



Microbiological characterization of Ebola Virus

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ABSTRACT

Ebola, also known as Ebola virus disease (EVD) or Ebola hemorrhagic fever (EHF), is a viral hemorrhagic fever of humans and other primates. As the virus spreads through the body, it damages the immune system and organs. Ultimately, it causes levels of blood-clotting cells to drop. This leads to severe, uncontrollable bleeding. Ebola was discovered in 1976 near the Ebola River in the Democratic Republic of the Congo. Ebola virus has been cultured from specimens such as serum or postmortem tissues. Ebola virus infection runs its course within 14 to 21 days.

KEY WORDS: Ebola virus, Ebola hemorrhagic fever, Filoviridae

Introduction

Viruses are submicroscopic, a small collection of genetic code, either DNA or RNA, surrounded by a protein coat. A virus cannot replicate alone. Viruses must infect cells and use components of the host cell to make copies of themselves. Often, they kill the host cell in the process, and cause damage to the host organism. Viruses have been found everywhere on Earth. Because viruses don't have the same components as bacteria, they cannot be killed by antibiotics; only antiviral medications or vaccines can eliminate or reduce the severity of viral diseases, including AIDS, Ebola, COVID-19, measles and smallpox.

Ebola, also known as Ebola virus disease (EVD) or Ebola hemorrhagic fever (EHF), is a viral hemorrhagic fever of humans and other primates (gorillas, monkeys, and chimpanzees) caused by Ebola viruses. It is a severe and often deadly disease. As the virus spreads through the body, it damages the immune system and organs. Ultimately, it causes levels of blood-clotting cells to drop. This leads to severe, uncontrollable bleeding. Ebola was discovered in 1976 near the Ebola River in the Democratic Republic of the Congo. Since then, several small outbreaks have occurred in Africa. The 2014 outbreak was the largest. The countries most affected in this outbreak included Guinea, Liberia, Sierra, and Leone. The Ebola outbreak in West Africa that began in March 2014 was the largest hemorrhagic viral epidemic in history. Almost 40% of the people who developed Ebola in this outbreak died. It cause fever, body ache and diarrhea.

Kingdom: *Orthornavirae*

Phylum: *Negarnaviricota*

Class: *Monjiviricetes*

Order: *Mononegavirales*

Family: *Filoviridae*

Genus: *Ebolavirus*

Species

- *Bombali ebolavirus*
- *Bundibugyo ebolavirus*
- *Reston ebolavirus*
- *Sudan ebolavirus*
- *Tai Forest ebolavirus*
- *Zaire ebolavirus*

Objective

To study regarding the microbiological characterization of Ebola virus

Morphology

Ebola Virus are generally approximately 80 nm in diameter, 970 nm long. They are cylindrical/tubular, and contain viral envelope, matrix and nucleocapsid components. The virus generally appears in a long, filamentous form, but it can also be “U-shaped,” in the shape of a “6” (the “shepherd’s crook” appearance), or even circular. They have a virally encoded glycoprotein (GP) projecting as 7-10 nm long spikes from its lipid bilayer surface. Glycoproteins are proteins that contain carbohydrate chains (glycan) covalently attached to their polypeptide side chains, a process known as glycosylation. The glycoprotein GP is the sole resident of the Ebolavirus surface and is responsible for attaching to and entering new host cells. The outer viral envelope of the virion is derived by budding from domains of host cell membrane into which the GP spikes have been inserted during their biosynthesis. This virus belongs to the Filovirus family, and structurally it resembles a length of thread.

Isolation

Isolation of Ebola virus and other hemorrhagic fever viruses in culture is a high-risk procedure and should be performed only in BSL-4 facilities, such as are available at the CDC. Ebola virus has been cultured from specimens such as serum or postmortem tissues. Monolayers of several cell types have successfully been used. Cultures using Vero or Vero E6 cells are typically held for 14 days, with cytopathic effect generally visible at about 7 days after inoculation. Vero cells of low passage number show a cytopathic effect as soon as 3 days, and culture medium without serum may generate a more complete cytopathic effect. Virus growth can be

identified by electron microscopy, fluorescein-labeled polyclonal Ebola virus-specific antibodies prepared from the sera of mice or rabbits challenged with Ebola virus, or PCR of culture supernatant. Antigens may be detectable by these techniques prior to the development of cytopathic effects and have been found as early as 3 days after inoculation. Similarly, human dendritic cells prepared from peripheral blood monocytes and CV-1 African green monkey kidney cells support the growth of Ebola virus, with virus particles detectable by electron microscopy at 3 days post inoculation before the appearance of a cytopathic effect. Ebola virus replication has been found to be particularly efficient in nonhuman primate alveolar macrophage cell cultures, with high virus titers and cytolysis evident within 24 h of inoculation.

Pathogenicity

Ebola virus is an aggressive pathogen that causes a highly lethal hemorrhagic fever syndrome in humans and nonhuman primates. Typically, Ebola virus infection runs its course within 14 to 21 days. Infection initially presents with nonspecific flu-like symptoms such as fever, myalgia, and malaise. As the infection progresses, patients exhibit severe bleeding and coagulation abnormalities, including gastrointestinal bleeding, rash, and a range of hematological irregularities, such as lymphopenia and neutrophilia. Cytokines are released when reticulo-endothelial cells encounter virus, which can contribute to exaggerated inflammatory responses that are not protective. Damage to the liver, combined with massive viremia, leads to disseminated intravascular coagulopathy. The virus eventually infects microvascular endothelial cells and compromises vascular integrity. The terminal stages of Ebola virus infection usually include diffuse bleeding, and hypotensive shock accounts for many Ebola virus fatalities.

