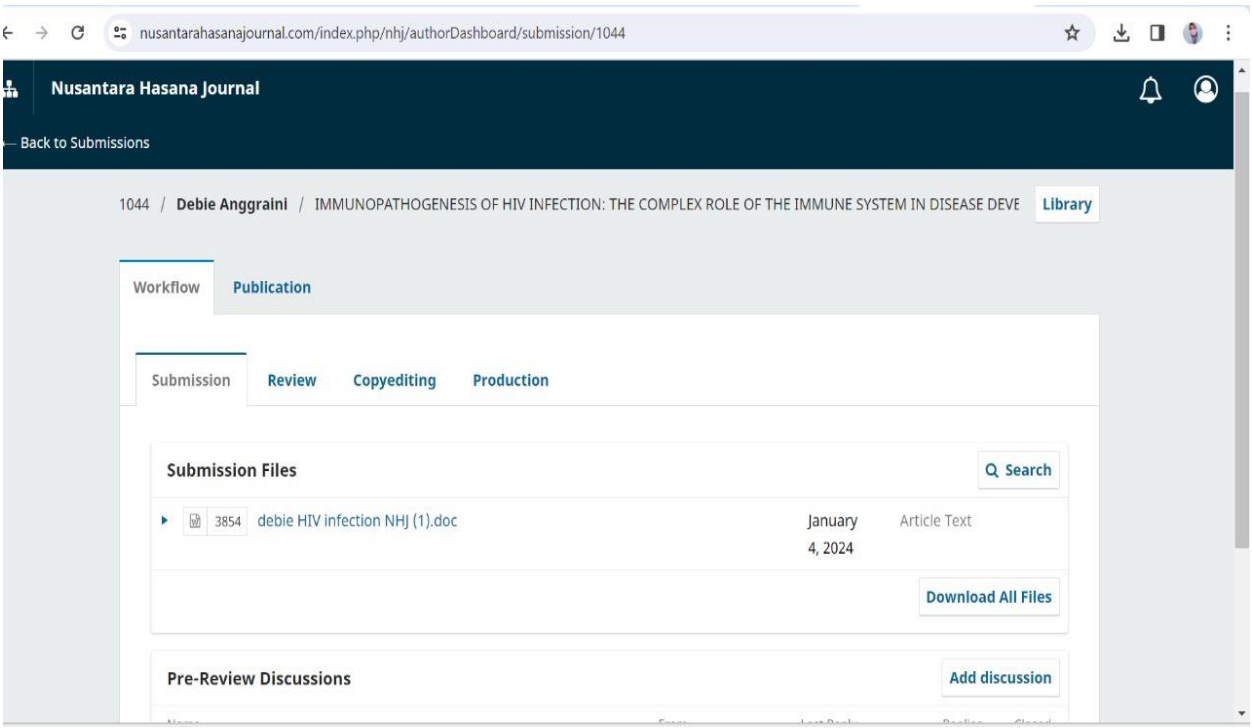
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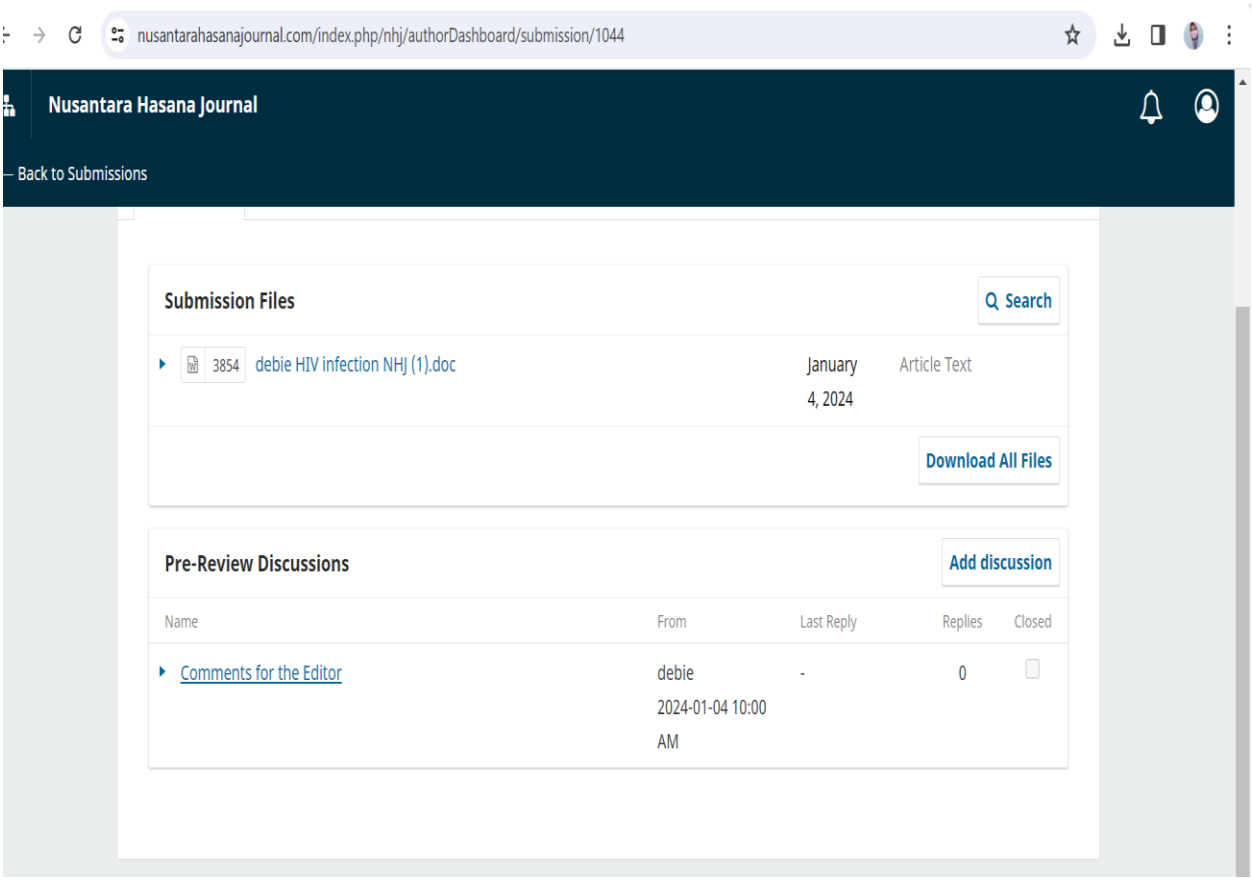
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Mataram, 26 November 2023

