OPEN ACCESS Freely available online

Journal of Antivirals & Antiretrovirals

Commentary

The Role of T Cells in Viral Immunity: A Critical Review

Thomas Oscar*

Department of Virology, University of Ghent, Ghent, Belgium

DESCRIPTION

Among the various components of the immune system, T cells play a central role in the defense against viral infections. These cells are essential for recognizing and eliminating infected cells, thereby preventing the spread of viruses within the host. T cells not only directly target and destroy infected cells but also help orchestrate the broader immune response. This review critically examines the role of T cells in viral immunity, highlighting their mechanisms of action, the different types of T cells involved, and their importance in both acute and chronic viral infections. They are essential for cell-mediated immunity, a process that involves the direct destruction of infected or altered cells. T cells are broadly categorized into two main types. $CD8^+$ Cytotoxic T Lymphocytes (CTLs) and $CD4^+$ helper T cells. Both types of T cells contribute to the immune response against viral infections, albeit through different mechanisms. $CD8^+$ T cells, or Cytotoxic T Lymphocytes (CTLs), are primarily responsible for directly killing virus-infected cells. Once activated, CTLs recognize viral peptides presented on the surface of infected cells by Major Histocompatibility Complex (MHC) class I molecules. Upon recognition, CTLs release cytotoxic granules containing perforin and granzymes, which induce apoptosis in the infected cells. This process is crucial for limiting the spread of the virus and eliminating the infection. In addition to their cytotoxic function, CTLs also secrete cytokines such as Interferon-Gamma (IFN-γ), which enhances the antiviral state of neighboring cells and helps recruit other immune cells to the site of infection.

$CD4^+$ T cells, also known as helper T cells, do not directly kill infected cells but play a key role in coordinating the immune response. Upon activation, $CD4^+$ T cells differentiate into various subsets, including Th1, Th2, Th17, and regulatory T cells (Tregs), each with distinct functions. Th1 cells, in particular, are important in viral immunity, as they produce cytokines like IFN-γ and Interleukin-2 (IL-2), which support the activation and proliferation of CTLs and enhance macrophage activity. Without this help, the humoral immune response would be significantly impaired, leading to inadequate viral clearance. The activation of T cells during viral infection is a highly regulated process. It begins with the recognition of viral antigens presented by Antigen-Presenting Cells (APCs) such as dendritic cells. The interaction between the T Cell Receptor (TCR) on T cells and the MHC-peptide complex on APCs, along with co-stimulatory signals, leads to the activation and clonal expansion of T cells. One of the most remarkable features of the T cell response is the formation of memory T cells. After the clearance of an acute viral infection, a subset of T cells persists as memory cells, which provide long-lasting immunity.

In acute viral infections, such as influenza or acute respiratory infections, T cells are essential for the rapid clearance of the virus. The effectiveness of the CTL response is often a determinant of the severity and duration of the infection. For instance, in cases of influenza, a robust CTL response is associated with faster recovery and reduced disease severity. They help sustain the CTL response by providing essential cytokines and by enhancing the function of macrophages and other immune cells. Chronic viral infections, such as those caused by Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV), present unique challenges to the immune system. In these infections, the virus persists in the host for extended periods, often leading to immune exhaustion. Exhausted T cells exhibit reduced effector functions, diminished cytokine production, and upregulation of inhibitory receptors such as Programmed Death-1 (PD-1). In chronic infections, the ability of T cells to control the virus is often compromised, allowing the virus to persist and cause long-term damage. Despite this, T cells still play a important role in managing chronic viral infections. For example, in HIV, a subset of CTLs known as "elite controllers" are able to maintain viral suppression without antiretroviral therapy, largely due to the presence of highly effective T cell responses. Viruses have evolved numerous mechanisms to evade T cell-mediated immunity, which can complicate the immune response and lead to persistent infections. Some of these mechanisms include. Certain viruses, such as Cytomegalovirus (CMV) and HIV, can downregulate Major Histocompatibility Complex (MHC) class I molecules on the surface of infected cells, making it more difficult for CTLs to recognize and eliminate these cells. This is particularly problematic in rapidly mutating viruses like HIV and influenza. Some viruses produce proteins that interfere with

Correspondence to: Thomas Oscar, Department of Virology, University of Ghent, Ghent, Belgium, E-mail: thomasoscar27@sina.com

Received: 02-Sep-2024, Manuscript No. JAA-24-33782; **Editor assigned:** 04-Sep-2024, PreQC No. JAA-24-33782 (PQ); **Reviewed:** 18-Sep-2024, QC No. JAA-24-33782; **Revised:** 25-Sep-2024, Manuscript No. JAA-24-33782 (R); **Published:** 02-Oct-2024, DOI: 10.35248/1948-5964.24.16.348

Citation: Oscar T (2024). The Role of T Cells in Viral Immunity: A Critical Review. J Antivir Antiretrovir. 16:348.

T cell activation pathways, preventing the effective initiation of the immune response.

CONCLUSION

T cells are indispensable to the immune system's ability to combat viral infections. Their roles in directly killing infected cells, coordinating the broader immune response, and forming immunological memory are essential for both the immediate control of viral infections and long-term immunity. While T cells are highly effective in managing acute viral infections, chronic infections pose significant challenges due to viral evasion strategies and the potential for T cell exhaustion. As research continues, strategies to enhance T cell function, reverse exhaustion, and prevent viral evasion are likely to play an increasingly important role in the fight against both acute and chronic viral infections.