MEDICAL UNIVERSITY – PLOVDIV

FACULTY OF PHARMACY

SYLLABUS

IN

CLINICAL LABORATORY

SPECIALTY MEDICINE

Approved by the Department Council on 12.05.2022

Confirmed by the Faculty Council - Protocol №6/15.06.2022

MEDICAL UNIVERSITY - PLOVDIV
FACULTY OF PHARMACY

CLINICAL LABORATORY

Syllabus

Discipline	Final exam/ semester	Auditorium classes				ECTS non-auditorium classes	ECTS total	Academic hours in years and semesters	
								3rd year	
		Total	Lectures	Practices	ECTS			V	VI
Clinical laboratory	VI	60	30	30	2.0	1.0	3.0		2/2

DISCIPLINE:
"Clinical Laboratory"

TYPE OF DISCIPLINE ACCORDING TO THE UNIFORM STATE REQUIREMENTS:
Mandatory

LEVEL OF QUALIFICATION:
Master's degree **/M/**

FORMS OF TRAINING:
Lectures, Practical Exercises

YEAR OF TRAINING:
3rd year

DURATION OF TRAINING:
One semester

ACADEMIC HOURS:
30 hours of lectures, 30 hours of practical exercises

TECHNICAL EQUIPMENT APPLIED IN THE TRAINING:
Multimedia, computers, microscopes and collections of smears, tables, diagrams, charts, albums, prints of the analysers and the laboratory information system (LIS); documented quality control data

FORMS OF EVALUATION:
Semester exam

EVALUATION CRITERIA:

Current control:

Written tests, tasks or presentation on a specific theme at least twice during the semester. Participation in discussions, solving clinical laboratory cases. The final semester grade is formed on the basis of all current tests and tasks.

Theoretical final exam: written form

ASPECTS OF EVALUATION CRITERIA:

The final grade is formed by the semester and exam grade, according to the academic standard of the discipline.

SEMESTER EXAM: Yes

STATE EXAM: No

LECTURER:

Habilitated lecturer from the Department of Clinical Laboratory

DEPARTMENT:

Clinical Laboratory

ANNOTATION

Clinical laboratory is an independent medical specialty and scientific discipline, which through quantitative and qualitative methods provides the necessary information for early diagnosis, control of the dynamics of the disease process and the effects of treatment and prevention.

The training in a clinical laboratory is carried out in three directions:

1. Pathobiochemical: explains theoretically and experimentally the cause and mechanism of various diseases at the molecular level; shows the relationship between physiological and pathological processes and changes in the cellular and chemical composition of the biological specimens.
2. Analytical: introduce methods of analysis; exercising control in the pre-analytical, analytical, and post-analytical stage.
3. Clinical and diagnostic: the information for test indications and clinical significance; interpretation of the results independently and in correlation

BASIC AIMS OF THE DISCIPLINE

To organize and implement optimum education in clinical laboratory to provide medical students preparation of the discipline for a complete, successful and effective work in the medical profession by:

1. Implementation and observing the requirements for preanalytical preparation of the patient and biological material, providing results with high reliability. To know and

eliminate errors in preanalytical stage and the possible interference (pharmaceutical, diagnostic and therapeutic procedures) on the results of clinical laboratory analysis.

2. Creating skills to fully use the capacity of clinical laboratory diagnostics for correct choice of parameters, taking into account the economic aspects of laboratory activities.
3. Creating skills for correct and complete interpretation of the results of clinical laboratory analysis, knowledge of their diagnostic reliability, the correlation between parameters in different diseases, allowing the selection of the most informative combination of indicators.
4. Learning of close practical skills to perform basic clinical laboratory activities (analysis of urine, microscope smears of peripheral blood, bone marrow).
5. Learning the rules for using tests for express diagnostics. Acquiring skills for solving clinical laboratory tasks after learning the reference range and the correlation between parameters.