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Nusantara Hasana Journal
July 2021, Vol. 1 No. 1, 1-11

ISSN: ….-….

Immunopathogenesis of HIV Infection: The Complex Role of the Immune System in Disease Development and Control

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Abstract:
Human immunodeficiency virus (HIV) infection remains a global challenge in public health, and a deeper understanding of its immunopathogenesis is essential for the development of more effective therapies and more efficient vaccines. the complexity of the interaction between HIV and the human immune system leads to a diverse course of the disease. Explanation of the main role of immune system components in detecting and responding to HIV infection, with special emphasis on the role of CD4+ T cells and the evation mechanisms applied by the HIV virus to avoid destruction by the immune system as well as the impact of HIV infection on dendritic cells, which play an important role in antigen presentation and initiation of immune response. We discuss how HIV utilizes dendritic cells for more efficient dissemination in the body and its impact on specific immunity. By integrating an in-depth understanding of the interaction between HIV and the immune system, this article aims to provide comprehensive insight into the immunopathogenesis of HIV infection and highlight future research directions to combat the disease. A better understanding of these complexities will hopefully support more effective HIV prevention and control efforts in the future.
Keywords: (12pt Times New Roman/Arial, Italic, Left)
Human Immunodeficiency Virus (HIV), Infection, Immunopathogenesis, Vaccines Mechanism

