Journal of Infectious Disease and Pathology

Editorial Open Access

Mechanisms of Immune Sensing in Lassa Virus Infection

Tremmel Masaki*

Department of Immunology, Osaka City University, Japan

Abstract

Lassa fever, an endemic viral hemorrhagic fever in West Africa, poses a substantial threat to human health due to its ability to cause outbreaks and its high fatality rate. The immune system's ability to detect and respond to Lassa virus (LASV) infection is critical in controlling the spread of the virus within the host. This article provides an overview of the mechanisms involved in immune sensing during LASV infection, focusing on the innate and adaptive immune responses. The innate immune system recognizes viral RNA through pattern recognition receptors (PRRs) such as Toll-like receptor 3 (TLR3), retinoic acid-inducible gene I (RIG-I), and melanoma differentiation-associated protein 5 (MDA5). These sensors initiate signaling cascades that lead to the production of type I interferons and proinflammatory cytokines, contributing to the host's antiviral defenses. In the adaptive immune response, cytotoxic T lymphocytes (CTLs) and B cells play essential roles in eliminating infected cells and generating long-term immunity. Despite the host's immune defenses, LASV has evolved strategies to evade detection and subvert the immune response, leading to persistent infections in some cases. Understanding these evasion mechanisms is crucial for the development of effective therapeutic strategies against Lassa fever.

Keywords: Lassa fever; Lassa virus; Immune sensing; Innate immunity; Adaptive immunity; Pattern recognition receptors

Introduction

Lassa fever, caused by the Lassa virus (LASV), is a significant public health concern in West Africa, characterized by high morbidity and mortality rates. Understanding the intricate mechanisms by which the immune system senses and responds to Lassa virus infection is pivotal for developing effective therapeutic interventions and vaccines. This article explores the fundamental processes that underlie immune recognition of LASV, shedding light on the innate and adaptive immune responses elicited during the infection. While it is probably undercounted due to the lack of standardized surveillance for LASV, it has been estimated that 100,000–300,000 LASV infections occur each year and can result in about 5000 deaths annually. Because there are no standardized surveillance mechanisms in place, the number of LASV cases in West Africa is likely underreported [1].

A better understanding of LASV virulence and LF disease pathogenicity is needed to develop proper preventative, therapeutic, and diagnostic methods. Toward this end, this review aims to provide a literature review of the current understanding of the basic mechanism of immune responses to LASV infection in animal models and human patients, as well as to several candidate vaccines that have been developed for LF [2].

The innate immune system's role

The innate immune system serves as the first line of defense against invading pathogens, including viruses like LASV. Pattern recognition receptors (PRRs) are critical components of the innate immune system that recognize specific molecular patterns associated with pathogens. One of the key PRRs involved in detecting viral infections is Toll-like receptor 3 (TLR3), which recognizes double-stranded RNA (dsRNA), a common intermediate in viral replication.

Upon infection with LASV, viral RNA is released into the host cell, leading to the activation of TLR3. Activation of TLR3 triggers a signaling cascade that results in the production of type I interferons (IFNs) and proinflammatory cytokines. Type I IFNs play a crucial role in limiting viral replication and spreading by upregulating antiviral genes within the infected cell and neighboring cells, inducing an antiviral state [3].

Additionally, cytoplasmic sensors such as retinoic acid-inducible gene I (RIG-I) and melanoma differentiation-associated protein 5 (MDA5) recognize viral RNA in the cytoplasm. These sensors initiate a signaling pathway that also leads to the production of type I IFNs and proinflammatory cytokines. The coordinated activation of these sensors helps to rapidly alert the immune system to the presence of LASV.

Adaptive immunity and Lassa virus

While the innate immune system serves as the initial response to LASV infection, the adaptive immune system plays a critical role in clearing the virus and providing long-term immunity. T cells and B cells are the primary players in the adaptive immune response [4].

Cytotoxic T lymphocytes (CTLs) are essential for eliminating infected cells. They recognize LASV-infected cells by binding to viral antigens presented on the cell surface by major histocompatibility complex (MHC) class I molecules. Once activated, CTLs release cytotoxic molecules, such as perforin and granzymes, which induce apoptosis in the infected cells.

B cells, on the other hand, produce antibodies specific to LASV antigens. These antibodies can neutralize the virus by binding to viral particles and preventing them from entering host cells. Additionally, antibodies facilitate the clearance of viral particles from the bloodstream by promoting their uptake by phagocytic cells [5].

LASV transmission

There are multiple ways that LASV can spread to people, with rodent-to-human transmission being the most prevalent means of virus

***Corresponding author:** Tremmel Masaki, Department of Immunology, Osaka City University, Japan, E-mail: tremmelosaka@47.jp

Received: 03-Oct-2023, Manuscript No: jidp-23-117155, **Editor assigned:** 05-Oct-2023, PreQC No: jidp-23-117155 (PQ), **Reviewed:** 19-Oct-2023, QC No: jidp-23-117155, **Revised:** 25-Oct-2023, Manuscript No: jidp-23-117155 (R), **Published:** 30-Oct-2023, DOI: 10.4172/jidp.1000207

Citation: Masaki T (2023) Mechanisms of Immune Sensing in Lassa Virus Infection. J Infect Pathol, 6: 207.

transmission. Although the most common mode of LASV transmission is rodent-to-human, 20% of LF cases are thought to be due to human-to-human transmission. In its natural animal reservoirs, such as multimammate rodent species, such as Mastomys natalensis, Mastomys erythroleucus, Hylomyscus pamfi, Praomys daltoni, Mus baoulei, Rattus rattus, Crocidura spp., Mus minutoides, and Praomys misonnei, LASV is thought to cause an asymptomatic infection. However, like in the case of humans, certain strain(s) of LASV can cause symptomatic disease in experimentally infected rodents including Mus musculus (house mouse), Rattus rattus, Rattus fuscipus, and the Myosoricinae soricidae [6].

