УДК 577

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BIOPHYSICS AS AN INTERDISCIPLINARY SCIENCE

Abstract: *In this article, biophysics is considered as an interdisciplinary field.*

Key words: *biophysics, physics, biology, medicine, physical processes, cell*

БИОФИЗИКА КАК МЕЖДИСЦИПЛИНАРНАЯ НАУКА

Аннотация: *В этой статье биофизика рассматривается как междисциплинарная область.*

Ключевые слова: *биофизика, физика, биология, медицина, физические процессы, клетка*

Biophysics a science that studies the physical properties of biologically important molecules, molecular complexes, cells and complex biological systems, as well as the physical and physicochemical processes occurring in them.

Biophysical research is used in the study of the mechanisms of occurrence of human diseases, the development of new drugs, methods of treatment and diagnostics, as well as in the creation of modern medical technology.

The study of the physicochemical basis of biological phenomena occurring at the molecular level became possible thanks to the advances in physics and physical chemistry in the late 19th - early 20th centuries. As the methods of physicochemical research improved, the possibilities of biology expanded considerably. The intensive development of science was facilitated by the emergence of new physical methods - X-ray diffraction analysis, radiospectroscopy, precision spectrometry and spectrofluorimetry, electrometry, optical measurements, methods based on nuclear magnetic resonance (Nuclear magnetic resonance) (NMR), etc., as well as computer technology. The study of the phenomenon of NMR and the propagation of ultrasonic waves in tissues

using computer technology has led to the creation of new, promising diagnostic methods - NMR and ultrasound tomography. Methods are being developed for automatic decoding of the ECG, the study of human magnetic fields, modern methods of laboratory diagnostics based on the measurement of luminescence, chemiluminescence, light scattering. New devices for physiotherapy are being created, based on the action of ultra-high frequency oscillations in different frequency ranges, lasers of different spectra, UV radiation in combination with chemotherapy, etc.

Biophysics includes quantum biophysics, molecular biophysics, cell biophysics, and the biophysics of complex systems (organs, tissues, and the organism). Information from various sections of biophysics used in medicine is conventionally combined into a complex called "medical biophysics."

Quantum biophysics studies the interaction of light and biological structures (molecules, biological membranes, cells, tissues), as well as the electronic structure of biologically important compounds and its relationship with their chemical properties and biological activity. In this case, theoretical calculations of molecular orbitals, spectral and luminescence analysis (see Optical research methods), methods based on electron paramagnetic resonance in combination with the technique of pulsed and continuous irradiation of biological objects with various light sources, including lasers, at ordinary temperatures and under conditions deep cooling of objects with liquid nitrogen or helium. With the help of these methods, medical biology studies the primary processes that arise when UV radiation acts on the skin, cells, blood plasma, and the visual apparatus, the participation in them of protein molecules, nucleic acids, and coenzymes that have absorbed a quantum of light, as well as lipid oxidation products (see . Photobiological processes). In the presence of photosensitizing agents (Photosensitizing agents), these processes can occur when the body is irradiated not only with short-wavelength (240-300 nm), but also with long-wavelength (more than 300 nm) and even visible light. Intense

visible light, such as laser light, can induce photochemical reactions in active sites of enzymes that underlie the therapeutic mechanism of low-energy lasers (Lasers).

Of great interest is the study of the role of free radicals in the life of cells and the development of pathological processes in the body (see. Free radicals). As it turned out, the formation of free radicals can occur not only as a result of photochemical reactions or the action of ionizing radiation on cells, but also in the process of biochemical reactions that occur during the activation of phagocytic cells (macrophages and granulocytes). dysfunction of mitochondria and the system of hydroxylation of foreign compounds in the endoplasmic reticulum. The resulting reactive oxygen species, including the superoxide radical, have a strong cytotoxic effect. The study of the mechanism of these processes has led to the creation of methods for controlling their intensity, based on measuring chemiluminescence (luminescence arising from these reactions), as well as drugs that limit the development of free radical reactions - superoxide dismutase, tocopherol, retinol, etc.

Molecular biophysics studies the structure of macromolecules, their physical properties and the relationship between the structure of molecules and their function. The main objects of research are nucleic acids and proteins, as well as polysaccharides and lipid complexes. These studies contribute to the disclosure of the nature of a number of pathological processes, the development of genetic and protein engineering, which open up great prospects for the creation of the most effective methods of treating human diseases.

Biophysics, the science of the physical foundations of living matter. It is at the intersection of physics and biology and uses physical, chemical and mathematical methods to study the structure and functions of living systems.

Optical and diffraction methods are widely used to study cell structures and biomolecules. Such types of microscopy as phase contrast, fluorescence and confocal, allow visualization of cellular structures in visible light; scanning and

transmission microscopy provide the study of structures at a higher resolution; Electron diffraction microscopy is used for the structural analysis of samples with an ordered structure. Using the methods of X-ray structural analysis and neutron diffraction, the crystal structure is determined at the atomic level. Nuclear magnetic resonance (NMR) is used to study the structure of molecules in solution. Various spectroscopic methods also provide useful information: absorption and fluorescence spectroscopy in infrared, visible and ultraviolet light, circular dichroism and optical rotation dispersion.

Structural studies have already produced impressive results. Thus, using X-ray structural analysis, the structure of a number of proteins was determined, including: a protein responsible for the transformation of normal cells into cancerous ones; an enzyme involved in the replication of the immunodeficiency virus (AIDS virus); some specific proteins that bind to DNA; one of the enzymes that catalyze protein synthesis. The structure of the viruses that cause poliomyelitis and the common cold has been established.

The main question that arises when studying any biological system is the following: how does this system work? Biophysicists first investigate the system itself, then build a model that describes its behavior in some approximation, and then check and refine the original model. Usually, kinetic and thermodynamic parameters play an important role in building a model. Among the biological processes that can be studied by biophysical methods are the perception of light and sound by higher organisms, muscle contraction, the passage of a nerve impulse, the work of membrane channels and receptors, the conversion of energy in mitochondria (cell organelles), the functioning of proteins involved in the regulation of gene expression, the mechanism the action of enzymes. Experimental approaches to the study of all these processes differ, but any research is based on the analysis of the energetics of the process.

With the advent of computers, the construction of models of biological systems and the use of mathematical methods in biophysics moved to a

qualitatively new level. Without computers, it would be impossible to quickly process X-ray structural and NMR data, create complex models that correspond to the entire set of experimental data.

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