Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Pharmaceutical and Biological Sciences

Journal homepage: https://www.jpbs.in/

Review Article

A review on ebola virus

Pallavi B Sadgir[1],*, Pradnya R Pawar[1], Prachi S Jondhale[1], Manisha N Sharmale[1], Priya Ambre[1], Pallavi L Phalke[1]

[1]*Dept. of Pharmacy, Matoshri Radha College of Pharmacy, Virgaon, Maharashtra, India*

ARTICLE INFO

Article history:
Received 22-03-2023
Accepted 15-06-2023
Available online 19-07-2023

Keywords:
Clinical Diagnosis
Complications
Ebola virus
Mode of transmission
Treatment

ABSTRACT

The Ebola virus of the Filoviridae family is the cause of Ebola virus disease (EVD), a deadly viral hemorrhagic sickness. Due to the prevalence of immigrants, the disease has become a global public health threat. The victims initially exhibit vague influenza-like symptoms before succumbing to shock and multiorgan failure. There is no established procedure for treating EVD; instead, only supportive and symptomatic therapy is used. The Ebola virus, including its clinical and oral symptoms, diagnostic tools, differential diagnoses, preventive measures, and management protocol, are thoroughly discussed in this review paper. Since then, the Ebola virus has occasionally started to infect humans, causing multiple epidemics. The expansion of the Ebola virus has resulted in the deadliest diseases for both animals and humans because of the growth of urbanization, invasion of forested areas, and intimate contact with wildlife creatures. The Ebola virus disease (EVD) has so far claimed the lives of numerous people, with an increased number of cases being seen throughout the African continent. Thus, a study was conducted to evaluate the efficacy and safety of medications approved for the treatment of EVD, trends in EVD outbreaks, morbidity and mortality among EVD patients, and other factors.

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

The disease Ebola, formerly known as Ebola hemorrhagic fever (EHF), is extremely deadly and mostly affects humans and nonhuman primates. A virus infection that belongs to the family Filoviridae and genus Ebolavirus causes the Ebola virus disease (EVD).[1] Particularly in the early stages of the disease, EVD can appear in strange and unusual ways, resembling other viral infections. Early presenting signs include constitutional symptoms such fever, myalgia, headache, vomiting, and diarrhea. In the late stages, hemorrhagic rash, internal bleeding, and external bleeding are typically the warning signs.[2] Increase their discovery, EVDs have presented diagnostic hurdles and represented a general hazard to public health. Dr. Peter Piot discovered yellow fever for the first time in 1976 while looking into a purported case in Zaire, Africa (now the Democratic Republic of Congo).[3] These viruses can transfer from person to person after coming into contact with polluted fluids, which helps them spread in impoverished places. The African fruit bat, Rousettus aegyptiacus, is thought to be the virus' natural reservoir and can spread the disease to apes, monkeys, and animals like antelopes that live in forested environments. Humans living in forested areas, eating such infectious animals, and touching dead bodies are all seen as risk factors linked to cultural and religious practices that make it difficult to suppress epidemics in these locations.[4] The human mortality rate caused with the EHF-causing EBOV is greatest (57%–90%), followed by SUDV (41%–65%) and Bundibugyo virus (40%). TAFV has only ever been associated with two non-fatal

* *Corresponding author*.
E-mail address: falkepallavi@gmail.com (P. B. Sadgir).

https://doi.org/10.18231/j.jpbs.2023.002
2320-1924/© 2023 Innovative Publication, All rights reserved.

human infections, whereas RESTV is associated with asymptomatic human infections. Early detection is still essential to lowering the danger of an epidemic due to the increased frequency of Ebola virus outbreaks. In an effort to lessen the likelihood of a pandemic or an epidemic, several countermeasures, including the development of a vaccine and quick testing using immunoassays or real-time polymerase chain reaction (PCR), were implemented. Previously, an electron microscope was used to find the virus in blood samples. Because the virus is so robust, it must be killed using large doses of gamma radiation, ultraviolet light, and prolonged exposure to 60 degrees Celsius (140 degrees Fahrenheit) of severe heat. For those who have the Ebola virus sickness, there is still no medication or prophylactic available.[5] Although the exact origin of the Ebola virus is still unknown, it is thought to be animal-borne because infected animals can directly transmit the virus to other animals, including monkeys, chimpanzees, and humans. This can then result in the virus spreading among humans through human-to-human transmission.[6] African fruit bats are probably a part of the Ebola virus' propagation and could perhaps serve as its reservoir host. Scientists are still looking for concrete proof that the bat played a part in the spread of the Ebola virus.[6]