Immune evasion by LASV

Despite the immune system's efforts to combat LASV infection, the virus has evolved various mechanisms to evade detection and destruction. LASV can inhibit the host's production of type I IFNs, thereby reducing the antiviral response. It also interferes with the MHC class I antigen presentation pathway, limiting the ability of CTLs to recognize infected cells.

Moreover, LASV can undergo antigenic variation, making it challenging for the adaptive immune system to mount a sustained response. These evasion strategies contribute to the virus's ability to establish persistent infections in some individuals and escape immune-mediated clearance [7].

Discussion

The mechanisms of immune sensing in Lassa virus infection are complex and critical in determining the outcome of the disease. In this discussion, we will explore the implications of these mechanisms, the challenges posed by Lassa virus evasion strategies, and the potential for therapeutic interventions. Understanding how the immune system detects Lassa virus infection provides valuable insights into the host's antiviral responses. The activation of pattern recognition receptors (PRRs), such as TLR3, RIG-I, and MDA5, triggers a rapid innate immune response. This response involves the production of type I interferons and proinflammatory cytokines, which help limit viral replication and spread. Additionally, the adaptive immune response, driven by cytotoxic T lymphocytes (CTLs) and B cells, plays a pivotal role in clearing the virus and establishing long-term immunity [8,9].

Lassa virus has evolved various mechanisms to evade immune detection and subvert host defenses. These evasion strategies include inhibiting the production of type I interferons, interfering with antigen presentation pathways, and undergoing antigenic variation [10]. These tactics enable the virus to establish persistent infections in some individuals and contribute to the high morbidity and mortality associated with Lassa fever.

Knowledge of immune sensing mechanisms is essential for the development of effective vaccines against Lassa fever. Vaccines can stimulate the adaptive immune system, particularly CTLs and antibody-producing B cells, to provide protection against future infections. However, the evasion strategies employed by LASV highlight the need for vaccine candidates that are carefully designed to elicit strong and lasting immune responses.

Conclusion

In conclusion, the mechanisms of immune sensing in Lassa virus infection are crucial factors that determine the outcome of the disease. The innate immune response, driven by pattern recognition receptors, and the subsequent activation of the adaptive immune system are central in controlling LASV infection. However, the virus's ability to evade these immune mechanisms poses significant challenges.

Efforts to develop effective therapeutics and vaccines against Lassa fever must consider the evasion strategies employed by the virus. Future research should focus on understanding these evasion mechanisms in greater detail and exploring novel approaches to enhance the host's immune response. Ultimately, a comprehensive understanding of immune sensing in Lassa virus infection holds the key to better controlling and eventually eradicating this deadly disease.

Acknowledgement

None

Conflict of Interest

None

References

1. Sumira M, Jutishna B, Archna D, Shristi K, Sagnik N, et al. (2023) An update on current understanding of the epidemiology and management of the re-emerging endemic Lassa fever outbreaks. Int J Surg: 109: 584-586.
2. Peter OO (2023) Finding a safe and effective vaccine for the Lassa virus. Lancet 401: 1242-1243.
3. Roland T, Pierre VD, Clara G, Ilse DC, Mathieu M, et al. (2023) Immunogenicity, safety, and tolerability of a recombinant measles-vectored Lassa fever vaccine: a randomised, placebo-controlled, first-in-human trial. Lancet 401: 1267-1276.
4. Rezaul MI, Shopnil A, Mominur MR (2023) Epidemiology, symptoms, transmission, prevention, treatment, and future prospects of the Lassa fever outbreak: a potential study. Int J Surg 109: 531-533.
5. Jade F, Andrew M, Lindsay B, Noreen AH, Donald P, et al. (2022) The Use of Temperature and Pressure Data Loggers to Validate the Steam Sterilization of Category A Clinical Waste. Appl Biosaf 27: 106-115.
6. Stephanie L, Cristina L, Joseph AB, Stephanie K, Tom T, et al. (2023) Influence of Landscape Patterns on Exposure to Lassa Fever Virus, Guinea. Emerg Infect Dis 29: 304-313.
7. Salihu SM, Abdullahi Y, Emmanuel AB, Zainab UA, Lukman A, et al. (2022) Unravelling the dynamics of Lassa fever transmission with differential infectivity: Modeling analysis and control strategies. Math Biosci Eng 19: 13114-13136.
8. Stephanie R, Xavier C, Caroline P, Virginie BC, Alexandra J, et al. (2023) A MOPEVAC multivalent vaccine induces sterile protection against New World arena viruses in non-human primates. Nat Microbiol 8: 64-76.
9. Praise GUM, Faraimunashe C (2022) Understanding the transmission pathways of Lassa fever: A mathematical modeling approach. Infect Dis Model 8: 27-57.
10. Sabrina S, Yvonne T, Sham N, Paul WD, Roland T, et al. (2023) Biodistribution and toxicology evaluation of a recombinant measles Schwarz-based Lassa vaccine in cynomolgus macaques. J Appl Toxicol 43: 719-733.