ЦЕНТЪР ЗА ОБУЧЕНИЕ – БАН

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Basic Information:
Course Title: Selected Topics in Pathobiochemistry
Lecturer: Prof. Radostina Alexandrova, PhD
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Total Teaching Hours: 45 academic hours

Annotation (up to 150 words):

The proposed course aims to introduce students to the molecular mechanisms and pathobiochemical alterations accompanying disturbances in the normal metabolism of carbohydrates, lipids, proteins, nucleic acids, bile pigments, and porphyrins. Biochemical changes associated with inherited and acquired abnormalities in enzyme function, hormonal disorders, imbalances in vitamins, macro- and microelements, as well as intoxications caused by various compounds, will be discussed. Special attention will be paid to the molecular basis, genetics/epigenetics, and pathobiochemistry of socially significant diseases, including cardiovascular diseases, cancer, bone and joint disorders, neurodegenerative diseases, diabetes, and immunopathologies. Some lectures will focus on the signaling pathways involved in damage to cells and cellular organelles, activated in response to stress signals and associated with aging and cell death. The manifestation of pathobiochemical alterations will be examined, where possible, at the molecular, cellular, tissue/organ, and organismal levels. Modern approaches for prevention, early diagnosis, and treatment will also be presented.

Course content (brief description by topics or modules):

Topic / Module 1: General overview of the ultrastructure and metabolic organization of the cell. Disturbances in the normal functioning of the cell membrane, lysosomes, peroxisomes, mitochondria, and nucleus – causes and consequences – 2 hours.

Topic / Module 2: Molecular mechanisms and pathobiochemistry of inherited and acquired enzyme defects. Major enzymopathies – 2 hours.

Topic / Module 3: Disorders of carbohydrate metabolism (galactose, glucose, glycogen, fructose). Molecular mechanisms of inherited and acquired diseases – 2 hours.

Topic / Module 4: Disorders of lipid metabolism – fatty acids, triacylglycerols, phospholipids, sphingolipids, lipoproteins, cholesterol. Molecular mechanisms of inherited and acquired disorders. Disturbances in ketone body formation – 2 hours.

Topic / Module 5: Disorders of amino acid and protein metabolism. Disturbances in urea and creatinine metabolism – 2 hours.

Topic / Module 6: Disturbances in purine and pyrimidine metabolism. Disorders of uric acid metabolism. Gout – 1 hour.

Topic / Module 7: Disorders of porphyrin and hemoglobin metabolism. Molecular mechanisms and pathobiochemistry of porphyrias and thalassemias – 1 hour.

Topic / Module 8: Disturbances in bile pigment metabolism. Pathobiochemistry of hyperbilirubinemias. Bile acids as potential carcinogens – 1 hour.

Topic / Module 9: Hyperfunction and hypofunction of the endocrine system. Hormonal resistance syndrome. Pathobiochemistry of corticosteroid metabolism. Hormone replacement therapy – benefits and risks – 2 hours.

Topic / Module 10: Metabolic syndrome and insulin resistance. Anorexia – 1 hour.

Topic / Module 11: Disturbances in insulin signaling pathways. Diabetes. Contemporary therapeutic approaches – 1 hour.

Topic / Module 12: Molecular mechanisms and pathobiochemical alterations in cardiovascular diseases. Pathobiochemistry of atherosclerosis – 1 hour.

Topic / Module 13: Metabolic disorders in connective tissue diseases. Molecular mechanisms and pathobiochemical alterations in inherited and acquired diseases. Autoimmune connective tissue diseases – 1 hour.

Topic / Module 14: Disorders in the normal functioning of the liver and kidneys – common causes, molecular mechanisms, and pathobiochemical alterations. Hepatitis. Liver failure. Kidney failure. Transplantation. Mechanisms of graft rejection – 3 hours.

Topic / Module 15: Metabolic disorders in bone tissue diseases. Osteoporosis. Rickets. Pathobiochemistry of musculoskeletal diseases and new therapeutic approaches. Bone tissue engineering – 1 hour.

Topic / Module 16: Alterations in the normal levels of vitamins, micro- and macroelements. Most common causes and consequences. Nutritional and genetic disorders in the metabolism of folic acid, vitamin D, cobalamin, iron, sulfur. Zinc deficiency. Biology of copper and cobalt – 2 hours.

Topic / Module 17: General overview of pathobiochemical alterations during intoxication with different groups of compounds (cyanides, alcohols, arsenic and heavy metals, foods and drugs of plant origin, snake venom). Acute and chronic intoxication. Antidotes. Morphine. Addiction and dependence – 3 hours.

Topic / Module 18: Molecular mechanisms of drug resistance. Strategies to overcome it – 1 hour.

Topic / Module 19: Human microbiome – 1 hour.

Topic / Module 20: Pathobiochemical changes in cells and the organism during infections with viruses and microorganisms, and parasitic invasion. Sepsis – 2 hours.

Topic / Module 21: Pathobiochemistry of carcinogenesis. Molecular mechanisms of physical, chemical, and biological carcinogens. Malignant transformation of cells and tissues. Signaling pathways. Oncogenes and tumor suppressor genes. Metabolic features of cancer cells. Molecular mechanisms of tumor progression. Metastasis. Neoangiogenesis. Matrix metalloproteinases – 3 hours.

Topic / Module 22: Pathobiochemistry of diseases affecting enamel, dentin, cementum, and periodontium – 2 hours.

Topic / Module 23: Endoplasmic reticulum stress. Metabolic alterations in the cell during hypoxia and ischemia/reperfusion – 1 hour.

Topic / Module 24: The phenomenon of aging at the cellular and organismal level. Genetic/epigenetic and pathobiochemical basis of aging. Age-related diseases (degenerative diseases, “diseases of civilization”). Factors determining cellular “immortality” – 2 hours.

Topic / Module 25: Cell death. Types. Signaling pathways. Influencing factors. Autophagy – 2 hours.

Topic / Module 26: Molecular mechanisms of cellular and tissue damage of different origin (mechanical, radiation, thermal, chemical). Disturbances in wound healing – 2 hours.

Topic / Module 27: Gene therapy – 1 hour.

Teaching and assessment methods:
Written assignment and oral interview

Competencies acquired as a result of training (3–5 points):
The acquired knowledge will expand and upgrade the medical-biological culture of doctoral students; will introduce them to modern data on molecular mechanisms and biochemical abnormalities involved in the origin and development of widespread pathological processes and diseases; will help develop them as specialists capable of working on solving important interdisciplinary problems; will direct their attention to the search for new strategies for early diagnosis and treatment of diseases, to the development and implementation of the so-called „personalized“ medicine.

Literature:

- Iozesf Mandl, Raymund Machovich. Medical Pathobiochemistry. 2014. ISBN: 978 963 226 407 3.
- Kazmierczak, S.C., H.M.E. Azzazy (Eds). Diagnostic Enzymology, 2nd Revised Edition. 2014. ISBN: 978 311 020 7248.
- Human Pathobiochemistry. From Clinical Studies to Molecular Mechanisms. EditorsToshitaka Oohashi, Hirokazu Tsukahara, Francesco Ramirez, Chad L. Barber, Fumio Otsuka. Springer, 2019. Hardcover ISBN978-981-13-2976-0; eBook ISBN978-981-13-2977-7
- Lectures continuously updated based on new scientific publications