2. Etiology

Through damaged skin or mucosal membranes, the virus enters the new host. Note that the virus can enter the host without causing harm to the mucosal membrane. Unknown durations of the virus's survival outside of the human body are possible. Most frequently, in order to prevent contamination and the possibility of viral transmission, patient bedding, clothing, and medical equipment are all burnt or disposed of as medical waste.[6,7] Infected humans can transmit the virus through contact with bodily fluids, including saliva, blood, urine, feces, sweat, breast milk, semen, or fomites. Interestingly, the Ebola virus can survive in semen for up to 21 days after the patient has recovered. To date, there is conflicting information on whether vaginal secretions harbor or spread the Ebola virus. Once infected, the virus will incubate within the host during an asymptomatic, non-contagious period, usually lasts between several days to a few weeks. An infected person exhibiting signs and symptoms resembling a typical viral illness is considered contagious.

Humans who are infected can spread the virus to others by coming into touch with saliva, blood, urine, faces, perspiration, breast milk, semen, or fomites. It's interesting to note that even after the patient has recovered, the Ebola virus can persist in semen for up to 21 days. Whether vaginal secretions carry or spread the Ebola virus is still a subject of debate. Once a host has been infected, the virus will incubate there for an unnoticeable, non-contagious period that typically lasts from a few days to a few weeks. When an infected person displays symptoms that are typical of a viral illness, that person is thought to be contagious.[7]

3. Epidemiology

The death rate varies depending on the ebolavirus strain from 25% to 90%. Zaire strain, the most lethal strain, used to be 90% deadly. The mortality rate has decreased to roughly 50% on average as a result of more awareness, education, and early detection. Only those who have prodromal symptoms like fever, chills, nausea, or vomiting or those who come into touch with infected dead corpses are contagious to the Ebola virus. The virus is regarded as a dangerous biowarfare agent due to its mechanism of dissemination and worrisome case-fatality rate.[6] When the Ebola virus was first identified in 1976, it was thought to be an uncommon, exotic illness that was mostly researched in highly-classified laboratories. Since its discovery, there have been over 20 outbreaks, many of which have only affected rural areas in the Sudan, Uganda, Gabon, the Democratic Republic of the Congo, and the Republic of the Congo. Eating tainted monkey meat has been linked to endemic epidemics of the Ebola virus, most frequently in Zaire and Sudan. The transmission of the disease to family members, then to members of the community, and funeral customs are typically to blame for its spread. Laboratory contamination was the root cause of several outbreaks.[5] Since June 1^{st}, 2020, the most current outbreak has been ongoing in the Democratic Republic of the Congo. The longest outbreak that eventually became an epidemic affected region of Western Africa, Europe, and the United States. It exposed the lack of preparedness for epidemics and brought down healthcare systems in certain nations. Only a small number of travelers were infected through direct human contact because of the severe travel restrictions and strong quarantine methods. The majority of recorded cases outside of Africa were in healthcare personnel delivering relief in areas where an active outbreak was occurring. The African continent has been home to the great majority of EVD cases and outbreaks; there have been 36 such outbreaks in six African.[7,8]

3.1. Mode of transmission

In animal models, direct virus inoculation in mucosa (via the oral or conjunctival channel), subcutaneous, intraperitoneal, or intramuscular injection, as well as respiratory droplets and aerosols, have all been shown to transmit the Ebola virus. One plaque-forming unit of a small viral inoculum can spread infection.[9,10] ThePteropodid family of fruit bats is thought to be the Ebola virus's most likely natural reservoir. And humans can contract the disease by direct contact with diseased wildlife or by handling it. The Ebola virus is then spread from person to person by coming into direct touch with an infected individual's bodily fluids or,

possibly, with contaminated objects and surfaces[9] Direct contact with a symptomatic Ebola patient's blood and bodily fluids—including but not limited to urine, faces, vomitus, saliva, and sweat—through cracks in the skin or inoculation into the mouth, nose, or eyes—are the primary routes of Ebola virus transmission.[10]

