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Ebola Virus Disease: Transmission and Treatments

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Abstract

Ebola virus disease is one of the most deadly ailments known to mankind due to its high mortality rate (up to 90%) accompanying with the disease. Ebola haemorrhagic fever (EHF) is an infectious disease of animal that can be transmitted to both human and non-human primates. The first epidemic of EHF occurred in 1976 in the Democratic Republic of the Congo. The incubation period of ebola is less than 21 days. Ebola virus infections are depicted by immune suppression and a systemic inflammatory response that leads to damage of the vascular, coagulation and immune systems, causing multi-organ failure and shock.

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Introduction

Control of outbreaks requires coordinated medical services and community engagement, including rapid detection, contact tracing of those exposed, quick access to laboratory services, care for those infected, and proper disposal of the dead through cremation or burial [1]. Samples of body fluids and tissues from people with the disease should be handled with extreme caution. Prevention measures include wearing proper protective clothing and washing hands when around a person with the disease, and limiting the spread of the disease from infected animals to humans-by wearing protective clothing while handling potentially infected bushmeat, and by cooking bushmeat thoroughly before eating it. An Ebola vaccine was approved in the United States in December 2019 [2]. While there is no approved treatment for Ebola as of 2019, two treatments (atoltivimab/maftivimab/odesivimab and ansuvimab) are associated with improved outcomes. Supportive efforts also improve outcomes. These include oral rehydration therapy (drinking slightly sweetened and salty water) or giving intravenous fluids, and treating symptoms. In October 2020, Atoltivimab/maftivimab/odesivimab (Inmazeb) was approved for medical use in the United States to treat the disease caused by Zaire Ebola virus [3].

The disease was first identified in 1976, in two simultaneous outbreaks: one in Nzara (a town in South Sudan) and the other in Yambuku (the Democratic Republic of the Congo), a village near the Ebola River, from which the disease takes its name. Ebola outbreaks occur intermittently in tropical regions of sub-Saharan Africa. Between 1976 and 2012, according to the World Health Organization, there were 24 outbreaks of Ebola resulting in a total of 2,387 cases, and 1,590 deaths. The largest Ebola outbreak to date was an epidemic in West Africa from December 2013 to January 2016, with 28,646 cases and 11,323 deaths. On 29 March 2016, it was declared to no longer be an emergency. Other outbreaks in Africa began in the Democratic Republic of the Congo in May 2017, and 2018. In July 2019, the World Health Organization declared the Congo Ebola outbreak a world health emergency [4, 5].

The length of time between exposure to the virus and the development of symptoms (incubation period) is between 2 and 21 days, and usually between 4 and 10 days. However, recent estimates based on mathematical models predict that around 5% of cases may take longer than 21 days to develop [6].

Symptoms usually begin with a sudden influenza-like stage characterised by fatigue, fever, weakness, decreased appetite, muscular pain, joint pain, headache, and sore throat. The fever is usually higher than 38.3 °C (101 °F). This is often followed by nausea, vomiting, diarrhoea, abdominal pain, and sometimes hiccups. The combination of severe vomiting and diarrhoea often leads to severe dehydration. Next, shortness of breath and chest pain may occur, along with swelling, headaches, and confusion. In about half of the cases, the skin may develop a maculopapular rash, a flat red area covered with small bumps; five to seven days after symptoms begin [7].

Virology

Ebolaviruses contain single-stranded, non-infectious RNA genomes. Ebolavirus genomes contain seven genes including 3'-UTR-NP-VP35-VP40-GP-VP30-VP24-L-5'-UTR. The genomes of the five different ebolaviruses (BDBV, EBOV, RESTV, SUDV and TAFV) differ in sequence and the number and location of

gene overlaps [8]. As with all filoviruses, Ebola virus virions are filamentous particles that may appear in the shape of a shepherd's crook, of a "U" or of a "6," and they may be coiled, toroid or branched. In general, ebolavirions are 80 nanometers (nm) in width and may be as long as 14,000 nm. Their life cycle is thought to begin with a virion attaching to specific cell-surface receptors such as C-type lectins, DC-SIGN, or integrins, which is followed by fusion of the viral envelope with cellular membranes. The virions taken up by the cell then travel to acidic endosomes and lysosomes where the viral envelope glycoprotein GP is cleaved. This processing appears to allow the virus to bind to cellular proteins enabling it to fuse with internal cellular membranes and release the viral nucleocapsid [9]. The Ebolavirus structural glycoprotein (known as GP1, 2) is responsible for the virus' ability to bind to and infect targeted cells. The viral RNA polymerase, encoded by the L gene, partially uncoats the nucleocapsid and transcribes the genes into positive-strand mRNAs, which are then translated into structural and nonstructural proteins. The most abundant protein produced is the nucleoprotein, whose concentration in the host cell determines when L switches from gene transcription to genome replication. Replication of the viral genome results in full-length, positive-strand antigenomes that are, in turn, transcribed into genome copies of negative-strand virus progeny. Newly synthesised structural proteins and genomes self-assemble and accumulate near the inside of the cell membrane [10].

