretion.
3. pH of biological fluids in the body.
4. What are the functions of the kidneys?
5. What are the organs of excretion other than the kidneys do you know?
6. What is urine?
7. How much urine is released per day from the body of a healthy person?
8. What is diuresis?
9. What is the ratio between daily water consumption and diuresis in the norm?
10. Hormones of the hypothalamic-pituitary system and the cortex of the adrenal glands, which take part in the regulation of water-salt metabolism.
11. Components of the renin-angiotensin system and its role in maintaining blood pressure.
12. Natriuretic factors of the atrium and other tissues

3.1 Demonstration and practical work «Qualitative determination of protein in urine (heating and acid precipitation".

Recommendations for performing tasks.

Progress

A) Boiling test: urine is tested in advance using litmus. If the urine has an acidic reaction, then it (2-3 ml) is immediately boiled in a test tube, and if the urine has an alkaline reaction, then it is first

acidified according to litmus by adding dropwise a 1% solution of acetic acid. In the presence of protein during boiling, turbidity or a precipitate of coagulated proteins is formed, which does not dissolve during repeated boiling after adding 3-5 drops of 10% acetic acid to the liquid.

B) Precipitation of protein with concentrated nitric acid (Heller's test): about 1 ml of concentrated nitric acid is poured into a test tube and urine is carefully poured from a pipette along the wall of the test tube. In the presence of protein, a white amorphous layer or turbidity, the so-called protein ring, forms at the boundary of both liquids. In the absence of protein in the urine, a colored transparent ring appears on the border between the two liquids, caused by a change in the pigments of the urine under the influence of nitric acid.

C) Precipitation of protein with sulfosalicylic acid: 2-3 drops of freshly prepared 20% solution of sulfosalicylic acid are added to 1-2 ml of urine. In the presence of protein in the urine, a white precipitate or turbidity is formed.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.2 Demonstration and practical work "Quantitative determination of protein by the Branderg-Stolnikov method".

Recommendations for performing tasks.

The principle of the method. The method is based on an experimentally established fact: the appearance of a barely noticeable protein ring in the Heller test occurs between the second and third minutes at a urine concentration of 0.0033% protein, i.e. 0.033 g/l. By successively diluting urine and layering it on nitric acid, such a maximum dilution of urine is achieved that a ring appears between the second and third minutes. Multiply the dilution by 0.033 g/l and get the protein content in the urine.

Progress. A Heller's test is performed with normal and pathological urine, for which 20 drops of concentrated nitric acid are placed in a test tube and the urine is carefully layered with a pipette. If the urine contains protein, then after 2-3 minutes. a white turbidity in the form of a ring is formed. Urine with a positive Heller test is used for protein quantification, for which a urine dilution is prepared. Pour 2 ml of distilled water into five test tubes. Add 2 ml of urine to the first, mix and take 2 ml of the mixture, transfer to the second, etc. Discard 2 ml of the collected liquid from the last test tube. Urine diluted 2, 4, 8, 16, 32 times is obtained. 2 ml of concentrated nitric acid is measured into the other five test tubes and a suitable sample of diluted urine is carefully layered on the acid using a pipette. They note the maximum dilution of urine, in which a cloudy white ring appears between the second and third minutes. The found urine dilution is multiplied by 0.033 g/l. For example, a ring of denatured protein was formed in the fourth test tube, where the dilution is equal to 16. Therefore, the protein content in the test urine is 0.033x16=0.548 g/l.

Medical and biological evaluation of the obtained results

Normal urine does not contain protein because it is unable to pass through the capillary walls. The appearance of protein in the urine indicates kidney disease. Protein can appear in the urine either as a result of a pathological change in the permeability of the capillary walls, when they begin to pass protein into the urine, or during inflammatory processes in the kidneys. For example, protein in urine appears in glomerulonephritis (that is, inflammation of the kidney glomeruli, when their permeability increases), in case of heart failure, sometimes during pregnancy.

3.3 Demonstration and practical work "Quantitative determination of glucose in urine using a polarimeter".

Recommendations for performing tasks.