Abstrak

Infeksi Human Immunodeficiency Virus (HIV) tetap menjadi tantangan global dalam bidang kesehatan masyarakat, dan pemahaman yang lebih dalam tentang imunopatogenesisnya sangat penting untuk pengembangan terapi yang lebih efektif dan vaksin yang lebih efisien. kompleksitas interaksi antara HIV dan sistem kekebalan tubuh manusia yang mengarah pada perjalanan penyakit yang beragam. Penjelasan mengenai peran utama komponen sistem kekebalan tubuh dalam mendeteksi dan merespons infeksi HIV, dengan penekanan khusus pada peran sel T CD4+serta mekanisme evasi yang diterapkan oleh virus HIV untuk menghindari penghancuran oleh sistem kekebalan serta dampak infeksi HIV pada sel-sel dendritik, yang berperan penting dalam presentasi antigen dan inisiasi respons kekebalan tubuh. Kami membahas bagaimana HIV memanfaatkan sel-sel dendritik untuk penyebaran yang lebih efisien dalam tubuh dan dampaknya terhadap kekebalan spesifik. Dengan mengintegrasikan pemahaman mendalam tentang interaksi antara HIV dan sistem kekebalan tubuh, artikel ini bertujuan untuk memberikan wawasan yang komprehensif tentang imunopatogenesis infeksi HIV dan menyoroti arah penelitian masa depan untuk memerangi penyakit ini. Pemahaman yang lebih baik tentang kompleksitas ini diharapkan akan mendukung upaya pencegahan dan pengendalian HIV yang lebih efektif di masa depan.
Kata Kunci : *Human Immunodeficiency Virus*, Infeksi, Imunopatogenesis, Mekanisme Vaksin

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July 2021, Vol. 1 No. 1, 1-11

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1. INTRODUCTION

Human Immunodeficiency Virus (HIV) is a virus that has been of global concern in the field of public health since its discovery in the 1980s. HIV causes Immune Deficiency Syndrome (AIDS), which damages the human immune system and makes individuals vulnerable to various infections and diseases. Today, more than 38 million people worldwide are living with HIV, with millions of new cases diagnosed each year. The virus affects a wide range of population groups, including men, women, children, as well as high-risk groups such as injecting drug users, commercial sex workers, and same-sex couples. HIV infection not only has serious medical repercussions, but also significant social and economic repercussions on a global level

HIV is a retrovirus virus of two main types, namely HIV-1 and HIV-2, with HIV-1 being the most common and pathogenic. The virus has a unique structure that allows it to infect immune cells, specifically CD4+ T cells, which are an important part of the body's defense system. The structure of the HIV virus includes two main layers: Envelop (Envelope): This is the outer layer of the virus containing glycoproteins gp120 and gp41 that allows the virus to bind to target cells and enter those cells. Capsid: This is the inner layer that contains HIV's genetic material in the form of RNA, as well as the enzymes necessary for viral replication

An understanding of the structure of the HIV virus is important because it allows us to understand how it interacts with the cells of the human body and why the immune system cannot always cope with it. Research on the structure of this virus has been the basis for the development of therapies and vaccines aimed at controlling and preventing HIV infection. HIV immunopathogenesis is a complex process that explains how the Human Immunodeficiency Virus (HIV) interacts with the human immune system and how such infection leads to decreased immune function. It involves a series of events and changes at the cellular and molecular level that occur during the development of HIV infection.

2. METHODS

HIV immunopathogenesis

HIV infection begins when the virus enters the human body through contact with blood, mucus, or other body fluids. The virus has the ability to infect target cells, which are mainly CD4+ T cells. Dendritic cells and macrophages play a role in the introduction of HIV antigens. They capture the virus and present HIV antigens to CD4+ T cells.CD4+ T cells are an important component of the immune system and play a role in coordinating the immune response. HIV recognizes CD4+ T cell surface proteins and uses these proteins as entry points into cells. Once inside, HIV replicates in CD4+ T cells, destroys those cells, and produces more virus. CD4+ T cells are activated when they interact with dendritic cells that present HIV antigens. These activated CD4+ T cells can coordinate the body's immune response and stimulate the activation of CD8+ T cells. CD8+ T cells are activated against HIV-infected cells. They recognized these cells based on HIV antigens presented by CD4+ T cells. Activated CD8+ T cells will multiply and attempt to destroy infected cells. During the progression of HIV infection, the number of CD4+ T cells in the blood continues to decline as these cells continue to be infected and destroyed by the virus. A drastic decrease in CD4+ T cell count results in decreased immune system function. HIV also interferes with the function of other immune cells, including dendritic cells and macrophage cells. This causes the immune system to be unable to respond effectively