EXPECTED RESULTS

Theoretical knowledge and practical skills of the student:

1. The result in clinical laboratory

- Be aware of the theoretical basis and practical application of the term "reference limits". Be able to use the reference intervals for interpretation of results.
- To assimilate main groups of clinical laboratory parameters. To properly select, order the necessary analysis trough hospital information system (HIS).
- To be aware of the possible sources of preanalytical and postanalytical errors in clinical laboratory analysis and the measures to limit them.
- To know the basic and special requirements for preparing the patient for clinical laboratory testing and be able to apply them in practice.
- To know the interference from medical procedures and medicines on clinical laboratory results and to apply in practice the measurements for control of this effect.
- To know and apply the basic rules and requirements, to observe basic procedures and avoid sources of errors in taking of biological material for analysis.
- To know the requirements for storage and transport of biological material, different types of closed systems for biological material. Selection of the proper tubes for analysis.
- To be aware of the principles and rules of internal quality control and external quality assessment.
- Have theoretical knowledge and practical skills for dealing with dry tests for qualitative and semi-quantitative analysis of urine.
- To know the principles of rational ordering of clinical laboratory tests in diagnosis and monitoring of treatment and be able to apply them in practice.

2. Urine. Physical characteristics, chemical tests

- To know the rules and requirements for urine collection - single portion and diuresis urine, reference limits, informative value.

- To be able to correctly select the necessary parameter for chemical testing - pH, glucose, protein, ketones, bilirubin, urobilinogen, blood - qualitative, quantitative analysis.
- To know the rules for operation and storage of urine express tests.

3. Electrolytes and trace elements in blood serum

- To know the basic macro- and micronutrients, their biological meaning, metabolism, regulation, indications for analysis. To properly select parameters for assessment of water electrolyte balance.
- To know the reference ranges of main parameters. To properly interpret the results.

4. Hematological parameters

- To know the hematological parameters, specimen collection, indications for examination and the reference ranges. To be able to correctly interpret the results.
- To know the normal cell composition in the bone marrow.
- To know the main indicators of CBC and their reference ranges, indications for examination, clinical significance. To be able to interpret of the results.
- To know the morphological characteristics of leukocytes in DBC and to recognize them microscopically.
- To know the morphological characteristics of erythrocytes and to be able to microscopically distinguish a normal from a pathological form.

5. Red blood cells disorders

- To know and be able to make a choice of clinical and laboratory indicators in diseases of the red blood line: iron deficiency, post-haemorrhage, pernicious and haemolytic anemia.
- To know and be able to recognize the microscopic characteristics of red blood cells on a swab of peripheral blood and bone marrow in different types of anemia.
- To know the laboratory constellations and to be able to make a differential diagnosis between different anemias

6. White blood cells disorders

- To know and be able to make a choice of clinical and laboratory indicators in diseases of the white blood line: acute and chronic leukemia, leukemoid reaction.
- To know and be able to recognize the microscopic characteristics of blast cells on a of peripheral blood and bone marrow smear in acute blast leukemia.
- To know the laboratory constellations and to be able to make a differential diagnosis between different leukemias.

7. Hemostasis

- To know the key phases in the process of blood coagulation, plasma factors and inhibitors, laboratory parameters and reference ranges. To be able to interpret the results.
- To know the factors and inhibitors of fibrinolysis. To be able to appoint the necessary indicators for its research. To interpret the obtained results.
- To know the informative content and the clinical significance of screening tests.
- To know the main clinical and laboratory parameters and for control of treatment with direct and indirect anticoagulants.

- To know the laboratory constellations in DIC syndrome, thrombophilia, haemorrhagic diathesis.

8. Disorders of the carbohydrate metabolism

- To know the informative importance of the basic, extended and specialized tests in patients with diabetes mellitus.
- To know the clinical significance of the "fasting glucose". To know the rules for patient preparation. To know the clinically significant reference values and correctly to interpret the obtained results.
- To know the rules for conducting glucose overload tests, their clinical significance and interpretation.
- To know glycated proteins as indicators for diagnosis and treatment control of diabetes mellitus. To be able to correctly select the appropriate parameters for monitoring hyperglycaemia for a previous period of time.