Transmission

It is believed that between people, Ebola disease spreads only by direct contact with the blood or other body fluids of a person who has developed symptoms of the disease. Body fluids that may contain Ebola viruses include saliva, mucus, vomit, feces, sweat, tears, breast milk, urine and semen. The WHO states that only people who are very sick are able to spread Ebola disease in saliva, and the virus has not been reported to be transmitted through sweat. Most people spread the virus through blood, feces and vomit. Entry points for the virus include the nose, mouth, eyes, open wounds, cuts and abrasions. Ebola may be spread through large droplets; however, this is believed to occur only when a person is very sick. This contamination can happen if a person is splashed with droplets. Contact with surfaces or objects contaminated by the virus, particularly needles and syringes, may also transmit the infection. The virus is able to survive on objects for a few hours in a dried state, and can survive for a few days within body fluids outside of a person.

The Ebola virus may be able to persist for more than three months in the semen after recovery, which could lead to infections via sexual intercourse. Virus persistence in semen for over a year has been recorded in a national screening programme. Ebola may also occur in the breast milk of women after recovery, and it is not known when it is safe to breastfeed again. The virus was also found in the eye of one patient in 2014, two months after it was cleared from his blood. Otherwise, people who have recovered are not infectious. The potential for widespread infections in countries with medical systems capable of observing correct medical isolation procedures is considered low. Usually when someone has symptoms of the disease, they are unable to travel without assistance.

Treatments

Researchers looking at slides of cultures of cells that make monoclonal antibodies. These are grown in a lab and the researchers are analyzing the products to select the most promising. As of July 2015, no medication has been proven safe and effective for treating Ebola. By the time the Ebola virus epidemic in West Africa began in 2013, there were at least nine different candidate treatments. Several trials were conducted in late 2014, and early 2015, but some were abandoned due to lack of efficacy or lack of people to study.

As of August 2019, two experimental treatments known as atoltivimab/maftivimab/odesivimab and ansuvimab were found to be 90% effective.

Diagnostic tests

The diagnostic tests currently available require specialised equipment and highly trained personnel. Since there are few suitable testing centres in West Africa, this leads to delay in diagnosis.

On 29 November 2014, a new 15-minute Ebola test was reported that if successful, "not only gives patients a better chance of survival, but it prevents transmission of the virus to other people." The new equipment, about the size of a laptop and solar-powered, allows testing to be done in remote areas. On 29 December 2014, the U.S. Food and Drug Administration (FDA) approved the Light Mix Ebola Zaire rRT-PCR test for patients with symptoms of Ebola.

Conclusion

Ebola virus has been a threat to human health due to dangerous, highly lethal and infectious behaviour since its discovery in 1976. Ebola fever has come out as one of the most fatal identified forms of hemorrhagic fever, for which there is no specific remedy available. The spread among humans occurs mainly through the exchange of blood and body secretions. Other noticeable forms of transmission include hospital acquired infection and inadequate hygiene practices. There is an urgent requirement of dissemination of information to community and training programmes for doctors, nurses and other hospital staff.

The future endeavors require the emphasis on the understanding of the differences among species of ebola virus. There is an urgent demand for more field studies into the ecology of reservoir species and shedding procedures. The discovery of novel targets for intervention tactics requires more exhaustive research into the pathophysiology of ebola virus infections with laboratory animals. The best method to lower the cases and epidemic is to prevent the spread of the disease. The awareness programmers should be organized on large scale to develop the attentiveness about disease for its eradication. The research should also essentially be focused on establishment of rapid and simple diagnostic kits for ebola infection. It is anticipated that outcome of research investigations would result in development of easily available and affordable drug for the treatment of ebloa virus. A great effort with clear strategy is needed for transforming the potential drugs and vaccines from lab to clinical trials and ultimately for treatment of patients with Ebola infection.

Acknowledgement

None

Conflict of Interest

None

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