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to other infections. As a result, HIV-infected individuals become susceptible to opportunistic infections, such as Pneumocystis pneumonia, tuberculosis, and other infections. HIV immunopathogenesis continues for many years, and if left untreated, can lead to the acquisition of Acquired Immunodeficiency Syndrome (AIDS). AIDS is an advanced stage of HIV infection, characterized by a drastic decrease in CD4+ T cell count and prone to severe opportunistic infections. Without treatment, AIDS can result in death. Genetic variations in HIV, along with ongoing mutations, allow the virus to evade detection by the immune system and become more resistant to therapy. This makes the development of effective vaccines and treatments more difficult.Understanding HIV immunopathogenesis is key to developing more effective therapies and vaccines that can prevent infection. Research continues to deepen the interaction between the virus and the immune system and to develop better treatment strategies to control HIV infection

The initial infection stage and the viral proliferation stage are two key stages in HIV immunopathogenesis that have a significant impact on the human immune system. An understanding of this process is critical in the development of more effective therapies and vaccines that can prevent HIV infection.

3. DISSCUSION

The windows period in HIV Infection

The windows period (also called the immunological window) in the context of HIV infection is the period of time between when a person is infected with HIV and when an HIV test can reliably detect the presence of the virus in the blood. During the window, an HIV test may give a negative result even though a person has been infected. This happens because the immune system has not produced enough amount of antibodies to be detected by an HIV test.

The windows period is a very important period in HIV testing, as it can affect the results of tests and diagnoses given to individuals who may be exposed to the virus. Here are some important things to understand about the HIV window period.

1. Windows Period Duration: The HIV window period varies from individual to individual, but generally ranges from 2 to 12 weeks (6 to 12 weeks is the more common period). In some rare cases, the windows period can be longer.
2. Types of HIV Tests: This type of HIV test can also affect the window period. First-generation HIV antibody tests have a longer window of time than more modern second- or third-generation tests. Antigen screening tests or PCR (Polymerase Chain Reaction) tests can detect the HIV virus earlier than antibody tests.
3. High Risk: People at high risk of HIV infection, such as those who have unprotected sex with a potentially infected partner, need to wait until the end of the window before getting tested for HIV. This is to ensure accurate results.
4. Follow-up tests: If a person experiences symptoms of HIV infection or has special concerns, follow-up tests such as PCR tests or antigen screening tests may be recommended because of their ability to detect the virus earlier than antibody tests.
5. Protection During the Windows Period: During the window period, a person at risk of HIV infection should still use preventive measures such as condom use and avoid sharing needles if they engage in risky behaviors

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July 2021, Vol. 1 No. 1, 1-11

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It is important to remember that the windows period are sensitive periods, and a negative HIV test result during this period does not guarantee that a person is not infected. If there is concern or risk of exposure to HIV, consultation with a medical professional or HIV-related health clinic can provide more detailed guidance on appropriate testing and the appropriate timeframe for testing based on the individual's situation.

Treg cells (regulatory T-cells or regulatory T cells) are a type of T cell that has a special role in regulating the body's immune response. The role of Treg cells in HIV infection is complex, and they play an ambiguous role in infection dynamics. Here are some aspects of Treg cells' role in HIV infection: Immune Response Regulation: Treg cells are known for their ability to regulate the activity of pro-inflammatory T cells, such as conventional CD4+ T cells and CD8+ T cells, to avoid excessive or overly damaging immune responses. In the context of HIV infection, it can help reduce excessive inflammation that can damage body tissues