9. Serum proteins

- To know the methods for fractionation of serum proteins (electrophoresis and immunoelectrophoresis), their informative value, way of conducting advantages, disadvantages. To be able to distinguish normal from pathological electrophoresis.
- To know the changes in the protein fractions obtained by electrophoresis, the basic terminology and its interpretation. To be able to connect them with the main groups of diseases.
- To know the proteins of the acute phase, to be able to list the positive and negative reactants, their clinical and biological significance. To be able to make a choice of laboratory parameters in inflammatory and neoplastic diseases.
- To know the essence of hyperimmunoglobulinemia. Be able to distinguish between polyclonal and monoclonal hyperimmunoglobulinemia by electrophoresis.
- To know the immunoglobulins, their structure, biological significance, classification, dynamics, synthesis, indications for analysis, reference values. To be able to specify the groups of diseases in which to assign them and to correctly interpret their values.
- To be able to evaluate the results of serum protein testing in the main groups of liver and kidney, autoimmune and malignant diseases.

10. Enzymes.

- To know the main cellular and secretory enzymes. Be able to make constellations of laboratory parameters and interpret increased blood levels according cell and organ pathology.
- To know organ and subcellular localization of enzymes (ASAT, ALAT, AP, LDH. HBDH, Amylase, GGT, Cholinesterase, indications for analysis, required biological material, reference ranges. Be able to evaluate results of their analysis in cardiovascular, liver and malignant diseases.

11. Bile pigments

- To know the bile pigments in blood and urine, their pathobiochemistry, indications for analysis, reference ranges. To be able to make differential diagnosis between haemolytic, mechanical and parenchymal icterus by the results obtained.

- Be able to interpret the results of bile pigments analysis in main liver and non-liver diseases.

12. Non-protein nitrogen containing compounds.

- To know the informative value of urea, creatinine and uric acid. To be able to make proper selection and interpretation of these laboratory parameters in renal diseases.
- To know the advantages and the way to avoid their disadvantages by examination of renal function.

13. Lipid parameters.

To know the requirements for analysis of lipid parameters, risk levels and sources of errors. To be able to distinguish the main types hyperlipidemia using laboratory results.

14. Hormonal parameters

- To know the main laboratory hormonal indicators and the correlations between them; methods, indications for research and interpretation

15. Tumor markers

- To know the tumor markers of first and second choice and their clinical significance in malignant diseases.

LECTURES

LECTURE №1 – 2 hours: The analysis and the result in clinical laboratory. Clinical laboratory parameters.

1. The clinical laboratory in the field of medical sciences. Subject and tasks.
2. Analytical reliability of the methods in the clinical laboratory.
3. Reference ranges – populational and individual.
4. Diagnostic reliability of clinical laboratory parameters. Requirements and criteria for diagnostic reliability of clinical laboratory parameters in different diseases.

LECTURE №2 – 2 hours: The clinical laboratory result and its reliability.

1. Reliability of clinical laboratory results.
2. Basic groups of factors affecting the clinical laboratory results. Mechanism of action.
3. The clinical laboratory investigations in the diagnostic process.

LECTURE №3 – 2 hours: Clinical laboratory parameters for evaluation of water-electrolyte exchange.

1. Body water and its distribution in the human body.
2. Osmolality and osmolarity. Methods of investigation. Reference ranges. Result interpretation.
3. Water-electrolyte balance disturbance and its evaluation.
4. Sodium and chloride. Analytical methods, indication of investigation, interferences, reference ranges, result interpretation.
5. Potassium. Analytical methods, indication of investigation, interferences, reference ranges, result interpretation.

LECTURE №4 – 2 hours: Steps and approaches for choice of clinical laboratory parameters and their interpretation in red blood cell disorders.

1. Basic and extended laboratory tests.
2. Specialized laboratory tests.
3. Assessment of clinical laboratory results in different types of anemia.