Infection of humans can also happen when they come into touch with wild animals, such as when they hunt, butcher, or prepare meat from diseased animals. A sort of direct contact that is crucial in the spread of Ebola among people is the ritual washing of Ebola victims at funerals.[11] A nosocomial outbreak occurred in DRC in 1995 when a patient hospitalized with abdominal pain underwent an exploratory laparotomy; the entire surgical team became infected.[12,13] Even after a severe infection, the Ebola virus can continue to exist in some parts of the body. The central nervous system, placenta, inside of the eyes, and testes are some examples of these regions. It has been proven that sexual interaction with a recovering patient or survivor can transmit the disease. After recovery, the virus can persist in semen for several months.[10]

3.2. Pathogenesis

Ebola viruses can enter the body of a human through mucous membranes, skin tears or abrasions, close contact with infected people, infected bodies, or even by direct parental transmission.[14] Dendritic cells, monocytes, and macrophages are among the immune system cells that EBOV like to infect. It also prefers to infect endothelium and epithelial cells, hepatocytes, and fibroblasts where it actively replicates through gene regulation and apoptosis and exhibits noticeably high viremia.[15] As the virus spreads through the blood to the liver and spleen, it causes lymphadenopathy in the local lymph nodes and activates an inflammatory response.[15] By upsetting the balance of the vasculature system, the release of chemical mediators of inflammation (cytokines and chemokines) results in an immunological response that is dysregulated, eventually leading to disseminated intravascular coagulation and various organ failure.[16]

Following entry through the host cell membrane, the virus multiplies through interaction with glycoprotein spikes and clathrinid-mediated endocytosis. The virus replicates in the host cell's cytoplasm after releasing its nucleocapsid inside the host cell. The start gene is activated by VP30, which then causes transcription and translation of the viral RNA into viral proteins to begin. In this, VP30 looks to be a regulatory protein, and pharmacological research is underway to precisely target VP30. Phosphorylation of VP30 by transcribed viral proteins turns VP30 off.[4] Inflicting immediate damage to the cell that may indicate cell death, the virus enters the cell by budding from the cell membrane. This procedure is currently not fully understood.[17]

3.3. Symptoms

Symptoms may appear anywhere from 2 to 21 days after contact with an ebolavirus, with an average of 8 to 10 days.

Patients with EVD experience symptoms following an incubation period of approximately 2–21 days. The typical features of the disease are that it can advance from 'dry' symptoms which are pain, aches, and weakness to 'wet' symptoms such as gastroenteritis.[18–20]

1. Fever
2. Aches and pains, such as severe headache and muscle and joint pain
3. Weakness and fatigue
4. Sore throat
5. Loss of appetite
6. Gastrointestinal symptoms including abdominal pain, diarrhea, and vomiting

4. Clinical Diagnosis

Due to the similarities of the symptoms, EVD is difficult to distinguish from other infectious diseases like typhoid fever and malaria.[21] Reverse transcriptase-polymerase chain reaction (RT-PCR) assay is the go-to diagnostic technique for EVD infections since it enables viral genome detection three days after the beginning of symptoms due to a high viral load in the patient's blood.[19,22] Additionally, during the late-stage illness progression and recovery period, a serological test like the enzyme-linked immunosorbent assay (ELISA) is employed for the detection of immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies against EVD antigens.[19,22] WHO (2014) advised collecting mouth swabs or entire blood samples in Ebola treatment centers that were appropriate.[23] The most widely used tests for laboratory confirmation of the EVD are the enzyme-linked immunosorbent assay (ELISA) and reverse transcriptase polymerase chain reaction (RT-PCR).[24]