Transmission

Ebola can only spread between humans by direct contact with infected body fluids including but not limited to urine, saliva, sweat, feces, vomit, breast milk, and semen. The virus can enter the body through a break in the skin or through mucous membranes, including the eyes, nose, and mouth. Ebola can also spread by contact with any surfaces, objects, and materials that have been in contact with body fluids from a sick person, such as:

- Bedclothes and bedding
- Clothing
- Bandages
- Needles and syringes
- Medical equipment
- Handling infected wild animals hunted for food (bushmeat)
- Contact with blood or body fluids of infected animals
- Contact with infected bats

Lab diagnosis

There is no test available to detect Ebola before symptoms begin. It can take up to three days after the start of symptoms to detect the virus, so some individuals may need to be tested more than once to avoid false-negative results.

Diagnostic tests for Ebola include:

- Reverse transcription polymerase chain reaction (RT-PCR)—these molecular tests look for Ebola virus RNA in a blood sample. RT-PCR can be used with saliva samples in acutely ill individuals. RT-PCR of blood is now the standard method used by international health organizations to diagnose acute Ebola during outbreaks. Saliva testing is the standard for postmortem testing. However, the laboratory infrastructure and staff training required for molecular testing still makes it challenging to deploy in resource-limited areas.
- Ebola antigen tests—these tests detect Ebola antigens in blood samples. They typically can detect antigens within a few days after symptoms (e.g., fever) begin. Two types are available:
 - Rapid Ebola antigen tests—these tests are designed to be performed at the point of care (e.g., near the patient) using a finger stick blood sample, providing results in under an hour. They also detect viral antigens in saliva postmortem. Rapid tests emerged during the 2014 West African outbreak and research continues on the best role for them in the future.
 - Laboratory antigen tests—these tests also detect Ebola antigen in blood samples but are designed to be performed in laboratories by laboratory personnel.
- Ebola antibody testing, IgM or IgG class—these tests are used to detect Ebola antibodies (immune proteins) in a blood sample that develop in response to the infection. The IgM class of antibody develops first, while IgG develops later. Antibody tests in general are best at detecting Ebola later in the illness and are often used in investigating Ebola outbreaks.

The World Health Organization (WHO) and the CDC recommend molecular testing and antigen ELISA testing for diagnosing acute Ebola. Laboratory tests may be used to establish and monitor the disease's impact on body function. Examples of these tests may include:

- Complete blood count (CBC), including a platelet count
- Tests to evaluate the liver, such as a liver panel
- Tests to evaluate kidney function, such as creatinine and blood urea nitrogen (BUN)
- Tests to evaluate bleeding, such as partial thromboplastin time (PTT) and prothrombin time (PT)

Prevention and Vaccine

Ebola prevention is of greatest concern for people traveling to regions affected by outbreaks and for healthcare and laboratory workers. Individuals traveling to countries experiencing Ebola outbreaks should wash or sanitize their hands frequently and generally avoid contact with sick people and the deceased. To help prevent becoming sick with Ebola avoid:

- Direct contact with infected body fluids.
- Items that may contain infected body fluids.
- Visiting Ebola treatment clinics or hospitals.
- Touching the body of someone who has died from an Ebola virus infection.
- Contact with certain animals such as bats, monkeys and chimps.
- Eating bush meat (the meat of wild animals such as bats, antelope and monkeys).

Care providers need to take extra care to avoid getting or spreading Ebola. Steps care providers can take to avoid getting Ebola include:

- Sterilizing equipment.
- Using disposable equipment and supplies.
- Washing hands.
- Wearing gloves, masks, glasses and other protective clothing.

Care providers can help reduce the spread of the Ebola virus by:

- Disinfecting homes of people who have Ebola. It can be killed and sterilized with bleach and hospital type disinfectants.
- Isolating people who have Ebola.
- Testing and monitoring people who have had contact with someone who has Ebola.
- Watching for new cases of Ebola.

The U.S. Food and Drug Administration (FDA) approved the Ebola vaccine rVSV-ZEBOV (called Ervebo®) on December 19, 2019. This is the first FDA-approved vaccine for Ebola. This vaccine is given as a single dose vaccine and has been found to be safe and protective against *Zaire ebolavirus*, which has caused the largest and most deadly Ebola outbreaks to date.

Treatment

The first drug approved in October 2020, Inmazeb™, is a combination of three monoclonal antibodies. The second drug, Ebanga™, is a single monoclonal antibody and was approved in December 2020. Monoclonal antibodies (often abbreviated as mAbs) are proteins produced in a lab or other manufacturing facility that act like natural antibodies to stop a germ such as a virus from replicating after it has infected a person. These particular mAbs bind to a portion of the Ebola virus's surface called the glycoprotein, which prevents the virus from entering a person's cells.

Neither Inmazeb™ nor Ebanga™ have been evaluated for efficacy against species other than *Zaire ebolavirus*. Basic interventions can significantly improve chances of survival when provided earlier. These are referred to as supportive care, and include:

- Providing fluids and electrolytes (body salts) orally or through infusion into the vein (intravenously).
- Using medication to support blood pressure, reduce vomiting and diarrhea, and to manage fever and pain.

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