LECTURE №5 – 2 hours: Steps and approaches for choice of clinical laboratory parameters in white blood cell disorders.

1. Basic, extended and specialized laboratory tests.
2. Flow cytometry – immunophenotyping of cells in leukemias and lymphomas.

LECTURE №6 – 2 hours: Clinical laboratory parameters' evaluation of the results of hormonal analysis.

1. Hormonal distribution and analysis. Biological meaning – classification of hormones, interactions and correlations.
2. Pituitary and adrenal (suprarenal) glands hormones' – methods of analysis, indications for investigation, patient preparation.
3. Valuation of laboratory data and correlations in pituitary and adrenal glands disorders.
4. Thyroid hormones. Methods of analysis, indications for investigation, patient preparation.
5. Valuation of laboratory data and correlations in thyroid gland disorders.
6. Hormones of reproductive system – evaluation of the results of the laboratory analysis.

LECTURE №7 – 2 hours: Clinical laboratory evaluation of the tumour markers investigation.

1. Definition and classification of the tumor markers.
2. Laboratory methods of analysis.
3. The "perfect" tumor marker.
4. The significance of tumor marker investigation in the follow-up and treatment of malignant diseases.

LECTURE №8 – 2 hours: Choice of laboratory parameters for evaluation of hemostasis disturbances.

1. Basic, extended and specialized laboratory tests parameters for evaluation of haemostasis disturbances.
2. Choice of clinical laboratory parameters and them consideration in bleeding tendency (haemorrhagic diatheses).
3. Selection of clinical laboratory parameters and their consideration in disorders leading to thrombosis.
4. Selection of clinical laboratory parameters in disseminated intravascular coagulation.

LECTURE №9 – 2 hours: Clinical laboratory evaluation of carbohydrate metabolism.

1. Blood sugar (glucose). Concentration in the blood. Regulation.
2. Pathobiochemical changes in diabetes mellitus disturbed carbohydrate metabolism:

- pathobiochemistry of hyperglycaemia and glucosuria
- pathobiochemistry of changes of the lipid fractions
- pathobiochemistry of ketoacidosis
- pathobiochemistry of changes ketoacidosis in changes of acid-alkaline and electrolyte equilibrium
- pathobiochemistry of glycated proteins and microalbuminuria.

LECTURE №10 – 2 hours: Clinical laboratory parameters evaluation of carbohydrate metabolism disturbance.

1. Selection of clinical laboratory parameters in detecting and follow-up of disturbance in patients with diabetes mellitus:
   - basic laboratory tests
   - extended laboratory tests
   - specialized laboratory tests
2. Control of diabetes mellitus patient's treatment – glycated hemoglobin.
3. Screening for microalbuminuria in patients with diabetes mellitus.

LECTURE №11 – 2 hours: Clinical laboratory evaluation of porphyrins and bile pigments in the blood.

1. Laboratory parameter for demonstration of destroyed hem synthesis – principle of methods, indications for investigation, specimen, reference values, results' interpretation.
2. Bilirubin in the serum – pathobiochemistry, principle of the methods, indications for investigation, results' interpretation.
3. Bile pigments in the serum and urine. Hyperbilirubinemia from different reasons. Correlation with other laboratory parameters.

LECTURE №12 – 2 hours: Clinical laboratory evaluation of serum proteins.

1. Changes in protein fractions – basic terminology and its interpretation.
2. Construction of appropriate strategy for clinical laboratory tests ordering for serum proteins evaluation.
3. Monoclonal and polyclonal hypergammaglobulinemia.
4. Selection of clinical laboratory parameters and their consideration in inflammatory and neoplastic diseases.

LECTURE №13 – 2 hours: Choice and evaluation of clinical laboratory parameters in liver and biliary diseases.

1. Basic pathobiochemical changes in liver diseases.
2. Special features of clinical laboratory diagnosis of destroyed liver function.
3. Basic, extended and specialized laboratory tests parameters.
4. Evaluation of the laboratory results from bile pigments, enzymes, serum proteins in the different groups of liver diseases.
5. Prognostic laboratory tests and parameters showing hepatocellular carcinoma development.

