

EBOLA VIRUS, A LIFE-THREATENING VIRUS: A REVIEW.

Somsak Pantuwatana

Burapha University, Chon Buri 20131, Thailand.

ABSTRACT

Ebola virus is currently created a panic among scientists and people around the world. All information concerning the biology and facts of Ebola virus were then reviewed and analyzed in order to reveal the facts and the possibility of gaining better understanding, how to prevent an outbreak and control the epidemic of diseases that caused by Ebola virus.

Keywords: Ebola virus, outbreak, prevention and control.

INTRODUCTION

According to the recently global warning of Ebola outbreak in Guinea, Liberia, Sierra Leone, and Nigeria, the World Health Organization (WHO) had declared major emergencies around the globe for an end to the targeting of health workers in conflicts and other humanitarian crises, which represent a breach of the fundamental right to health in August 2014. WHO had started to draw attention to attacks on health-care workers, hospitals, clinics and ambulances in Syria, Gaza, Central African Republic, Iraq, South Sudan and other areas (WHO, 2014). The mortality rate that causes by Ebola virus is expected to rise as outbreak runs its deadly course (Kelland, 2014), whereas the death rate so far in the world's worst outbreak of Ebola is not as extreme as recorded in the past. However, experts expect that the virus itself

is no less virulent in the end, while more victims succumb and the grim data are tallied up. Latest figures from the World Health Organization revealed 1,603 cases of Ebola in the West African outbreak with 887 deaths, which was given a death rate of just over 55 percent (WHO, 2014). That makes the death rate is well below the 78.5 percent average death rate over 14 past outbreaks of the same virus, which is called the "Zaire strain" in the recognition of the former name of the Democratic Republic of Congo, where it was first detected in 1976. Things are getting worse and more scarily because Ebola has no proven cures and there is no vaccine to prevent infection currently available. Thus, the best treatment is focused on alleviating symptoms such as fever, vomiting, and diarrhea, where all of which can contribute to severe dehydration.

*Corresponding author. E-mail address: pantuwan@buu.ac.th

Regarding to the high death rate caused by Ebola virus and there is no proven cure and there is no vaccine to prevent infection currently available, where all of these concerns have led to the outbreaks spark fear and panic among local people. Health workers and clinics have come under attack from residents, who sometimes blame foreign doctors for the deaths. People with Ebola or other illnesses may fear going to a hospital, or may be shunned by friends and neighbors.

Therefore, there is a need to put an effort to support the response in many different capacities and get the worst Ebola outbreak in history under control. In doing so, it is necessary to provide guidance to healthcare professionals and local people in the African continent and around the world to understand about Ebola virus and to focus on stopping the spread of the disease.

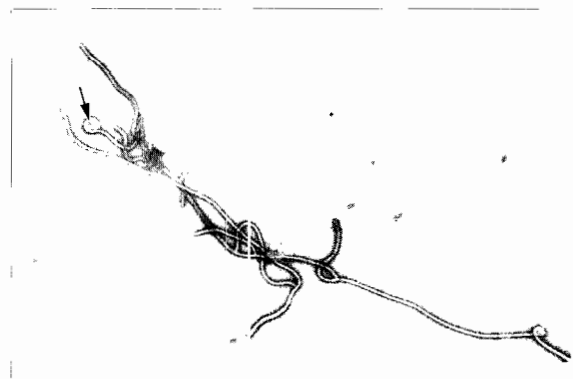
The biology of Ebola virus

Outbreaks of severe and frequently fatal viral hemorrhagic fever occurred in the equatorial provinces of Sudan and Zaire, which were causing widespread international concern (Pattyn, 1978). It was documented that 33 of the 70 cases in Sudan were fatal, where 117 of 290 cases were fatal in Maridi, Sudan. It was also reported that of the 230 members of the staff in Maridi Hospital, 76 were infected and 41 died, while there were 237 cases including 211 deaths in Zaire. One member of the laboratory staff of the Microbiological Research Establishment, Porton Down, England had contracted the disease but recovered.

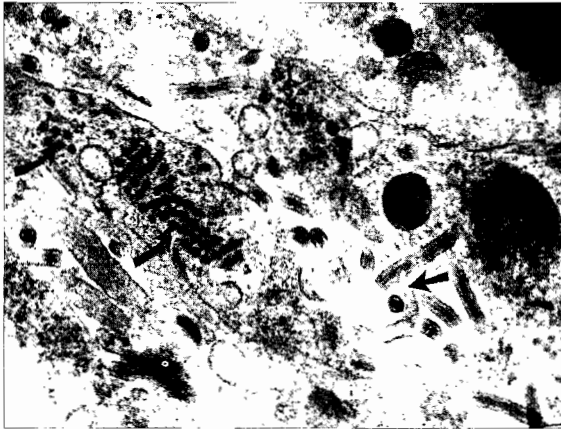
The prototype of the virus strains isolated has been named Ebola virus, which was named after a small river in Zaire that flows north of Tambuku. Tambuku is the village of origin of the patient from whom the first isolate of the virus was obtained. It has been established that the viruses isolated from both northern Zaire and southern Sudan are morphologically related but antigenically distinct from Marburg virus (Howard et al., 1990)

