MEDICAL UNIVERSITY - PLOVDIV

MEDICAL FACULTY

PROGRAM

IN

MEDICAL GENETICS

Accepted by the Department Council №4 on June 24, 2020

Approved by the Faculty Council with Protocol № 5 from 08.07.2020

MEDICAL GENETICS

CURRICULUM

Discipline	Semester exam	Hours				By year and semester
						VII
MEDICAL GENETICS	VII	Overall	Lectures	Practicals	Credit	1/3
		60	15	45	2,3	

Name of the discipline:

„ MEDICAL GENETICS”

Type of discipline according to EDI:

Mandatory

Level of education:

Master / M /

Forms of education:

Lectures, practicals, self-preparation.

Training course: IV

Duration of training:

One semester

Hours:

15 hours of lectures, 45 hours of exercises

Teaching aids: Multimedia presentations, discussions, demonstration of methods for genetic analysis, observation of microscopic preparations, karyograms for analysis, reagents for the implementation of methods, solving practical problems, building and analyzing a pedigree.

Forms of assessment: Current evaluation, tests, colloquiums, essay preparation.

Formation of the assessment: The average current grade for the semester is formed.

Aspects in the formation of the assessment: Participation in discussions, solving tests.

Semester exam:
Yes (written test and oral)

State Examination:
No

Leading lecturer:
Full Professor from the Department of Pediatrics and Medical Genetics.

Department:
Pediatrics and medical genetics

- **ANNOTATION**

The discipline "Medical Genetics" provides an opportunity to acquire modern knowledge about the patterns of inheritance of genetic diseases; features of hereditary pathology; etiology and clinic of the most common genetic diseases - chromosomal, monogenic and multifactorial and skills for active involvement in the prevention of hereditary diseases and predispositions.

- **MAIN TASKS OF THE CURRICULUM**

 Acquisition of knowledge about the basics of medical genetics; understanding the genetic nature of hereditary diseases, hereditary predispositions to diseases and pathology due to somatic mutations;

 Introduction to modern diagnostic methods of medical genetics and algorithm of behavior;

 Acquisition of skills for active participation in the prevention of hereditary diseases and predispositions through competent referral of patients to genetic counseling, assistance in

conducting screening programs, assessment of indications for DNA diagnostics, cytogenetic analysis, prenatal, preimplantation and postnatal diagnosis.

- **EXPECTED RESULTS**

After completing the training, students must have knowledge and specific practical skills:

• to build pedigrees of families with hereditary diseases and predispositions;

• to determine the type of inheritance, to assess the genetic risk in Mendelian and multifactorial diseases;

• recognize, classify and interpret congenital malformations;

• know the cytogenetic, molecular genetic and biochemical diagnostic tests;

• to know the indications, the main tasks and the organization of the medical-genetic consultation;

• to know the indications for prenatal diagnosis and types of antenatal diagnosis;

• to assist in the implementation of existing screening programs;

• use clinical information to search for various inherited diseases in databases.

LECTURE-THESIS

LECTURE № 1 - 2 hours. Medical genetics as an integrating science and practical medical specialty. Material bases of heredity. Organization of the genetic material in the cell. Human karyotype. Mutation process in humans. Basic methods for genetic research.

Purpose, subject and tasks of medical genetics. Subcellular and molecular organization of the genome. Human karyotype-organization. Mutation process in humans. Types of mutations: genomic, chromosomal and gene mutations. Basic methods for genetic research

LECTURE № 2 - 2 hours. Chromosomal bases of heredity. Chromosomal pathology.

Chromosomal bases of heredity. Chromosomal heteromorphism - biological nature and clinical significance. Chromosomal pathology. Numerous and structural chromosomopathies: etiology, pathogenesis, cytogenetic forms, clinical and characteristics, medical-genetic consultation**.**

LECTURE № 3 - 2 hours. Classic type of inherited monogenic diseases. Autosomal dominant and autosomal recessive type of inheritance type of inheritance.