LECTURE №14 – 2 hours: Choice and evaluation of clinical laboratory parameters in heart (myocardial) diseases.

1. Clinical laboratory risk factors in ischemic myocardial diseases (IMD)
2. Early and late laboratory parameters for myocardial ischemia.
3. Clinical laboratory changes in IMD
4. Future perspectives for clinical laboratory diagnosis.

LECTURE №15 – 2 hours: Steps and approaches for clinical laboratory parameters in renal diseases.

1. Evaluation of changes in values of pH, Osmolality and 24-hours diuresis in the course of renal diseases diagnostics.
2. Evaluation of proteinuria – glomerular and tubular. Sequences of procedures in explanation of proteinuria.
3. Evaluation of haematuria. Sequences of procedures in its explanation.
4. Kidney functional tests and result interpretation.

PRACTICES

EXERCISE №1- 2 hours: The result in the clinical laboratory.

1. Introduction to the structure and work process of the clinical laboratory. The main groups of clinical and laboratory indicators. Appointment of clinical and laboratory indicators - LIS. Basic methods and equipment in the clinical laboratory. Internal and external evaluation of the quality of laboratory results.
2. Influence of laboratory results in the preanalytical stage. Basic rules and requirements. Venous or capillary blood for examination.
3. Basic procedures and sources of errors in taking biological material for analysis and sending it to the clinical laboratory. Closed system for taking biological material.
4. Demonstration of impact on the results of changes in the biological material (hemolysis, clot, lipemia, etc.)

EXERCISE №2 – 2hours: Urine. General characteristics and chemical tests.

1. Rules and requirements for urine collection– random urine and diuresis.
2. Urine - general characteristics, reference ranges, results interpretation.
3. Chemical analysis - pH, glucose, protein, ketone bodies, bilirubin, urobilinogen, blood – quality and quantity analysis.
4. Presentation of samples of different color and transparency.
5. Getting to know the rules of processing and storage of express urine tests.

EXERCISE №3 2hours: Evaluation of the laboratory results of micro- and macroelements in human serum.

1. Inorganic Phosphorus, Calcium, Magnesium -
   total and ionized: laboratory methods, indications for investigation, reference ranges, r esults interpretation.
2. Serum Iron and Iron Binding Capacity. Laboratory methods, interferences, indications for investigation, reference ranges, results interpretation.

EXERCISE №4 – 2 hours: Evaluation of the laboratory results of hematological parameters.

1. Basic hematological parameters - CBC, DBC, RSR, reference ranges.
2. Indications for research, interpretation of results.
3. Normal and pathological morphology of erythrocytes in peripheral blood.

EXERCISE №5 - 2 hours Clinical laboratory parameters in red blood cell disorders.

1. Post-hemorrhagic anemia, iron deficiency, pernicious, hemolytic, etc.
2. Evaluation of the results of hematological parameters examination.
3. Microscopy of peripheral blood smear in different types of anemia.
4. Discussion of the clinical cases.

EXERCISE №6 – 2 hours: Clinical laboratory parameters in white blood cell disorders.

1. Diseases of the white blood cell - acute and chronic leukemia, leukemoid reactions.
2. Evaluation of the results of hematological parameters examination.
3. Specialized tests in acute and chronic leukemias.
4. Discussion of the clinical cases.

EXERCISE №7 – 2 hours: Microscopic observation of bone marrow and venous blood smears

EXERCISE №8 – 2 hours: Clinical laboratory evaluation of hemostasis.

1. The hemostasis as an integrated functional system. The action of vessels' wall, platelets and blood plasma in the hemostasis.
2. Coagulation. Key phases in the process of coagulation.
3. Plasma factors of coagulation and them inhibitors– necessity and opportunity for investigation.
4. Fibrinolysis – factors and inhibitors - necessity and opportunity for investigation.