Principle of the method: glucose rotates the plane of the polarized beam to the right. The amount of glucose in the urine is determined by the angle of rotation.

Progress. Determination is carried out strictly according to the instructions for the polarimeter. The polarimeter tube is filled with filtered urine (without air bubbles), covered with ground glass,

screwed tightly, wiped dry and inserted into the device. Determination is carried out 2-3 minutes after filling the tube, because fluctuations of liquid particles interfere with the study. When the color or intensity of illumination of a part of the field of view changes, the fields are equalized by the rotation of the disk and the angle of deviation of the polarized beam is determined, which is expressed in degrees of the scale of the device. With a tube length of 18.94 cm, the deflection angle of 10 corresponds to 1% glucose; if the length of the tube is 9.47 cm, then the obtained results are multiplied by 2, if the length is 4.74 cm, then by 4. After the work is finished, the urine is poured out, the tube and the glass of the polarimeter are washed with distilled water and dried. It is impossible to wash with tap water, because a dull coating forms on the glass.

Requirements for work results.

Enter the obtained data and calculations into the workbook.

Make medical and biological conclusions.

3.4Formation of professional skills and abilities.

Functions and composition of connective tissue

1) Protective: mechanical barrier, immune protection

2) Supporting: bones, cartilage, tendons, fascia

3) Plastic, reparative (scars)

4) Trophic (metabolic)

5) Depot of fats, vitamins, hormones, pigments (melanins, porphyrins, hemosiderin, bilirubin).

Extracellular matrix: cellular elements, collagen fibers, elastic fibers, intercellular substance: proteoglycans, glycoproteins

Connective tissue cells: constant: fibroblasts, reticulocytes, chondrocytes, osteoblasts (synthesis of biopolymers (collagen, proteoglycans), enzymes, cytokines); histiocytes (macrophages), tissue basophils.

Collagen fibers are filamentous formations consisting of collagens.

Reticular fibers - form three-dimensional meshes; a bundle of microfibrils wrapped in a shell of glycoproteins and proteoglycans.

Elastic fibers from elastin - a glycoprotein, a feature of the primary structure - many residues of glycine, valine, proline. Mature elastin is a fibrillar protein, consisting of tropoelastin connected by covalent bonds. U3 is formed from tropoelastin. In the intercellular matrix, lysine residues are oxidized to allisine, which form cross-links, as well as desmosine and isodesmosine from lysine. Due to this, they are combined by stable covalent bonds.

Fibrillin is a glycoprotein necessary for the formation of elastic fibers of connective tissue.

Proteoglycans are molecular complexes that ensure high viscosity of the main substance of the connective tissue. Polysaccharide chains are connected to a polypeptide fragment of a proteoglycan.

Glycosaminoglycans are heteropolysaccharides, the monosaccharide components of which are hexuronic acid, N-acetyl derivatives of hexosamines.

Glycoproteins-adhesive proteins:

- fibronectin "molecular glue"
- cell adhesion
- participation in blood clotting, binds fibrin
- participation in phagocytosis
- laminin
- interaction with basal membranes, cells

Collagen is a fibrillar protein, glycoprotein

Type I – bones, skin, tendons, cornea (90%)

II - articular cartilage

III - vessel walls

IV – basement membrane

Gives fabrics strength and elasticity

Collagen molecule = tropocollagen - Helix of 3 protein chains of 2 types (α1 and α2) of glycine,

proline and oxyproline, a lot of lysine and oxylysine. Carbohydrates (glu, gala) are attached to oxylysine. Pyridine crosslinks (between lysine and oxylysine residues).

Synthesis of collagen

They are synthesized on ribosomes bound to the membranes of the endoplasmic reticulum, in the cells of the fibroblastic series of connective tissue.

1. Synthesis of procollagen.

2. Reaction of hydroxylation of proline and lysine residues catalyzed by proline and lysine hydroxylase. Molecular oxygen and alpha-ketoglutaric acid are needed as substrates for enzyme action, and Fe2+ ion and ascorbic acid are needed as cofactors.

