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Prespective

Targeting Viral Entry: New Frontiers in Antiviral Drug Development

Jmily Carter*

Department of Virology, Institute of Biomedical Sciences, California, USA

DESCRIPTION

Viral entry is a complex process orchestrated by viral surface proteins interacting with host cell receptors. This initial interaction determines the tropism and infectivity of the virus, making it an attractive target for therapeutic intervention. Traditional antiviral drugs often focus on inhibiting viral replication post-entry, but targeting viral entry offers distinct advantages. By preventing the virus from entering host cells, these drugs can halt infection at the outset, potentially curbing disease progression and transmission. One of the most promising approaches to targeting viral entry is the development of entry inhibitors, compounds that block the interaction between viral proteins and host cell receptors. These inhibitors can act at various stages of the entry process, including attachment, fusion, and endocytosis, offering multiple points of intervention. For example, fusion inhibitors such as enfuvirtide have revolutionized HIV treatment by blocking the fusion of viral and cellular membranes, preventing viral entry into T- lymp-lymphocyte cells. Moreover, advancements in structural biology computational modeling have enhanced our understanding of viral entry mechanisms, facilitating the rational design of entry inhibitors. By elucidating the atomic-level interactions between viral proteins and host receptors, researchers can identify druggable targets and develop potent inhibitors with improved efficacy and specificity. This multidisciplinary approach has led to the discovery of novel entry inhibitors targeting a wide range of viruses, including influenza, Ebola, and SARS-CoV-2. Another promising frontier in antiviral drug development is the exploitation of host factors involved in viral entry. Viruses hijack various host cell components to facilitate entry, offering alternative targets for therapeutic intervention. By targeting host proteins essential for viral entry, such as cell surface receptors or co-factors, researchers can disrupt the interaction between the virus and host cell, effectively blocking viral entry without directly targeting the virus itself. This host-targeted approach not only expands the repertoire of potential drug targets but also reduces the risk of viral resistance. Furthermore, the advent of genome editing technologies such as CRISPR-Cas provides unprecedented opportunities to target viral entry pathways at the genetic level. By engineering host cells to express resistant or modified receptors, researchers can render cells impervious to viral entry, offering a potential long-term solution to viral infections. Additionally, CRISPR-based screens enable the systematic identification of host factors essential for viral entry, paving the way for the development of novel entry inhibitors and host-targeted therapies. Despite the immense potential of targeting viral entry, several challenges remain to be addressed. One major hurdle is the high mutation rate of many viruses, which can lead to the emergence of drug-resistant variants. To mitigate this risk, combination therapies targeting multiple stages of the viral lifecycle may be necessary to prevent the emergence of resistance. Additionally, the development of entry inhibitors for emerging and neglected viruses poses unique challenges due to limited knowledge of their entry mechanisms and host interactions. In conclusion, targeting viral entry represents a promising approach in antiviral drug development, offering new frontiers in the fight against viral infections. By intercepting the initial stages of infection, entry inhibitors and host-targeted therapies can prevent viral replication and transmission, potentially revolutionizing the treatment of viral diseases. Continued research into the molecular mechanisms of viral entry, coupled with innovative drug discovery strategies, holds the key to unlocking the full therapeutic potential of this approach. As we stand on the cusp of a new era in antiviral drug development, targeting viral entry offers hope for combating both current and future viral threats. By harnessing the power of scientific innovation and collaboration, we can show the path towards a world where viral infections are no longer a global health burden.

Correspondence to: Jmily Carter, Department of Virology, Institute of Biomedical Sciences, California, USA, E-mail: mily.carter@halld.com

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