EXERCISE №9 – 2 hours: Clinical laboratory evaluation of hemostasis

1. Clinical laboratory parameters for evaluation of hemostasis – test principles, sources of errors, patient preparation, specimen, indications for investigation.
2. Screening tests for evaluation of hemostasis. Results interpretation
3. Tests for investigation of activity and concentration of individual plasma factors of coagulation and fibrinolysis. Results interpretation.
4. Specialized analysis for evaluation of hemostasis.
5. Control of anticoagulant therapy.
6. Discussion of the clinical cases.

EXERCISE №10 – 2 hours: Clinical laboratory parameters for evaluation disturbance of carbohydrate metabolism.

1. Glucose in the blood – definition, interferences, indications for investigation, reference ranges, results interpretation.
2. Tests with overload – two-hour postprandial test and oral glucose tolerance test - indications for investigation, reference ranges.
3. Evaluation of glycaemia for preceded period of time - test principles (demonstration), sources of errors, patient preparation, specimen, reference ranges, indications for investigation.
4. Discussion of the clinical cases.

EXERCISE №11 – 2 hours: Clinical laboratory parameters for evaluation of serum proteins.

1. Total serum protein: principle of determination methods - sources of errors, drug interference, test indications, patient preparation, biological material, reference limits, interpretation of results.
2. Methods for serum protein fractionation - types, principles, disadvantages and advantages.
3. Discussion of electrophoresis results in different diseases

EXERCISE №12 – 2 hours: Clinical laboratory parameters for evaluation of serum proteins.

1. Individual proteins – biological characteristics. Results interpretation.
2. Immunoglobulins – quantity measurement, methods, specimen, reference ranges, indications for investigation, results interpretation in patients with disturbed immunoglobulin synthesis.
3. Demonstration of cases and finding of different types of myeloma multiplex and other diseases with hyperimmunoglobulinemia.
4. Discussion of the clinical cases.

EXERCISE №13 –2 hours: Clinical laboratory parameters for evaluation of serum enzymes.

1. Enzymes in the serum. Mechanisms of hyperenzymemia. Advantages and disadvantages of enzyme analysis.
2. Cell and secretory enzymes in the serum - test principles, sources of errors, reference ranges, indications for investigation, results interpretation.
3. Discussion of the clinical cases.

EXERCISE №14 – 2 hours: Clinical laboratory parameters for evaluation of nonprotein nitrogen containing substances

1. Urea – common data, principle of analytical methods, sources of errors, drug interference in laboratory testing, patient preparation, specimen, reference ranges, indications for investigation, results interpretation.

2. Creatine and creatinine – common data, principle of analytical methods, sources of errors, drug interference in laboratory testing, patient preparation, specimen, reference ranges, indications for investigation, results interpretation.
3. Uric acid and ammonia – common data, principle of analytical methods, sources of errors, drug interference in laboratory testing, patient preparation, specimen, reference ranges, indications for investigation, results interpretation.
4. Discussion of the clinical cases.

EXERCISE №15 – 2 hours: Clinical laboratory evaluation of lipid parameters and lipoproteins.

1. Basic classes of lipoproteins.
2. Basic clinical and laboratory indicators for assessment of lipid metabolism - methods, indications for examination, patient preparation, risk values.
3. Stages and approaches for selection of clinical and laboratory indicators in disorders of lipid metabolism.
4. Discussion of the clinical cases.

