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Epigenetics in Infectious Diseases: The Hidden Influence of Genetics and Epigenetics on Host-Pathogen Interactions and Therapeutic Strategies

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Abstract

Epigenetics is the study of heritable changes in gene expression or cellular phenotype that occur without alterations to the underlying DNA sequence. These changes can be influenced by various factors, including environmental exposures, lifestyle choices, and infectious diseases. Epigenetic modifications can affect gene activity by altering the accessibility of DNA to transcriptional machinery, thereby regulating gene expression.

In the context of infectious diseases, epigenetic mechanisms play a crucial role in modulating host-pathogen interactions. Here are some key points regarding epigenetics and infectious diseases:

1. **Immune response modulation:** Epigenetic modifications can influence the immune response to infectious agents. They can regulate the expression of genes involved in immune cell development, activation, and differentiation, as well as the production of cytokines and chemokines. These modifications can enhance or suppress the immune response, impacting the outcome of the infection.
2. **Viral latency and reactivation:** Certain viruses have the ability to establish latent infections, where they persist in a dormant state within the host cells. Epigenetic modifications, such as DNA methylation and histone modifications, play a role in establishing and maintaining viral latency. They can also contribute to viral reactivation by regulating the switch between latency and active replication.
3. **Host susceptibility and resistance:** Epigenetic factors can influence an individual's susceptibility or resistance to infectious diseases. For example, specific epigenetic marks may make certain individuals more prone to infection, while others may exhibit greater resistance. These variations can be influenced by genetic and environmental factors.
4. **Transgenerational effects:** Epigenetic changes induced by infectious diseases can potentially be inherited across generations. The transmission of epigenetic modifications to offspring can affect their susceptibility to infections or alter the immune response.
5. **Epigenetic-based therapies:** Understanding the epigenetic mechanisms underlying infectious diseases can lead to the development of novel therapeutic strategies. Epigenetic modifiers, such as DNA methylation inhibitors or histone deacetylase inhibitors, can be used to reactivate latent viruses or modulate the immune response to combat infections.



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It's important to note that the field of epigenetics and infectious diseases is still evolving, and research in this area continues to uncover new insights into the complex interactions between pathogens and host epigenetic regulation.