5. Treatment and Management

For EVD, there is currently no precise antiviral treatment or immunization.[25] Supportive and symptomatic therapy make up the majority of the management approach. To stop the spread of EVD, public health measures emphasizing epidemiological monitoring, contact tracking, and patient quarantine have been suggested.[26] Rehydration, appropriate nutrition, analgesics, and blood transfusions are the cornerstones of the patient's supportive care for EVD.[27] The intravascular volume is maintained and endowed with the right electrolytes by intravenous fluids and oral rehydration solutions. Antiemetics and antidiarrheal medications are used to treat persistent vomiting and diarrhea.[27–29] The use of prophylactic antibiotic regimens (third generation intravenous cephalosporins) is the best way to treat

suspected cases of secondary bacterial infections and septicemia[29,30] It is possible to observe concurrent parasite coinfections, which need for quick management and research.[20,30] The development of numerous vaccines has made prevention one of the most effective treatments. A crucial non-medical strategy is to further prevent the spread of the disease by enforcing international travel restrictions and exit inspections when leaving countries where there is an active Ebola outbreak.[31]

5.1. Complications

Hemorrhagic fever and multi-system organ failure that causes shock and ultimately death are the main side effects of the Ebola virus. Due to the virus' tolerance to mild temperature fluctuations, handling the deceased bodies requires the use of appropriate PPE.

6. Conclusion

Particularly in relation to ophthalmologic or urological treatments, the appropriate infection prevention and control strategies while providing care for survivors are still being contested. It is yet unknown if and how EBOV can survive in protected body compartments other than semen, such as the eye, CSF, or intra-articular fluid, or if it can cause virus transmission. To fully comprehend the shedding and transmission of the Ebola virus, systematic data gathering and exhaustive laboratory studies are still required.