BIBLIOGRAPHY

Basic:

1. Bishop M., E. Fody, L. Schoeff. Clinical chemistry: principles, techniques, and correlations. 7th ed. Edited by Lippincott Williams&Wilkins. 2013
2. Extended theses of lectures and exercises
3. Theml H., H. Diem, T. Haferlach. Color Atlas of Hematology. Practical Microscopic and Clinical Diagnosis. 2th revised ed. Thieme, Stuttgart, 2004

Additional:

1. Henry's Clinical Diagnosis and Management by laboratory methods, 21st ed., edited by Richard Mcpherson and Matthew Pincus
2. Kaplan LA, Pesce AJ (ed). Clinical Chemistry. Theory, analysis, and correlation. 3th edition. St. Louis, Missouri, Mosby-Year Inc., 1996
3. Burtis CA, Ashwood ER&DEBruns (ed). Tietz Textbook of Clinical Chemistry and molecular diagnostics. 4th ed. Elsevier Sounders, 2006
4. Mcpherson R. and M. Pincus. Henry's Clinical diagnosis and Management by laboratory methods, 21st ed.
5. S. K. Strasinger, M. Sch. Di Lorenzo. Urinalysis and Body Fluids. 5th ed. E. A. Davis Company-Philadelphia, 2008

CONSPECTUS

1. Reference ranges – populational constructed (definition, reference groups, reference status, reference condition, choice of statistical method, performance, disadvantages) individual (performance, advantages).

2. Diagnostic reliability of clinical laboratory parameters – criteria. Requirements to the criteria of diagnostic reliability of clinical laboratory tests in different group of diseases.

3. Permanent, long-term, and short-term acting factors on the biological variation of the results – examples.

4. Influence of medical procedures and medicines on the clinical laboratory results (chemical and pharmacological interferences). Instructions for control of medicinal effects on the clinical laboratory investigations.

5. Specimen collection for clinical laboratory investigation – basic rules and requirements. Venous and capillary blood for analysis? Closed system for biological samples collection –advantages for the clinic, advantages for the laboratory.

6. Venous blood collection clinical laboratory investigation – basic procedures and sources of errors.

7. Storage of the biological samples for analysis and transportation to the laboratory – requirements and sources of errors. Criteria for rejection of the specimen for laboratory analysis.

8. Urine for clinical laboratory investigation – basic rules and requirements for urine collection, storage, and transportation to the laboratory. Sources of errors. Cerebrospinal fluid, body fluids and stool - basic rules and requirements for urine collection, storage, and transportation to the laboratory. Sources of errors.

9. Body water and its distribution in the human body. Osmolality and osmolarity - methods of investigation, reference ranges, result interpretation.

10. Water-electrolyte balance disturbance. Clinical laboratory parameters for evaluation of water-electrolyte balance.

11. Sodium and chloride – common data for the parameters, indications for investigation, principles of the analytical methods, reference ranges, result interpretation.

12. Potassium - common data for the parameter, indications for investigation, principles of the analytical methods, reference ranges, result interpretation.

13. Total and ionized calcium, total and ionized magnesium - common data for the parameters, indications for investigation, principles of the analytical methods, reference ranges, result interpretation.

14. Inorganic phosphate - common data for the parameter, indications for investigation, principles of the analytical methods, reference ranges, result interpretation.

15. Serum Iron and Iron Binding Capacity - common data for the parameters, indications for investigation, principles of the analytical methods, reference ranges, result interpretation.

16. Diabetes mellitus – metabolism disturbance of: glycolysis, gluconeogenesis, glycogenolysis and glycogen synthesis, ketogenesis, ketonuria, glucosuria, osmotic diur esis, polyuria.

17. Glucose in the blood - common data for the parameters, indications for investigation, principles of the analytical methods, reference, borderline and pathological ranges, result interpretation.

18. Glucose in the blood - tests with overload: two-hour postprandial test and oral glucose tolerance test (GTT) - indications for investigation and contraindications, implementation of the tests, source of errors, reference ranges, results interpretation.

19. Evaluation of glycaemia for preceded period of time: glycated proteins - glycated hemoglobin HbA1; HbA1c and fructosamine: common data for the parameters, indications for investigation, patient preparation, specimen, reference ranges, informative content and results interpretation.

20. Selection of clinical laboratory tests in detecting and monitoring disturbance of carbohydrate metabolism in patients with diabetes mellitus - basic, extended and specialized laboratory tests (glycated proteins, microalbuminuria) and their discussion.

