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EPIGENETICS AND ITS ROLE IN DISEASE DEVELOPMENT.

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Annotation: This article reviews the biological basis of epigenetics and its important role in the development of diseases. Epigenetic mechanisms, including DNA methylation, histone modifications, and microRNAs, regulate gene expression without altering the DNA sequence and are important in cellular function and organismal adaptation. The article highlights the association of epigenetic changes with cancer, cardiovascular, metabolic, neurodegenerative, and immune diseases. The diagnostic and prognostic significance of epigenetic biomarkers and the prospects for epigenetic therapy are also reviewed.

Keywords: Epigenetics, Gene expression, DNA methylation, Histone modification, microRNA, Disease development, Epigenetic biomarkers, Epigenetic therapy, Environmental factors, Personalized medicine

Epigenetics is the field that studies the complex interactions between the human genome and the environment, which allows the control of gene expression without changing the DNA sequence. In recent years, the role of epigenetic mechanisms in the development of diseases has gained wide attention, as they are not only associated with genetic mutations, but are also sensitive to environmental, nutritional, stress and lifestyle factors. Epigenetic processes, including DNA methylation, histone modifications and microRNAs, regulate the activity of genes and thereby play an important role in cellular function, development and disease pathogenesis. These mechanisms ensure the adaptive response of the organism to various conditions without changing the innate genetic code. Therefore, epigenetic disorders are considered to be an important factor in the development of various pathological conditions, such as cancer, cardiovascular diseases, neurodegenerative diseases, metabolic diseases and immune system disorders. Modern research is aimed at identifying the relationship between epigenetic changes and diseases, which allows for early detection, diagnosis and development of individual treatment strategies for these diseases. At the same time, epigenetic therapy, that is, targeted modulation of epigenetic mechanisms using pharmacological agents, is one of the promising areas of modern medicine. The article provides a detailed analysis of the main types of epigenetic mechanisms, their role in the development of diseases, their clinical and prophylactic significance, as well as the prospects for modern research and epigenetic therapy. At the same time, it is emphasized that understanding the complex relationship between epigenetics and diseases is of great importance in the development of health care and individual treatment strategies. Epigenetics offers a revolutionary approach to human health and disease pathogenesis. This field allows for the control of gene expression without changing the DNA sequence, regulating cell function and ensuring adaptive responses to environmental factors. Studies show that disruptions in epigenetic

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mechanisms are an important factor in the development of various pathological conditions, such as cancer, cardiovascular diseases, metabolic diseases, neurodegenerative diseases and immune system dysfunction. By identifying and analyzing epigenetic changes, it is possible to conduct early diagnosis of diseases, assess their risk and develop individual treatment strategies. At the same time, targeted modulation using pharmacological agents through epigenetic therapy is one of the promising areas of modern medicine. This approach is important not only for the treatment of diseases, but also for the prevention and formation of a healthy lifestyle. It is worth noting that a deep understanding of the complex relationship between epigenetics and disease, through the integrative analysis of genetic and environmental factors, will allow for increased efficiency of the healthcare system and the development of individualized treatment methods. Therefore, the integration of epigenetic research and clinical practice is considered an important factor not only in improving patient health, but also in the future development of medicine. In conclusion, epigenetics is an important scientific basis for a deep understanding of disease pathogenesis and individualized treatment strategies, and plays a key role in increasing the effectiveness of modern medicine and preventive approaches.

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