Classic type of inherited monogenic diseases. Autosomal dominant and autosomal recessive type of inheritance type of inheritance: clinical and genealogical criteria, features, deviations. Examples: etiology, pathogenesis, clinical characteristics, medical-genetic consultation

LECTURE № 4 - 2 hours. Classic type of inherited monogenic diseases. Sexually related type of inheritance - X-dominant and X-recessive type of inheritance. Non-Mendelian type of inheritance.

Classic type of inherited monogenic diseases. Sex-related type of inheritance - X-dominant and X-recessive type of inheritance: clinical and genealogical criteria, features, deviations. Examples: etiology, pathogenesis, clinical characteristics, medical-genetic consultation. Non-Mendelian type of inheritance (genomic imprinting, uniparent disomy, mitochondrial heredity, expansion of triplet repeats) - characteristics, features, examples, medical-genetic consultation.

LECTURE № 5 - 2 hours. Genetics of diseases with multifactorial heredity. MGK.

Genetics of diseases with multifactorial heredity - criteria, features. Multifactorial inheritance and common diseases. Genetics of congenital defects with multifactorial heredity. Genetic predisposition to certain mental, cardiovascular, gastrointestinal and other diseases. MGK**.**

***LECTURE № 6 - 2 hours. Oncogenetics. Pharmacogenetics*.**

Genetic aspects of malignancies. Cell cycle. Apoptosis. Tumorogenesis - oncogenes, tumor suppressor genes, mechanisms of activation. Hereditary and sporadic cancers. Pharmacogenetics and pharmacogenomics - definition, characteristics, application**.**

LECTURE № 7 - 2 hours. Medicogenetic consultation. Prevention of genetic diseases

Medicogenetic consultation - nature, indications, tasks. The organization of the medical-genetic consultation. Prenatal diagnosis - methods, indications. Mass and selective screening. Prenatal diagnosis - methods, indications.

EXERCISE – THESIS

EXERCISE № 1 - 3 hours: Research methods in medical genetics. Cytogenetic methods.

1. Introduction to the cytogenetic laboratory

2. Technique for obtaining chromosomes

- Preparation of lymphocyte cultures from peripheral blood (application of biostimulants and mitostatics)

- Hypotonic processing, fixation and preparation of preparations for chromosome analysis

- Coloring techniques: routine and tape

3. Technique for preparation of preparations for X sex chromatin

EXERCISE № 2 - 3 hours: Cytogenetic methods - continued

1. Microscopy of preparations for chromosome analysis and X sex chromatin.

2. Work with karyograms and karyotyping.

3. Cytogenetic diagnosis in normal and abnormal karyotype. Philadelphia chromosome.

4. Forensic examination by chromosome markers**.**

EXERCISE № 3 - 3 hours: Numerous autosomal chromosomal diseases: Down syndrome

1. Consideration of a case of a family with a child with a common form of Down syndrome (trisomy 21) and medical-genetic consultation. Discuss the age of the parents as a risk factor.

2. Consideration of a case of a family with a child with a congenital translocation form of Down syndrome and medical-genetic consultation.

3. Consideration of a case of a family with a child with a hereditary translocation form of Down syndrome and medical-genetic consultation.

4. Consideration of a case of a family with a child with a mosaic form of Down syndrome and medical-genetic consultation**.**

5. Prenatal biochemical screening - types; discussion of results

EXERCISE № 4 - 3 hours: Other autosomal chromosomal diseases (numerical and structural)

1. Consideration of a case of a family with a child with Patau's syndrome (trisomy 13) and medical-genetic consultation

2. Consideration of a case of a family with a child with Edwards syndrome (trisomy 18) and medical-genetic counseling

3. Consideration of a case of a family with a child with Rethore syndrome (partial trisomy 9p) and medical-genetic consultation

4. Consideration of a case of a family with a child with “cri du chat” syndrome (partial monosomy 5p) and medical-genetic consultation

