BIOCHEMICAL MECHANISMS OF APOPTOSIS

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Relevance. Apoptosis is a genetically programmed and highly regulated process of cell death that plays a crucial role in maintaining tissue homeostasis in the organism. Disruption of apoptotic processes has been shown to contribute to the development of various diseases. Insufficient apoptosis can lead to uncontrolled cell proliferation, creating conditions for cancer development. Therefore, an in-depth study of the biochemical mechanisms of apoptosis is essential for understanding intracellular signaling pathways, enzyme systems, and genetic regulatory processes. This knowledge serves as an important scientific basis for the development of new diagnostic methods and effective therapeutic strategies.

Objective of the study. The main aim of this study is to investigate the biochemical mechanisms of apoptosis, identify the key signaling pathways, enzyme systems, and genetic factors regulating this process, and analyze their role in maintaining organismal homeostasis. In addition, particular attention is given to the scientific evaluation of the functional significance of key components involved in apoptosis, including caspase enzymes, Bcl-2 family proteins that regulate cell death, and mitochondrial signaling pathways.

Materials and methods. The study is based on the analysis of scientific literature, textbooks, and contemporary research findings related to the biochemical and molecular mechanisms of programmed cell death (apoptosis). Molecular genetic and biochemical approaches were used for analysis. The mechanisms of apoptosis at the cellular level, signaling pathways, and interactions between intracellular enzyme systems were examined. Special focus was placed on the activation of caspase enzymes, mitochondrial-mediated signaling pathways, and the functional role of Bcl-2 family proteins in regulating cell death, based on scientific sources. Key biochemical processes such as DNA fragmentation, changes in mitochondrial membrane permeability, release of cytochrome c, and activation of intracellular signaling cascades were analyzed theoretically. General scientific methods including analysis, comparison, systematization, and theoretical generalization, along with comprehensive review of scientific sources, were applied. The obtained data were processed using an analytical approach to substantiate the biochemical mechanisms of apoptosis and their importance in maintaining cellular function and physiological balance in the organism.

Conclusion. The pathogenesis of many diseases is associated with нарушения (disruptions) in the key regulatory mechanisms of apoptosis. Identification of morphological and biochemical markers of apoptosis allows for a deeper understanding of disease pathogenesis, improvement of diagnostic approaches, and development of novel therapeutic strategies. Targeting apoptotic regulatory mechanisms may contribute to the creation of promising new drugs for the treatment of diseases associated with impaired cell death regulation.