Ebola virus is classified as a member in the genus *Ebolavirus*, where it is one of three members of the family *Filoviridae* (filovirus), along with genus *Marburgvirus* and genus *Cuevavirus* (WHO-SEARO, 2014). The genus *Ebolavirus* comprises 5 distinct species, i.e., *Bundibugyo ebolavirus* (BDBV), *Zaire ebolavirus* (EBOV), *Reston ebolavirus* (RESTV), *Sudan ebolavirus* (SUDV), and *Tai Forest ebolavirus* (TAFV). All of BDBV, EBOV, and SUDV have been associated with large Ebola virus disease (EVD) outbreaks in Africa, whereas RESTV and TAFV have not. The RESTV species, which is found in the Philippines and the People's Republic of China, can infect humans, whereas no illness or death in humans from this species has been reported to date.

The members of the family *Filoviridae* are single-stranded RNA virions, which are present in a variety of forms, i.e. long, short, branched and torus. The virions have their nucleoprotein capsid or core contained within an enveloping membrane of a constant 70 nm diameter, where they are spirally arranged spikes project. Cores develop in the cytoplasm of an appropriate infected cell, where they are budding from the plasmalemma. They can follow each other nose to tail or at angles to produce very long and branched forms, which some of them are up to 20 μm , where each of them containing large numbers of individual cores. Torus forms arise from the rounding up of cores, the excess material being pinched off as shown in Figure 1 (Howard et al., 1990).



(a)



(b)

Figure 1. Electron micrograph of Ebola virus (Modified from Howard et al., 1990).

- (a) A long, branched, negatively stained Ebola virus particle isolated from the outbreak in Zaire. A developing torus form is arrowed. Some of the branches here appear to be made up of single core lengths or their multiples. x9,450.
- (b) The same agent as above, seen in a section of monkey liver. The forming RNA cores (here in cross section), marked with curved arrows, are within a hepatocyte. Mature particles are lying in the spaces between the liver cells. A branched filamentous form is indicated by the straight arrow. x37,500.

Transmission

Ebola introduces into the human population through close contact with the blood, secretions, organs or other bodily fluids of infected animals. An infection has been documented through the handling of infected chimpanzees, gorillas, fruit bats, monkeys, forest antelope and porcupines found ill or dead or in the rainforest in Africa. The virus is subsequently spread in the community through human-to-human transmission, with infection resulting from direct contact, i.e., through broken skin or mucous membranes, with the blood, secretions, organs or other bodily fluids of infected

people, and indirect contact with environments contaminated with such fluids. The direct contact of mourners with the body of the deceased person during burial ceremonies can also play a role in the transmission of Ebola. It has been shown that men who have recovered from the disease can still transmit the virus through their semen for up to 7 weeks after recovery from illness (WHO-SEARO, 2014).

Health-care workers have frequently been infected while treating patients with suspected or confirmed EVD. This has occurred through close contact with patients when infection control precautions are not strictly practiced. It had been documented that several infections were found with clinically asymptomatic among workers in contact with monkeys or pigs infected with *Reston ebolavirus*. Thus, RESTV appears less capable of causing disease in humans than other Ebola species. However, the only available evidence comes from healthy adult males. It would be premature to extrapolate the health effects of the virus to all population groups, such as immunocompromised persons, persons with underlying medical conditions, pregnant women and children. More studies of RESTV are needed before definitive conclusions can be drawn about the pathogenicity and virulence of this virus in humans (WHO-SEARO, 2014).

Signs and symptoms

EVD is a severe acute viral illness that often characterized by the sudden onset of fever, intense weakness, muscle pain, headache and sore throat. The symptom is followed by vomiting, diarrhea, rash, impaired kidney and liver function, and in some cases with both internal and external bleeding. Laboratory findings are included low white blood cell and platelet counts and elevated liver enzymes. Infected persons are infectious as long as their blood and secretions contain the virus. It was shown that Ebola virus could be isolated from semen 61 days after onset of illness in a man who was infected in a laboratory. The incubation period or the time interval from infection with the virus to onset of symptoms is 2 to 21 days (WHO-SEARO, 2014).

Diagnosis

It is noted that several other diseases that should be ruled out before a diagnosis of EVD can be made, i.e., malaria, typhoid fever, shigellosis, cholera, leptospirosis, plague, rickettsiosis, relapsing fever, meningitis, hepatitis and other viral haemorrhagic fevers. Ebola virus infections can be diagnosed definitively in a laboratory through several types of tests, i.e., antibody-capture enzyme-linked immunosorbent assay (ELISA) antigen detection tests, serum neutralization test, reverse transcriptase polymerase chain reaction (RT-PCR) assay, electron microscopy, and virus isolation by cell culture (WHO-SEARO, 2014).