Reduced Immune Response to HIV Virus: One impact of Treg cells' regulatory role is that they can reduce the body's immune response to HIV. This is because Treg cells can inhibit the activation and proliferation of CD4+ T cells which are essential for fighting viral infections. Inhibition of Vaccine Response: Treg cells can also inhibit the vaccine response to HIV. This is a significant problem in HIV vaccine development efforts, as an effective vaccine response requires the activation of strong CD4+ and CD8+ T cells. Regulates the Sustainability of HIV Infection: Several studies have shown that in some cases, an increase in the number of Treg cells can contribute to the sustainability of HIV infection in the body. This is because Treg cells can help HIV evade detection by the immune system and increase the ability of the virus to survive in the body Although Treg cells can have a negative impact on the body's efforts to control HIV infection, they are also important to avoid excessive inflammation that can damage body tissues. Therefore, research continues to better understand the role of Treg cells in HIV infection and to look for ways to regulate their interaction with other CD4+ T cells in an effort to develop more effective therapies and efficient vaccines.

Immunology, vaccination and HIV Infection Theraphy

1. Antiretroviral Therapy (ART): What is ART? Antiretroviral therapy (ART) is the use of a combination of antiretroviral drugs to treat HIV infection. These drugs work by various mechanisms to inhibit the development of the HIV virus in the body. Purpose of ART: The main purpose of ART is to suppress the reproduction of the HIV virus in the body, reduce the amount of virus in the blood (viral load), and restore immune system function. This helps maintain the health of infected individuals and also reduces the risk of transmitting the virus to others.
2. Drug Combinations: ART usually consists of a combination of drugs from several classes, such as nucleotide reverse transcriptase inhibitors, non-nucleoside reverse transcriptase inhibitors, and protease inhibitors. The combined use of these drugs is called therapy with three or more drugs. Adherence and Side Effects: Good adherence to ART is critical to successful HIV therapy. Side effects of medications are a common problem, but they can often be managed. Most people who undergo ART can lead normal, healthy lives.
3. Drug Resistance: HIV has a high mutation rate, which can lead to the development of resistance to drugs. Therefore, it is important to follow the recommendations of the doctor and undergo regular monitoring during therapy.

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Nusantara Hasana Journal
July 2021, Vol. 1 No. 1, 1-11

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Role of Vaccines in HIV

Primary Prevention: An effective HIV vaccine will be a powerful primary prevention tool to prevent infection in uninfected individuals. This will be a key step in reducing the number of new HIV cases.

Secondary Prevention: In addition, vaccines can also be used in the context of secondary prevention, which is to reduce the risk of HIV transmission from infected individuals to other individuals. HIV Vaccine Research continues to develop an effective HIV vaccine. There are a variety of approaches being tested, including vaccines that stimulate antibody responses and strong T cells against viruses. Importance of Vaccination HIV development is an important goal in controlling the HIV pandemic. While there are still some challenges in vaccine development, great hope is for ongoing research and global collaboration to achieve significant progress in this effort.

HIV control involves a combination of strategies including antiretroviral therapy, transmission prevention, testing, community education, and vaccine research. There continues to be a major effort to address challenges in controlling the HIV pandemic and improving care and support for infected individuals. Good adherence to ART is essential. This involves taking medicines according to a schedule prescribed by the doctor and regular monitoring. Good adherence helps prevent the development of drug resistance and ensures the effectiveness of treatment. Implementation of evidence-based approaches in HIV treatment and prevention is key to success. This includes the use of proven effective strategies and ongoing research to improve understanding and treatments. Global Collaboration of The HIV pandemic is a global problem, and global collaboration in research, vaccine development, and prevention efforts is essential. Cooperation between countries and international organizations is key in HIV control

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4. CONCLUSION AND RECOMENDATION

The main conclusion is that HIV treatment and prevention is a complex and multidimensional effort. The combination of appropriate antiretroviral therapy, effective prevention, stigma reduction, vaccine development, and global collaboration are important factors in controlling the HIV pandemic and improving the quality of life of infected individuals. There continues to be a major effort in research and implementation to address the challenges in this effort and towards an HIV-free world.

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