EXERCISE № 5 - 3 hours: Gonosomal chromosomal diseases (numerical and structural)

1. Consideration of a case of a family with a child with Turner's syndrome (total monosomy X) and medical-genetic consultation

2. Consideration of a case of Turner syndrome with other cytogenetic variants and medical-genetic consultation

3. Consideration of a case with Triple X syndrome and medical-genetic consultation

4. Consideration of a case with Klinefelter's syndrome and medical-genetic consultation

5. Consideration of a case with "supermen" syndrome and medical-genetic consultation

6. Prenatal biochemical screening - discussion of results.

EXERCISE № 6 - 3 hours: Summary exercise on chromosomal diseases and colloquium

1. Chromosomal diseases

2. Cytogenetic methods

3. Test test

EXERCISE № 7 - 3 hours: Autosomal recessive diseases

1. Consideration of a case of a family with a child with cystic fibrosis and medical-genetic consultation. DNA analysis techniques: Southern blot hybridization, PCR amplification.

2. Consideration of a case of a family with a child with phenylketonuria and medical-genetic consultation. Guthrie test.

3. Consideration of a case of a family with a child with Werdnig-Hoffmann disease and medical-genetic consultation.

4. Consideration of a case of a family with a child with adrenogenital

syndrome and medical-genetic counseling.

EXERCISE № 8 - 3 hours: Autosomal recessive diseases - continued

1. Consideration of a case of a family with a child with thalassemia and medical-genetic consultation.

2. Consideration of a case of a family with a child with glycogenosis and medical-genetic consultation.

3. Consideration of a case of a family with a child with Hurley's disease and medical-genetic consultation.

4. Consideration of a case of a family with a child with Wilson-Konovalov disease and medical-genetic consultation**.**

EXERCISE № 9 - 3 hours: Autosomal dominant diseases

1. Consideration of a case of a family with a child with Huntington's disease and medical-genetic consultation.

2. Consideration of a case of a family with a child with achondroplasia and medical-genetic consultation.

3. Consideration of a case of a family with a child with myotonic dystrophy and medical-genetic consultation.

4. Consideration of a case of a family with a child with Neurofibromatosis and medical-genetic consultation.

EXERCISE № 10 - 3 hours: Heterogeneous diseases

1. Consideration of a case of a family with a child with Osteogenesis imperfecta and autosomal recessive type of inheritance and medical-genetic consultation.

2. Consideration of a case of a family with a child with Osteogenesis imperfecta and autosomal dominant type of inheritance and medical-genetic consultation.

3. Consideration of a case of a family with a child with Polycystosis renis and autosomal recessive type of inheritance and medical-genetic consultation.

4. Consideration of a case of a family with a child with Polycystosis renis and autosomal dominant type of inheritance and medical-genetic consultation.

5. Commentary on families with deafblindness, albinism, etc.

EXERCISE № 11 - 3 hours: X - recessive diseases

1. Consideration of a case of a family with a boy with Duchene muscular dystrophy and medical-genetic consultation.

2. Consideration of a case of a family with a boy with hemophilia and medical-genetic consultation.

3 Consideration of a case of a family with a boy with Wiscott-Aldrich and medical-genetic consultation.

4. Consideration of a case of a family with a boy with G6FD and medical-genetic consultation.

5. Consideration of a case of a family with "Fragile X" syndrome and medical-genetic consultation.

EXERCISE № 12 - 3 hours: X - dominant type of inheritance

1. Clinical-genetic criteria of X - dominant type of inheritance

2. Diseases inherited as XD type .

3. Consideration of a case of a family with incontinentio pigmenti and medical-genetic consultation**.**

EXERCISE № 13 - 3 hours: Multifactorial defects. Screening for open neural tube defects.

