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Ebola Virus Disease: Diagnostic Techniques and Therapeutic Approaches

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Abstract

Ebola virus is associated with adverse indirect effects since resources are diverted from programs aimed at controlling important diseases such as malaria, tuberculosis, and HIV infection. We hypothesize that a significant burden of Ebola viral disease if undetected may lead to missed opportunities for prevention and heighten the risk for large-scale outbreaks and pandemics. Further, Ebola is associated with high fatality rate and significant socio-economic impact. Therefore, the need for a rapid diagnostic technique to be used at the point of care, universal Polyvalent-Ebola virus vaccine, and effective anti-Ebola drug cannot be overemphasized. Thus, this review focuses on the availability, suitability, and significance of current advances in diagnostics, vaccines, and therapeutic options for the Ebola disease and the need to develop novel vaccines and antiviral therapies that are effective against all known Ebola virus species. The disease is considered among the top five most dangerous diseases, as captured in the list of prioritized diseases. The significance of Ebola hemorrhagic fever lies on its morbidity, the splanchnic manner in which it kills the high mortality rate and absence of efficacious drugs. As such, Ebola virus disease has become a global public health burden that has led to major epidemics in resource-poor settings and posing an imminent threat of global pandemics. Thus, the Ebola virus is identified as a bio-safety level-4 pathogen and CDC category A-agents of bioterrorism.

Keywords: Ebola virus; Diagnostics; Vaccines; Antiviral drugs

Introduction

Ebola Virus Disease (EVD), also known as Ebola hemorrhagic fever, is a severe and often fatal illness caused by the Ebola virus. It gained worldwide attention during the devastating outbreak in West Africa from 2013 to 2016, which claimed thousands of lives [1]. Timely and accurate diagnosis of Ebola is crucial for effective disease management and containment. Additionally, the development of therapeutic approaches has played a significant role in improving patient outcomes and reducing mortality rates. In this article, we will explore the diagnostic techniques used to identify Ebola virus infection and the latest therapeutic approaches being developed to combat this deadly disease. The unfamiliarity with the Ebola virus disease outside the endemic areas usually leads to delayed diagnosis and management response thus precipitating the spread of Ebola virus disease in the population.

Ebolavirus

Muyembe is head of the DRC's Institut National de la Recherche Biomédicale in Kinshasa and the inaugural president of the Congolese Academy of Science [2]. He was the first to discover the Ebola virus during his work in the first-ever outbreak in 1976, in central Congo.

Ebola disease is the term for a group of deadly diseases in people caused by four ebolaviruses within the genus Ebolavirus. There are occasional Ebola disease outbreaks in people, occurring primarily on the African continent. Bola Disease. Ebola disease is caused by an infection with one of a group of viruses, known as Ebola viruses that are found primarily in sub-Saharan Africa. The natural reservoir for Ebola virus is believed to be fruit bats from the Pteropodidae family. Ebola, also known as Ebola virus disease (EVD) and Ebola hemorrhagic fever (EHF), is a viral hemorrhagic fever in humans and other primates, caused by Ebola viruses. There's no cure for Ebola, though researchers are working on it. There are two drug treatments which have been approved for treating Ebola. Inmazeb is a mixture of three monoclonal antibodies.

Diagnostic techniques

Polymerase Chain Reaction PCR is the gold standard diagnostic method for Ebola virus detection. It involves amplifying and detecting viral genetic material in patient samples such as blood, serum, or other body fluids. PCR provides rapid and highly specific results, allowing early identification of infected individuals [3].

Rapid diagnostic tests (RDTs)

RDTs offer a quick and cost-effective way to diagnose Ebola virus infection in resource-limited settings. These tests detect viral antigens or antibodies in blood samples, providing results within minutes. While RDTs are less sensitive than PCR, they are valuable for initial screening and triage purposes [4].

Serological tests

Serological tests detect antibodies produced by the immune system in response to Ebola virus infection. Enzyme-linked immunosorbent assays (ELISAs) and indirect fluorescent antibody tests (IFAT) are commonly used to detect specific antibodies. These tests are useful for retrospective diagnosis, surveillance, and assessing immune response in vaccinated individuals [5].

Point-of-care testing (POCT)

POCT devices are portable diagnostic tools that enable rapid testing

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at the patient's bedside or in remote areas. These devices often employ nucleic acid amplification techniques or antigen detection methods to provide quick and accurate results, facilitating prompt decision-making and patient management [6].

Therapeutic approaches

Supportive care

Currently, there is no specific antiviral treatment for Ebola virus disease. Supportive care focuses on managing symptoms and maintaining vital organ functions. Intravenous fluid replacement, electrolyte balance, and the treatment of secondary infections are crucial in the management of EVD patients [7].

Experimental therapeutics

Several experimental therapies have shown promising results in preclinical and clinical trials. These include monoclonal antibody-based treatments, such as ZMapp and REGN-EB3, which target the Ebola virus and neutralize its effects. Other approaches involve using antiviral drugs, such as remdesivir, to inhibit viral replication [8].

Vaccines

The development of Ebola vaccines has been a significant breakthrough in preventing and controlling outbreaks. Vaccines like rVSV-ZEBOV have demonstrated efficacy in clinical trials, providing protection against Ebola virus infection. Mass vaccination campaigns have proven successful in curbing the spread of the disease in affected regions [9].

Convalescent plasma therapy

Convalescent plasma, obtained from individuals who have recovered from EVD, contains antibodies that can neutralize the virus. Transfusing this plasma into infected patients may boost their immune response and aid in recovery. However, further research is needed to establish its effectiveness [10].

Conclusion

The diagnostic techniques for Ebola virus disease have advanced significantly, enabling early detection and prompt response. Polymerase Chain Reaction (PCR), rapid diagnostic tests (RDTs), and serological assays contribute to accurate diagnosis and surveillance. On the therapeutic front, supportive care remains the cornerstone of management, while experimental therapeutics and vaccines offer hope for effective treatment and prevention. Continued research and collaboration are vital to developing improved diagnostic tools and expanding therapeutic options to combat Ebola virus disease and mitigate its impact on public health worldwide. Ebola virus disease is arguably considered as one of the highly severe and fatal diseases of primates with great economic losses. Lack of access to rapid diagnostic tools has proven to be a setback to early identification, isolation, and management of the disease. This is further complicated by the non-specificity of symptoms presented during early stages of Ebola disease infection With such nonspecific symptoms and the virus being highly contagious with high mortality rate, the need importance of developing a rapid diagnostic assays that can be deployed to resource-limited regions to be used at the point of care for diagnosis and identification of the disease cannot be overemphasized.

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