3. Galactose and glucose are added to part of the oxylysine and oxyproline residues. The glycosylation reaction is catalyzed by lycosyltransferases in the tubules of the granular endoplasmic reticulum, where procollagen polypeptide chains enter.

4. Polypeptide chains form a three-stranded helix, which is facilitated by the formation of disulfide bonds between the chains at the C-ends

5. Procollagen is secreted in vesicles from the cell into the intercellular space. Under the action of procollagenpeptidases, the final propeptides are cleaved.

6. The formed tropocollagen molecules form fibrils, which are stitched together by transverse covalent bonds. Collagen-bound proteoglycans contribute to the structural organization of collagen fibers.

Questions to check the final level of knowledge:

1. Biochemical processes in the cortical and medullary layers of the kidneys.
2. Glomerular filtration.
3. Reabsorption and secretion.
4. Involvement of kidneys in regulation of volume, electrolyte composition and pH of body fluids.
5. Specify the acidity of urine. What buffer system plays an important role in maintaining the constancy of urine pH?
6. Amount, color, smell, transparency, reaction of normal urine.
7. Clinical and diagnostic value of quantitative and qualitative analysis of urine.
8. How much urea, uric acid, creatinine is excreted in the urine per day?
9. How much residual nitrogen is in urine?
10. What is Creatine Ratio?
11. What causes the active reaction of normal urine?
12. How many chlorides, sulfates, phosphates are excreted in the urine per day, the sources of their origin.
13. Basic elements of connective tissue.
14. Features of the structure and amino acid composition of collagen.
15. The main structural unit of collagen.
16. Mechanisms of collagen synthesis. Scheme of the formation of a mature collagen fiber.
17. The biological role of vitamin C in the formation of mature collagen.
18. Features of the structure of elastin. Its biological role.
19. Features of the structure and biological role of proteoglycans.
20. Features of the structure of glycosaminoglycans.
21. The main representatives of glycosaminoglycans, their structure and functions.
22. Age-related features of the connective tissue structure.
23. Pathological conditions associated with impaired functioning of connective tissue.

Test tasks.

A 30-year-old woman has been sick for about a year, since the time when they first appeared

pain in the joints, their swelling, redness of the skin over them.
Previous diagnosis - rheumatoid arthritis. One of the probable reasons
this disease has a change in the protein structure of the connective tissue:
A. Myosin
B. Mucin
S. Collagen
D. Troponin
E. Ovalbumin

Increased fragility of blood vessels, destruction of enamel and dentin of teeth
patients with scurvy are largely due to impaired maturation
collagen What stage of procollagen modification is violated in this case
vitamin deficiency?
A. Removal of C-terminal peptide from procollagen
B. Glycosylation of hydroxylysine residues
C. Cleavage of the N-terminal peptide
D. Formation of polypeptide chains
E. Hydroxylation of proline

In patients with collagenosis, the process of destruction of connective tissue takes place.
This is confirmed by an increase in the blood:
A. Creatine and creatinine content
B. Contains oxyproline and oxylysine
C. Activities of transaminases
D. Contains urates
E. Activities of LDH isozymes

Fibrillar elements of connective tissue include collagen,
elastin and reticulin. Specify the amino acid that is included only in
composition of collagen, and its determination in biological fluids
used to diagnose connective tissue diseases.
A. Lysine
B. Proline
C. Glycine
D. Phenylalanine
E. Hydroxyproline

A 63-year-old woman has symptoms of rheumatoid arthritis. Level up
which of the blood indicators listed below will be the most significant
to confirm the diagnosis?
A. Acid phosphatase
B. Total glycosaminoglycans
C. N-glycosidases
D. Lipoproteins
E. Total cholesterol

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

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2. http://libblog.odmu.edu.ua/
3. https://moodle.odmu.edu.ua/login/index.php
4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization

6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 14

Topic:Clinical biochemistry of inflammation and carcinogenesis.

