EBOLA VIRUS DISEASE (EVD): A REVIEW
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Abstract: Ebola virus is the cause of a viral hemorrhagic fever disease. The Ebola virus is a lipid enveloped virus in the family Filoviridae. Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever is a severe, often fatal illness, with a case fatality rate of up to 90%. In outbreak settings, Ebola virus is typically first spread to humans after contact with infected wildlife and is then spread person-to-person through direct contact with bodily fluids such as, but not limited to, blood, urine, sweat, semen, and breast milk. The incubation period is usually 8–10 days (ranges from 2–21 days). Patients can transmit the virus while febrile and through later stages of disease, as well as post-mortem, when persons touch the body during funeral preparations. There are no licensed specific treatments or vaccine available for use in people or animals. Symptoms of Ebola include fever and additional symptoms like severe headache, muscle pain, vomiting, diarrhoea, stomach pain, or unexplained bleeding or bruising.

Keywords: Ebola virus disease, Haemorrhagic fever, Symptoms
INTRODUCTION

Ebola virus disease (EVD) is caused by infection with Ebola virus which belongs to the family called Filoviridae. EVD in humans has a case fatality rate of up to 90% [1]. Since the first report of the EVD outbreak in West Africa in March 2014, the cumulative numbers of cases attributed to EVD are continuously increasing, making this EVD outbreak the most extensive ever recorded in terms of geographical spread and overall number of cases and deaths reported [2]. EVD is transmitted to human through contact with blood, secretions, organs or other body fluids of infected animals including chimpanzees, gorillas, fruit bats, monkeys, forest antelopes and porcupines. Human-to-human transmission is possible through direct contact with blood, secretions, organs or other body fluids of infected people, and indirect contact with environments contaminated with such fluids. In a later stage, some patients may have profuse internal and external bleeding and multi-organ failure. There is no licensed vaccine or validated treatment for the disease [3].

![Fig 1: The EBOLA virus](image)

HISTORY

Ebola is found in several African countries. The first Ebola species was discovered in 1976 near the Ebola River in what is now the Democratic Republic of the Congo. Since then, outbreaks have appeared sporadically in Africa. The first outbreak infected over 284 people, with a mortality rate of 53%. A few months later, the second Ebola virus emerged from Yambuku, Zaire, Ebola-Zaire (EBOZ). EBOZ, the highest mortality rate of any of the Ebola virus (88%) infected 318 people. The third strain was identified in 1989. Fortunately, only few were infected and those infected never developed Ebola hemorrhagic fever (EHF). Since the virus has been discovered around 1,850 cases are diagnosed and 1,200 people have died [4].

CLASSIFICATION OF EBOLA VIRUS

EBOLA viruses are classified as enveloped, nonsegmented, negative strand RNA viruses. It belongs to the Order Mononegavirales and Family Filoviridae contains 3 genera:
• *Ebola virus* (1976)

• *Marburgvirus* – Lake Victoria marburgvirus (1967)

• *Cuevavirus* – Lloviu virus (bats, Spain, 2002)

**EBOLA VIRUS VIRION**

![Ebola virus virion diagram]

**Fig 2: The Ebola virus virion**

• The Genome is 19kb long, with a diameter of 80nm and length 960nm to 1200nm.

• The four viral proteins present on it are polymerase (L), nucleoprotein (NP), and proteins VP35 and VP30.

• The spikes are formed by GP1/GP2 complexes (envelope glycoprotein) and VP24 (membrane protein) associated with envelope.

The secretory Glycoprotein binds to antibody and has possible antineutrophil activity [5].

**RESERVOIR AND TRANSMISSION TO HUMANS**

• Fruit bats are the reservoir of virus. They drop the partially eaten fruits.

• Bats infect chimpanzees, gorillas, forest antelopes, porcupines.

• Humans handle and eat bush meat (bats, chimpanzees, gorillas).

• Infected human passes from person to person.
When an infection does occur in humans, there are several ways the virus can be spread to others. These include:

- Direct contact with the blood or body fluids (including but not limited to feces, saliva, urine, vomit and semen) of a person who is sick with Ebola
- Contact with objects (like needles and syringes) that have been contaminated with the blood or body fluids of an infected person or with infected animals

The virus in the blood and body fluids can enter another person’s body through broken skin or unprotected mucous membranes in, for example, the eyes, nose, or mouth. The viruses that cause Ebola are often spread among families and friends, because they come in close contact with blood or body fluids when caring for ill persons [6].

During outbreaks of Ebola, the disease can spread quickly within healthcare settings, such as clinics or hospitals. Exposure to Ebola can occur in healthcare settings where hospital staffs are not wearing appropriate protective clothing including masks, gowns, gloves, and eye protection. Dedicated medical equipment (preferably disposable, when possible) should be used by healthcare personnel providing care for someone sick with Ebola. Proper cleaning and disposal of instruments, such as needles and syringes, is also important. If instruments are not
disposable, they must be sterilized before being used again. Without adequate instrument sterilization, virus transmission can continue and amplify an outbreak [7].

PATHOGENESIS

• Virus enters the body via infected blood/body fluid in contact with a mucosal surface or a break in intact skin.