1. Consideration of a case of a family with a previous child with anencephaly and medical-genetic consultation.

2. Consideration of a case of a family with a previous child with spina bifida and medical-genetic consultation.

3. Consideration of a case of a family with a previous child with a cleft palate and medical-genetic consultation.

4. Consideration of a case of a family with a child with heart malformation and medical-genetic consultation.

5. Ultrasound screening - interpretation and comment of results.

6. Prenatal biochemical screening for open fetal defects.

EXERCISE № 14 - 3 hours: Summary exercise on monogenic and multifactorial diseases, screening tests and colloquium.

1. DNA research methods in monogenic diseases.

2. Types of inheritance in monogenic diseases and differential diagnosis.

3. Multifactorial defects and diseases.

4. Screening.

5. Test test.

EXERCISE № 15 - 3 hours: Non-Mendelian type of inheritance

1. Uniparal disomy. Genomic imprinting.

2. Mosaicism.

3. Mitochondrial type of inheritance.

4. Consideration of a case of a family with Prader-Willi syndrome and medical-genetic consultation.

LITERATURE

Basic

1. G. Efremov, V. Baranov, V. Gorbunova, D. Toncheva, St. Lalchev, I. Kremenski, T. Ivashchenko, T. Kuznetsova, T. Kasheeva. Medical genetics. Ciela, Sofia 1999

2. Medical genetics in the post-genomic era. Genomic Medicine (edited by D. Toncheva) ed. Simelpress, 2010.

3. Rare genetic diseases. (edited by D. Toncheva), ed. Simelpress, 2014.V. Stoyanova. Lecture course in medical genetics, VAP, Plovdiv, 2011.

Additional

1. Nussbaum R., R.McInnes, H.Willard. Thompson & Thimpson GENETICS IN MEDICINE, 7th ed. Saunders Elsevier, 2007.
2. Strachan T. Human Molecular Genetics, Garland Publishing Inc, 2010
3. Read A. New Clinical Genetics, Scion Publishing LTD, 2010
4. Turnpenny P. D. Emery's Elements of Medical Genetics, Churchill Livingstone, 2011
5. Gardner R.J.M., Chromosome Abnormalities and Genetic counseling. Oxford University Press Inc, 2011
6. Francis R. C. Epigenetics. WW Norton & Co, 2012

Web sites:

http://www.ncbi.nlm.nih.gov

http://www.geneticalliance.org/

http://www.ncbi.nlm.nih.gov/Omim/allresources.html

http://archive.uwcm.ac.uk/uwcm/mg/hgmd0.html

http://www.ncbi.nlm.nih.gov/Omim/allresources.html#LocusSpecific

http://www.ncbi.nlm.nih.gov/Omim/allresources.html#ModelOrganisms

http://www.mitomap.org/

http://www.ncbi.nlm.nih.gov/Omim/allresources.html#Phenotypes

http://www.ncbi.nlm.nih.gov/ncicgap/

http://www.ncbi.nlm.nih.gov/Homology/Davis/

http://www.gene.ucl.ac.uk/nomenclature/

http://www.ncbi.nlm.nih.gov/disease/

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?CMD=search&DB=omim

http://www.docnmail.com/learnmore/medical/genetics.htm

http://www.who.int/genomics/public/geneticdiseases/en/index1.html

http://www.wellcome.ac.uk/en/genome/genesandbody/hg06b010.html

CONSPECTUS FOR SEMESTRIAL EXAM

1. Material bases of heredity. Nucleic acids. Proteins. Gene - structure and function, mechanisms of gene regulation. Genetic code.

2. Molecular and subcellular organization of human chromosomes. Karyotype.

3. Gene mutations. Mutagenic factors. Significance of mutagenesis. Genetic monitoring.

4. Basic disorders of the karyotype. Mechanisms of chromosomal aberration, designation.

5. Chromosomal diagnostics - methods (direct and indirect). Tape techniques - diagnostic capabilities. Chromosomal polymorphism. Heterochromatin markers. Sex chromatin - essence, diagnostic value.