Goal: To interpret the mechanisms of biotransformation of xenobiotics and endogenous toxins. To study theoretical material on the biochemistry of the immune system.

Basic concepts:*microsomal oxidation, cytochrome P-450, animal indican, hippuric acid, immunoglobulins, cytokines*

Equipment: Laboratory of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. Control of the reference level of knowledge.

The student should know:
- stages and key enzymes of inflammation. chemical mediators of inflammation.
- biological amines: formation, characteristics, biological effects, role in inflammation.
- formation of eicosanoids: characteristics, biological effects, role in inflammation.
- the role of active forms of oxygen and nitrogen in inflammation.
- acute phase proteins. immunoglobulins. cytokines.
- modern biochemical markers in oncology. concept of tumor markers.
- classification of tumor markers.

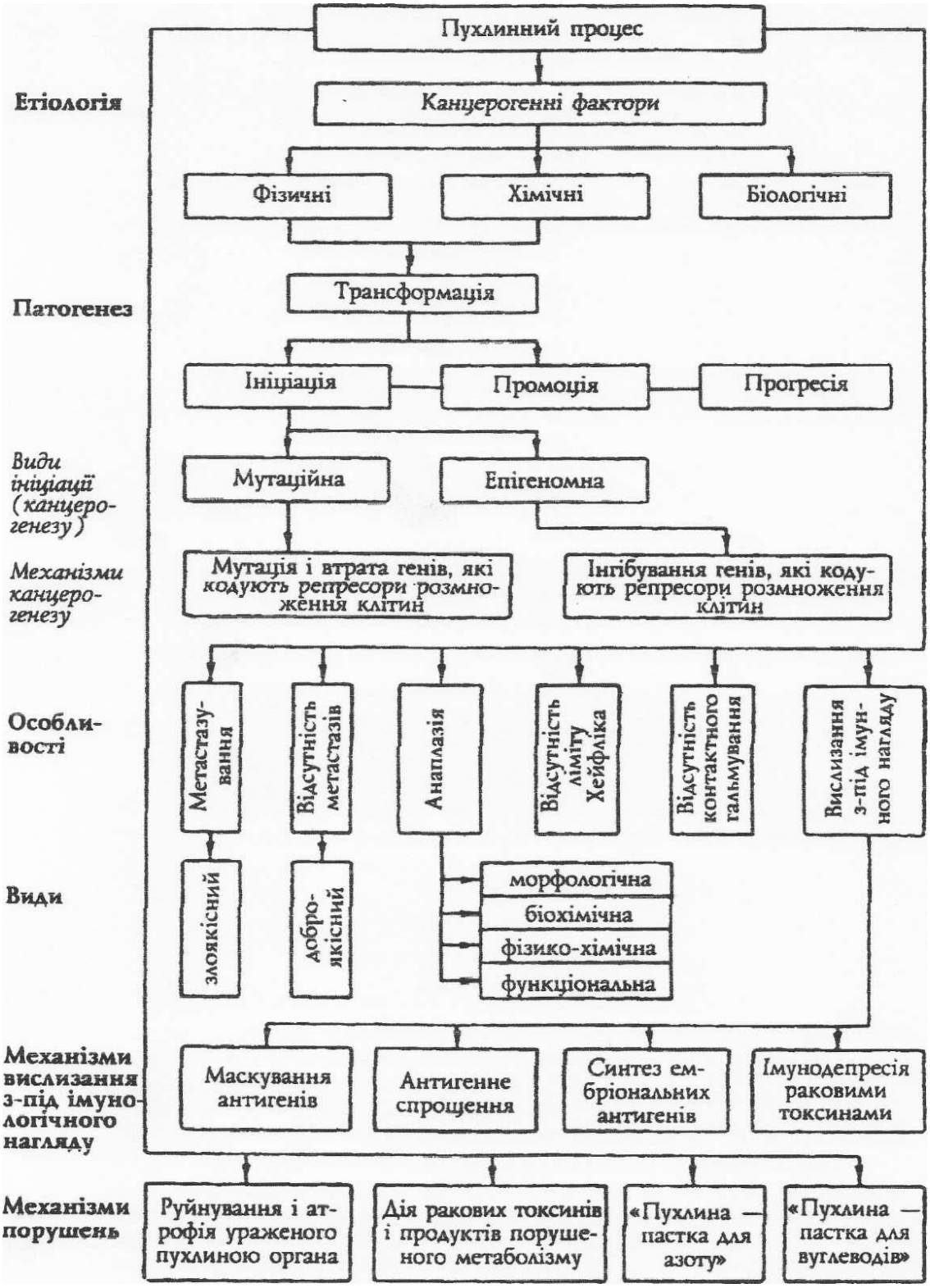
The student should be able to:
– screenings for determining tumor markers.;
– evaluate the criteria of an ideal tumor marker.
– to characterize individual tumor markers