Samples from patients are an extreme biohazard risk, where testing should be conducted under maximum biological containment conditions.

Vaccine and treatment

To date, there is no available licensed vaccine for EVD. Several vaccines are being tested, but none are available for clinical use. Severely ill patients require intensive supportive care, because patients are frequently dehydrated and require oral rehydration with solutions containing electrolytes or intravenous fluids. There is no specific treatment available, whereas new drug therapies are being evaluated.

Natural host of Ebola virus

It has been shown that fruit bats in Africa, particularly species of the genera *Hypsignathus monstrosus*, *Epomops franqueti* and *Myonycteris torquata*, are considered possible natural hosts for Ebola virus (Leroy et al., 2009). As a result, the geographic distribution of Ebola viruses may overlap with the range of the fruit bats.

Ebola virus in animals

Although non-human primates have been a source of infection for humans, they are not thought to be the reservoir but rather an accidental host like human beings. Ebola outbreaks from the EBOV and TAFV species have been observed only in chimpanzees and gorillas since 1994. RESTV has caused severe

EVD outbreaks in macaque monkeys (*Macaca fascicularis*) farmed in Philippines and detected in monkeys imported into the USA in 1989, 1990 and 1996, respectively, and in monkeys imported to Italy from the Philippines in 1992. RESTV viruses have been detected during several outbreaks of a deadly disease in pigs in the People's Republic of China and the Philippines since 2008. Asymptomatic infection in pigs has been reported and experimental inoculations have shown that RESTV cannot cause disease in pigs (WHO-SEARO, 2014).

Prevention and control

Controlling *Reston ebolavirus* in domestic animals

To date, there is no available animal vaccine against RESTV. The routine cleaning and disinfection of pig or monkey farms with sodium hypochlorite or other detergents should be done effectively in inactivating the virus. If an outbreak is suspected, the premises should be quarantined immediately, where culling of infected animals, with close supervision of burial or incineration of carcasses, may be necessary to reduce the risk of animal-to-human transmission. Restricting or banning the movement of animals from infected farms to other areas can reduce the spread of the disease (WHO-SEARO, 2014).

It has been shown that RESTV outbreaks occur in pigs and monkeys have preceded human infections; therefore, the establishment of an active animal health surveillance system to detect new cases is essential in providing early warning for veterinary and human public health authorities.

Reducing the risk of Ebola infection in people

In the absence of effective treatment and a human vaccine, awareness of the risk factors for Ebola infection should be raised among individuals, and the protective measures individuals can take is the only way to reduce human infection and death. In Africa, during EVD outbreaks, educational public health messages for risk reduction should focus on several factors, i.e., reducing the risk of wildlife-to-human transmission from contact with infected fruit

bats or monkeys/apes, and the consumption of their raw meat. Animals should be handled with gloves and other appropriate protective materials.

REFERENCES

- Goldsmith, B. and Fofana, U. 2014. British national contracts Ebola in Sierra Leone - Yahoo News. Available at URL: <http://news.yahoo.com/sierra-leone-makes-harboring-ebola-victims-crime-161037243.html>. Retrieved August 2014.
- Howard, C.R., Simpson, D.I.H., and Ellis, D.S. 1990. Viral Haemorrhagic Fevers. In *Principles and Practice of Clinical Virology*, 2nd Edition, Edited by Zuckerman, A. Z., Banatvala, J.E., and Pattison. John Wiley & Sons Ltd. West Sussex, UK, pp 449-473.
- Kelland, K. 2014. Ebola mortality rate expected to rise as outbreak runs its deadly course.
- Leroy, E.M., Epelboin, A., Mondonge, V., Pourrut, X., Gonzalez, J-P., Muyembe-Tamfum, J-J., and Formenty, P. 2009. Human Ebola outbreak resulting from direct exposure to fruit bats in Luebo, Democratic Republic of Congo. 2007. *Vector Borne and Zoonotic Diseases* 9(6): 723-728. @Mary Ann Liebert, Inc. DOI: 10.1089=vbz.2008.0167.
- Pattyn, S.R. (ed). 1978. *Ebola Virus Haemorrhagic Fever*. Elsevier North-Holland Biomedical Press, Amsterdam, The Netherland.
- WHO. 2014. Global Alert and Response (GAR), Ebola virus disease. Available at URL: (<http://www.who.int/entity/csr/disease/ebola/en/index.html>). Retrieved August 2014.
- WHO-SEARO. 2014. SEARO | Ebola virus disease. Available at URL: <http://www.searo.who.int/thailand/factsheets/fs0034/en/#.U9i74NPxW4>. facebook. Retrieved July 30, 2014.