21. Total protein - common data for the parameters, principles of the analytical methods and interferences, indications for investigation, patient preparation, reference ranges, result interpretation.

22. Major protein fractions – electrophoreses: indications for investigation, result interpretation, informational value.

23. Individual proteins – proteins of the acute phase – types, analytical methods for investigation, indications for investigation, patient preparation, reference ranges, results interpretation.

24. Immunoglobulins in the serum – common data for the parameters, classification, dynamic in prenatal and early postnatal period, methods of investigation, results' interpretation.

25. Selection of clinical laboratory tests and their discussion in inflammatory and neoplastic diseases: white blood cells, differential count, hemoglobin, red blood cells, proteins of acute phase, ESR, serum proteinogram, specific laboratory parameters.

26. Urea - common data for the parameter, principles of the analytical methods, source of errors, indications for investigation, patient preparation, reference ranges, result's interpretation.

27. Creatinine - common data for the parameter, principles of the analytical methods, source of errors and interference, indications for investigation, patient preparation, specimen, reference ranges, result's interpretation.

28. Uric acid - common data for the parameter, principles of the analytical methods, source of errors and interference, indications for investigation, patient preparation, specimen, reference ranges, result's interpretation.

29. Selection of clinical laboratory tests in renal diseases. Evaluation of the results of a study of non-protein nitrogen containing substances – advantages and disadvantages.

30. Transaminases in serum – general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.

31. Alkaline and acid phosphatase in serum - general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.

32. Lactate dehydrogenase and creatine phosphokinase in serum - general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.

33. Amylase, gamma glutamyltransferase and cholinesterase - general information, principles of analytical methods, sources of errors, indications for analysis, biological material, reference ranges, interpretation of results.

34. Choice and evaluation of clinical laboratory parameters in myocardial diseases.

35. Cholesterol in serum and its fractions - general information, analytical methods, interferences, risk limits, interpretation of results.

36. Triglycerides in serum general information, analytical methods, interferences, risk limits, interpretation of results.

37. Serum bilirubin and fractions – metabolism, methods, interferences, reference ranges, interpretation of results.

38. Choice and evaluation of clinical laboratory parameters in hepatic and bile diseases.

39. Hemostasis as a complex functional system – phases and factors.

40. Blood coagulation and fibrinolysis – factors and inhibitors.

41. Clinical laboratory parameters for evaluation of hemostasis.

42. Choice and discussion of laboratory parameters in hemorrhagic diathesis.

43. Choice and discussion of laboratory parameters in thrombophilia.

44. Choice and discussion of laboratory parameters in DIC syndrome.

45. Choice and assessment of clinical laboratory parameters in renal diseases – basic, extended and specialized analysis.

46. Evaluation of changes in the values of pH, osmolality 24-hour diuresis in the course of diagnosis of renal diseases. Evaluation and procedures for clarifying of hematuria.

47. Choice of clinical laboratory parameters in renal diseases – sequence of procedures for clarifying and assessment of proteinuria – mainly glomerular and mainly tubular proteinuria. Mechanism of appearance, diagnostic significance.

48. Tumor markers. Markers of the first and second choice.

49. Choice and assessment of clinical laboratory parameters in iron deficiency anemias.

50. Choice and assessment of clinical laboratory parameters in megaloblastic anemias.

51. Choice and assessment of clinical laboratory parameters in hemolytic anemias.

52. Choice and assessment of clinical laboratory parameters in white blood cell line disorders. Cytochemical and immunophenotype characteristics of leukocytes in acute leukemia.

53. Choice and assessment of clinical laboratory parameters in white blood cell line disorders. Cytochemical and immunophenotype characteristics of leukocytes in chronic leukemias (lymphocytic and granulocytic).

54. Hormones - biological material and patient preparation. Groups of laboratory parameters.

55. Hormones of thyroid gland. Evaluation of laboratory data and correlations in thyroid diseases.

Approved: Assoc. Prof. Tanya Deneva, MD, PhD
/Head of Department of Clinical laboratory /