Questions to check basic knowledge on the topic of the lesson:

1. List and explain the main functions of the liver.
2. Microsomal oxidation: cytochrome P-450; molecular organization of the electron transport chain. Biological significance.
3. Formation of peroxides. Antioxidant systems.
4. Structure and functions of blood plasma γ-globulins.
5. Formed elements of blood. Structure and functions.
6. Anatomical and physiological features of the lymphoid system.

3. Formation of professional skills and abilities.

3.1 Demonstration and practical work «Graph-logic schemes".



Questions to check the final level of knowledge:

- 1. stages and key enzymes of inflammation. chemical mediators of inflammation.
- biological amines: formation, characteristics, biological effects, role in inflammation.
- formation of eicosanoids: characteristics, biological effects, role in inflammation.
- the role of active forms of oxygen and nitrogen in inflammation.
- acute phase proteins. immunoglobulins. cytokines.
- modern biochemical markers in oncology. concept of tumor markers.
- classification of tumor markers.

Test tasks.

1. Choose the mechanisms for regulating cell division: A. Suppression of the synthesis of growth factors by the feedback mechanism.V. Contact inhibition (a cell stops dividing after its membrane comes into contact with the membrane of a neighboring cell). Hayflick's limit - the cell divides a certain number of times, then dies.D. External paracrine growth regulators.E. A system of initiator genes that start mitosis. (Correct answer: A, B, C)

222. Endogenous factors causing the occurrence of tumors: A. Genetic predisposition.V. Primary or secondary immunodeficiencies.S. Depletion of the antioxidant system.D. Endogenous carcinogens.E. Stresses. (Correct answer: A, B, C, D, E)3. Biological characteristics of tumor tissue are: A. Tissue and cellular anaplasia or metaplasia and uncontrolled and often limitless growth. V. Autonomy of tumor tissue.S. Change in the metabolism of tumor cells.D. Change of regulation mechanisms.E. A change in the antigenic properties of a tumor cell. (Correct answer: A, B, C, D, E)

4. Summing up.

5. List of recommended literature (main, additional, electronic information resources):

Main:

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5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)

Practical lesson No. 15

Topic: Final control of knowledge: credit

Goal: To determine the level of students' assimilation of the mainmethods of clinical diagnosis of diseases using various research objects: whole blood, blood serum and plasma, urine and other biological materials, as well as providing students with practical skills necessary for independent conduct of individual research.

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Equipment: audience of the department

Plan:

1. Organizational activities (greetings, verification of those present, announcement of the topic, purpose of the lesson, motivation of higher education seekers to study the topic).