6. DNA analysis. PCR. Southern blot. Mutation analysis. DNA sequencing and cloning. Human genomic project. Gene mapping and identification strategies. Human gene map.

7. Chromosomal pathology. Chromosomal diseases associated with numerous aberrations of autosomes, complete and mosaic forms. Genetic counseling.

8. Chromosomal pathology. Chromosomal diseases associated with structural aberrations of autosomes. Partial monosomies and trisomies. Microdeletion syndromes. Subtelomeric aberrations. Molecular cytogenetics.

9. Chromosomal pathology. Chromosomal diseases associated with gonosome aberrations. Genetic counseling.

10. Gender determination and differentiation. Male and female pseudohermaphroditism, true hermaphroditism. Examples. Genetic counseling

11. Autosomal dominant type of inheritance - clinical and genetic patterns, examples. Genetic

12. Autosomal recessive type of inheritance - clinical and genetic patterns. Examples. Genetic counseling.

13. Sex-related type of inheritance (X-recessive and X-dominant). Clinical and genetic patterns, examples, genetic counseling. Gender-dependent scars.

14. Heterogeneous diseases - nature, examples, clinical-genetic polymorphism.

15. Multifactorial type of inheritance - clinical and genetic patterns, examples, genetic counseling. Diseases with hereditary predisposition.

16. Non-Mendelian type of inheritance - species. Dynamic mutations. Expansion of triplet repetitions - nature, examples, clinical and genetic characteristics. Genetic counseling.

17. Non-Mendelian type of inheritance - species. Genetic imprinting - essence, examples, clinical-genetic characteristics. Genetic counseling.

18. Mitochondrial genome. Mitochondrial type of inheritance - nature, examples, clinical and genetic characteristics. Genetic counseling.

19. Cystic fibrosis - clinical and genetic characteristics, Genetic counseling.

20. Phenylketonuria - clinical and genetic characteristics, treatment, genetic counseling. Other hereditary aminoaciduria. Mass screening for hereditary diseases in newborns.

21. Hemophilia - types, clinical and genetic characteristics,gGenetic counseling.

22. Muscular dystrophy type Duchenne and type Becker. Clinical and genetic characteristics, Genetic counseling.

23. Enzymopathies and lysosomal diseases of accumulation - lipidosis, mucopolysaccharidosis, glycogenosis. Clinical-genetic characteristics, genetic counseling.

24. Hereditary diseases of lipid metabolism. Hyperlipidemia. Kinds. Clinical-genetic characteristics, genetic counseling.

25. Defects of purine metabolism, clinical and genetic characteristics, genetic counseling.

26. Polycystic kidney disease - types, clinical and genetic characteristics, genetic counseling.

27. Hereditary diseases of collagen - examples, clinical and genetic characteristics, genetic counseling.

28. Hemoglobin. Hemoglobinopathies and hemoglobinosis - clinical and genetic characteristics, genetic counseling.

29. Hereditary diseases of metals. Hemochromatosis. Wilson-Konovalov disease. Clinical-genetic characteristics, genetic counseling.

30. Immunogenetics. Gene regulation of immunity. Hereditary immunodeficiency conditions. Clinical-genetic characteristics, genetic counseling. Complement system - genetic disorders and diseases. Genetic counseling.

31. Pharmacogenetics. Pharmacogenetic defects and pharmacogenetic polymorphism. Glucose-6-PDN. Clinical-genetic characteristics, genetic counseling.

32. Oncogenetics. Oncogenes and tumor suppressor genes. Chromosomal markers in leukemias, lymphomas and myelodysplastic conditions. Diagnosis. Prognostic significance, attitude to therapeutic behavior.

33. Leukemia - molecular genetic studies, diagnostic and prognostic significance.

34. Prevention and therapy of hereditary pathology - basic approaches. Genetic counseling. Prenatal diagnosis.

35. Screening of hereditary diseases and defects: mass and selective, prenatal and postnatal. Biochemical screening in pregnant women.