• Virus replicates preferentially in monocytes/macrophages and dendritic cells which facilitate dissemination of the virus throughout the body via lymphatic system.

• Other cells are secondarily infected and there is rapid viral growth in hepatocytes, endothelial and epithelial tissues.

• There is strong cytokine/inflammatory mediator release of TNF-α and inflammatory cascade, which leads to endothelial damage, increased vascular permeability and shock.

• This results in the end organ damage and multi-organ dysfunction and Diffuse intravascular coagulopathy (DIC) with platelet and coagulation factor consumption which leads to hemorrhage.

• IgM starts forming in 2 day and IgG in 5-8 days post infection. Immunologic response correlates with survival. Thus it is observed that those who live >1 week are more likely to survive [8].

Fig 4: EBOLA pathogenesis pathway
SIGNS AND SYMPTOMS OF EBOLA [9]

The signs and symptoms of EBOLA typically include:

- Fever (greater than 38.6°C or 101.5°F)
- Severe headache
- Muscle pain
- Vomiting
- Diarrhoea
- Stomach pain
- Unexplained bleeding or bruising

Symptoms may appear anywhere from 2 to 21 days after exposure to Ebola but the average is 8 to 10 days.

Recovery from Ebola depends on the patient’s immune response. People who recover from Ebola infection develop antibodies that last for at least 10 years.

DIAGNOSIS

Diagnosing Ebola in a person who has been infected for only a few days is difficult because the early symptoms, such as fever, are not specific to Ebola infection and are seen often in patients with more commonly occurring diseases, such as malaria and typhoid fever [10]. However, if a person has symptoms of Ebola and had contact with blood or body fluids of a person sick with Ebola, contact with objects that have been contaminated with blood or body fluids of a person sick with Ebola or contact with infected animals, the patient should be isolated and public health professionals notified. Samples from the patient can then be collected and tested to confirm infection [11].

Laboratory tests used in diagnosis are given in the Table 1

<table>
<thead>
<tr>
<th>Timeline of Infection</th>
<th>Diagnostic Tests Available</th>
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<tbody>
<tr>
<td>Within a few days after symptoms begin</td>
<td>- Antigen-capture enzyme-linked immunosorbent assay (ELISA) testing</td>
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<tr>
<td></td>
<td>- IgM ELISA</td>
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<td></td>
<td>- Polymerase chain reaction (PCR)</td>
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<td>- Virus isolation</td>
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<tr>
<td>Later in disease course or after recovery</td>
<td>- IgM and IgG antibodies</td>
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<td>Retrospectively in deceased patients</td>
<td>- Immunohistochemistry testing</td>
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<tr>
<td></td>
<td>- PCR</td>
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<td></td>
<td>- Virus isolation</td>
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TREATMENT

Currently there are no specific vaccines or medicines (such as antiviral drug) that have been proven to be effective against Ebola [12].

The following basic interventions, when used early, can significantly improve the chances of survival:

• Providing intravenous (IV) fluids and balancing electrolytes (body salts)
• Maintaining oxygen status and blood pressure
• Treating other infections if they occur

Timely treatment of Ebola is important but challenging since the disease is difficult to diagnose clinically in the early stages of infection. Because early symptoms such as headache and fever are not specific to Ebolaviruses, cases of Ebola may be initially misdiagnosed [13].

Currently, several experimental Ebola virus vaccines confer varying degrees of protective efficacy in animal models. An ideal Ebola virus vaccine would elicit strong and protective responses after a single immunization and have therapeutic benefits. One of the most extensively tested Ebola virus vaccine platforms is based on a replication-competent vesicular stomatitis virus (VSV) expressing Ebola virus glycoprotein(s) (the major viral immunogen). A single dose of 10^7 recombinant VSV particles has been shown to be effective against Ebola, and its close relative Marburg virus, in prophylactic and post-exposure situations in nonhuman primate models [14]. The use of replication-competent vaccine viruses always raises safety concerns; however, such concerns will be addressed in current and future clinical trials. Another vaccine platform is based on a replication-defective, chimpanzee adenovirus vector, ChAd3. One study showed that the vaccination of nonhuman primates with a single dose of 10^10 recombinant adenovirus particles expressing the glycoproteins of Z. ebolavirus conferred complete protection from a lethal challenge with Z. ebolavirus. Given the success of this vaccine platform in nonhuman primates, ChAd3 has now entered a Phase I clinical trial to test its safety, tolerability, and immunogenicity in human volunteers [15], [16].

PREVENTION

When cases of the disease do appear, there is increased risk of transmission within healthcare settings. Therefore, healthcare workers must be able to recognize a case of Ebola and be ready to use appropriate infection control measures [17]. The aim of these techniques is to avoid contact with the blood or body fluids of an infected patient [18], [19], [20].

Appropriate procedures include:

• Isolation of patients with Ebola from contact with unprotected persons
• Wearing of protective clothing (including masks, gloves, impermeable gowns, and goggles or face shields) by persons caring for Ebola patients

• The use of other infection-control measures (such as complete equipment sterilization and routine use of disinfectant)

• Avoid touching the bodies of patients who have died from Ebola

REFERENCES