Due to numerous illness outbreaks over the past 25 years, EVD has become a significant global public health threat. The development of a potent Ebola virus vaccine and anti-Ebola medication is a recent development. However, there are a number of potential obstacles to containing this dreaded public health threat, including rapid geographic transmission, unclear clinical presentation, lack of vaccine, and particular diagnostic test.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Arinola AA, Joel SA, Tubosun OE, Folagbade OA. Ebola virus disease (EVD) information awareness among the people of Ogbomoso Environs. *Int J Library Information Sci*. 2015;4:55–69.
2. Naieni KH, Ahmad A, Raza O, Assan A, Elduma AH, Jammeh A. Assessing the knowledge, attitudes, and practices of students regarding Ebola virus disease outbreak. *Iran J Public Health*. 2015;44:1670–1676.
3. Rajak H, Jain DK, Singh A, Sharma AK, Dixit A. Ebola virus disease: Past, present and future. *Asian Pac J Trop Biomed*. 2015;5(5):337–80.
4. Malvy D, Mcelroy AK, De Clerck H, Günther S, Griensven JV. Ebola virus disease. *Lancet*. 2019;393:936–48.
5. Nkoghe D, Formenty P, Leroy EM, Nnegue S, Edou SY, Ba JI, et al. Multiple Ebola virus haemorrhagic fever outbreaks in Gabon. *Bull Soc Pathol Exot*. 1990;98(3):224–9.
6. Jacob ST, Crozier I, Fischer WA, Hewlett A, Kraft CS, Kuhn J, et al. Ebola virus disease. *Nat Rev Dis Primers*. 2020;6(1):13. doi:10.1038/s41572-020-0147-3.
7. Amundsen S. Historical analysis of the Ebola virus: Prospective implications for primary care nursing today. *Clin Excell Nurse Pract*. 1998;2(6):343–51.
8. Aurelie KK, Guy MM, Bona NF, Charles KM, Mawupemor AP, Shixue L. A historical review of Ebola outbreaks. In: and others, editor. Advances in Ebola control. vol. 2; 2017. p. 1–27.
9. Leroy EM, Baize S, Volchkov VE. Human asymptomatic Ebola infection and strong inflammatory response. *Lancet*. 2000;355:2210–5.
10. Alfson KJ, Avena LE, Beadles MW. Particle-to-PFU ratio of Ebola virus influences disease course and survival in cynomolgus macaques. *J Virol*. 2015;89(13):6773–81.
11. Bray M. Epidemiology, pathogenesis, and clinical manifestations of Ebola and Marburg virus diseases; 2014. Available from: https://www.uptodate.com/contents/epidemiology-and-pathogenesis-of-ebola-virus-disease.
12. Peters CJ. Principles and Practice of Infectious Diseases. Elsevier; 2010. p. 2259–63.
13. Khan AS, Tshioko FK, Heymann DL. The reemergence of Ebola hemorrhagic fever, Democratic Republic of the Congo. *J Infect Dis*. 1995;179(1):76–86.
14. Hofmann-Winkler H, Kaup F, Pohlmann S. Host cell factors in filovirus entry: Novel players, new insights. *Viruses*. 2012;4:3336–62.
15. Mahanty S, Bray M. Pathogenesis of filoviral hemorrhagic fevers. *Lancet Infect Dis*. 2004;4(8):487–98.
16. Ansari AA. Clinical features and pathobiology of Ebolavirus infection. *J Autoimmun*. 2014;55:1–9.
17. Zawilińska B, Kosz-Vnenchak M. General introduction into the Ebola virus biology and disease. *Folia medica Cracoviensia*. 2014;.
18. Signs and Symptoms. Ebola Hemorrhagic Fever; 2021. Available from: https://www.cdc.gov/vhf/ebola/symptoms/index.html.
19. Chertow DS, Bray M, Palmore T. Clinical manifestations and diagnosis of Ebola virus disease; 2021. Available from: https://www.uptodate.com/contents/clinical-manifestations-and-diagnosis-of-ebola-virus-disease.
20. Shea O, Clay MK, Craig KA, Matthews DG, Kao SW, Fletcher RL. Diagnosis of febrile illnesses other than Ebola virus disease at an Ebola treatment unit in Sierra Leone. *Clin Infect Dis*. 2015;61(5):795–803.
21. Ebola virus disease; 2020. Available from: https://www.who.int/news-room/fact-sheets/detail/ebola-virus-disease.
22. Huang Q, Fu WL, You JP, Mao Q. Laboratory diagnosis of Ebola virus disease and corresponding biosafety considerations in the China Ebola. *Treatment Center Crit Rev Clin Lab Sci*. 2016;53(5):326–340.
23. Balami LG, Ismail S, Saliluddin SM, Garba SH. Ebola virus disease: Epidemiology, clinical feature and the way forward. *Int J Community Med Public Health*. 2017;4:1372–1380.
24. Sarwar UN, Sitar S, Ledgerwood JE. Filovirus emergence and vaccine development: A perspective for health in travel medicine. *Travel Med Infect Dis*. 2011;9(3):126–60.
25. Scully C. Ebola: A very dangerous viral hemorrhagic fever. *Dent Update*. 2015;42:7–12.
26. Pandey A, Atkins KE, Medlock J, Wenzel N, Townsend JP, Childs JE. Strategies for containing Ebola in West Africa. *Science*. 2014;346:991–6.
27. Schieffelin JS, Shaffer JG, Goba A, Gbakie M, Gire SK, Colubri A. Clinical illness and outcomes in patients with Ebola in Sierra Leone. *N Engl J Med*. 2014;371:2092–100.
28. Feldmann H, Geisbert TW. Ebola hemorrhagic fever. *Lancet*. 2011;377:849–62.
29. Chertow DS, Kleine C, Edwards JK, Scaini R, Giuliani R, Sprecher A. Ebola virus disease in West Africa-Clinical manifestations and management. *N Engl J Med*. 2014;371(22):2054–61.

30. Plachouras D, Monnet DL, Catchpole M. Severe Ebola virus infection complicated by gram-negative septicemia. *N Engl J Med*. 2015;372(14):1376–83.
31. Bogoch MII, Bogoch I, Cetron MS, et al. Assessment of the potential for international dissemination of Ebola virus via commercial air travel during the 2014 west African outbreak. *Lancet*. 2015;61(5):795–8.

Author biography

Pallavi B Sadgir, Student

Pradnya R Pawar, Student

Prachi S Jondhale, Student

Manisha N Sharmale, Assistant Professor

Priya Ambre, Assistant Professor

Pallavi L Phalke, Principal

Cite this article: Sadgir PB, Pawar PR, Jondhale PS, Sharmale MN, Ambre P, Phalke PL. A review on ebola virus. *J Pharm Biol Sci* 2023;11(1):9-13.