2. List of questions for preparation for control:

1. Organization of clinical diagnostic laboratory work. Basic rules of conducting laboratory tests. Prevention of AIDS and serum hepatitis.
2. Clinical and laboratory indicators as criteria of effectiveness and safety of drug therapy.
3. Procedure for carrying out biochemical research
4. Collection, storage and delivery of biological material to the laboratory
5. Anticoagulants used in laboratory practice
6. Stages of laboratory analysis
7. The influence of physiological factors and the environment on the concentration of substances in the blood (biological variation)
8. Change in the results of clinical and biochemical studies under the influence of diagnostic and therapeutic measures (iatrogenic variation)
9. Clinical and biochemical characteristics of indicators of carbohydrate metabolism.
10. Research methods and clinical analysis of human sputum in various diseases.
11. Clinical and biochemical characteristics of lipid metabolism indicators.
12. Ammonia exchange. Indicators of violation of the processes of its use and disposal.
13. Creatine, creatine phosphate, creatinine. Clinical and biochemical significance of disorders of their metabolism.
14. Violation of tissue metabolism of individual amino acids (cyclic, sulfur-containing and others); arginine-succinic aciduria (Hartnup's disease), glycinuria and others.
15. The main clinical indicators of the blood system. General clinical blood analysis. Blood plasma proteins in normal and pathological conditions.
16. Biochemistry of formed elements. General information about erythropoiesis and leukopoiesis. Peculiarities of the blood picture in various diseases. Pathochemistry of water-electrolyte exchange. Immunochemistry of blood.
17. Dyslipoproteinemia. Structure and principles of classification of blood plasma lipoproteinemias. Lipid transport proteins. Biochemical characteristics of different types of blood hyper- and hypolipoproteins. During their circulation in the bloodstream and cells. The role of individual forms of lipoproteins in the mechanisms of the development of atherosclerosis.
18. Blood hemoglobin. Structure, methods of determination of hemoglobin concentration. Hemoglobinopathy and hemoglobinosis. Porphyria. Hematological characteristics of anemia.
19. Hemostasis system and its disorders: Laboratory diagnosis of changes in the hemostasis system. Hemophilia. Thrombocytopenia, thrombocytopenia. DVZ syndrome. The effect of drugs on indicators of the hemostasis system.
20. Pigment exchange and its disorders. The main pigments of the human body. Differential diagnosis of jaundice (hemolytic, mechanical, parenchymal). Biochemical parameters and diagnostic tests for various liver diseases.

21. Laboratory studies in diseases of the digestive organs. Violation of processes of secretion of bound and free hydrochloric acid and their diagnosis. Indicators of gastric juice in the diagnosis of digestive disorders in the stomach. Methods of research of gastric and duodenal contents.
22. Characteristics of the chemical composition of bile and the mechanism of its formation. Technique of taking and methods of research of duodenal contents. Diagnostic value of the study of duodenal contents.
23. Pathology of vitamin metabolism. Laboratory diagnosis of changes in vitamin metabolism.
24. Clinical analysis of urine in various human diseases. Methods of studying the physical properties and chemical composition of urine.
25. Blood and urine indicators in the diagnosis of glomerulonephritis and pyelonephritis. Urine pigments. Diagnostic value of determination of bile pigments for differential diagnosis of jaundice.
26. Laboratory studies in diseases of the endocrine system.
27. Hormones of the hypothalamus, pituitary gland. Thyroid and parathyroid hormones. Regulation of phosphorus-calcium metabolism.
28. Violation of calcium homeostasis. Pathology of the thyroid gland.
29. Clinical and biochemical characteristics of diabetes, diagnosis, principles of therapy.
30. Cytochemical methods of diagnosis of diseases of female and male genital organs.
31. The method of polymerase chain reaction (PCR) in the diagnosis of diseases of the female and male genital organs.
32. Stages and key enzymes of inflammation. chemical mediators of inflammation.
33. Biological amines: formation, characteristics, biological effects, role in inflammation.
34. Formation of eicosanoids: characteristics, biological effects, role in inflammation.
35. The role of reactive forms of oxygen and nitrogen in inflammation.
36. Acute phase proteins. immunoglobulins. cytokines.
37. Modern biochemical markers in oncology. concept of tumor markers.
38. Classification of tumor markers.

4. Summary.

1. List of recommended literature (main, additional, electronic information resources):

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4. http://moz.gov.ua- Ministry of Health of Ukraine
5. www.who.int- World Health Organization
6. www.dec.gov.ua/mtd/home/- State Expert Center of the Ministry of Health of Ukraine
7. http://bma.org.uk– British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)