



Ebola Fever

Pathogen: *Ebola virus*

During the 1976 epidemic, the Ebola virus was isolated for the first time in former Zaire (Since 1997, the Democratic Republic of Congo) and in neighbouring Sudan. It takes its name from a river close to where the virus was first discovered. The zoonotic (transmitted from animal to human) Ebola virus is part of the filoviridae family, which are characterised by their filamentous structure (from the Latin "filo" = thread-like). The protective lipid membrane of the viral particle encases a helically wound nucleocapsid (spiral protein membrane), which contains single-stranded, negative-sense RNA (approx. 18,000 bases). 80 nm in diameter and up to 1400 nm in length, filoviruses are the best known RNA viruses. To date, four Ebola viral species have been identified. Three are human pathogens (*Zaire ebolavirus*, *Sudan ebolavirus* and *Ivory Coast ebolavirus*). The remaining strain is *Reston ebolavirus* (Western Pacific): It appears to be lethal for only certain non-human primates.



Picture: Columbia University, Oracle, USA.

Occurrence

Human-pathogenic Ebola viruses have been isolated solely in Africa. The countries affected are Congo, Sudan, Gabon and Côte d'Ivoire. Animal pathogenic cases (*Reston ebolavirus*) have been reported in the Philippines; only monkeys developed the fatal infection. The original source of the Ebola virus has yet to be found in spite of the large amount of resources deployed to this end. The risk of infection for people travelling to jungle regions is incalculable. Below are brief descriptions of the three Ebola epidemics.

- At the beginning of October 2000, on the outskirts of the Uganda town of Gulu (43,000 inhabitants) around 423 people fell ill. 169 (40%) would later die due to the infection.
- In February 2003, a second outbreak of the Ebola virus was reported in the villages of Kelle and Mbomo, situated approximately 800km north of the Congolese capital, Brazzaville. 140 people were infected, of whom 123 subsequently died (88%). Most picked up the infection in hospitals, where hygiene conditions were sub-optimal and scant regard was paid to isolating infectious patients.
- Between October and December 2003, a further epidemic took the lives of 29 people in the Republic of Congo.
- In May 2004, 19 people fell ill in Sudan, 7 of whom later died.
- Between April and June 2005, 12 people in the Uganda towns of Etoumbi and Mbomo fell ill; 9 later died.

Transmission

The transmission routes from unidentified primary carriers to humans are still unknown. It was long thought that apes were the carriers, since they are often eaten by the local human population. The most recent studies suspect that bats may be the source. When infected artificially with the Ebola viruses, they did not fall ill. The infection can be transmitted from person to person through direct contact with bodily fluids. A further transmission route of *Reston ebolavirus* among monkeys could be through aerosol inhalation (airborne droplet infection). It is debatable whether the same can also be said of the human-pathogenic variants.

In past epidemics, most people had contracted the infection in a hospital setting (nosocomial infections), where they were directly exposed to infected patients. It is unlikely that someone carrying the virus but has yet to show any symptoms can transmit the infection. People who have recovered from the Ebola virus no longer pose a risk to others. There are no documented cases of re-infection.

Symptoms (pathology)

The incubation period (time between infection and onset of the disease) can vary from 2 to 21 days. After this time, the first symptoms appear, such as painful frontal and temporal headaches, sore throat, high fever and muscle pain, especially back pain. These could also be accompanied by watery diarrhoea which quickly leads to dehydration. Between the 5th to 7th day, a characteristic, scaly, maculopapular exanthem (blotchy, blistered rash) appears. Generally, this is accompanied by heavy internal and external bleeding. Externally, the skin, mucous membranes and the nose are affected. Internally, severe liver damage is typically observed, which also affects the spleen and gastrointestinal tract. Heavy blood loss and circulatory failure can lead to death within 7 to 16 days. The mortality rate for Ebola viral infections is between 40% and 98% depending on the viral species.



Picture: Center for Disease Control and Prevention (CDC), Atlanta, USA.

Diagnosis

The first medical indication of infection with the Ebola virus is the patient's symptoms. Diagnosis is confirmed either by immunological tests, e.g. ELISA (enzyme-linked immunosorbent assay), or molecular tests (e.g. real-time reverse transcription polymerase chain reaction (RT-PCR)). Although the filamentous structure of the virus facilitates identification, only level 4 biosafety laboratories are authorised to carry out such procedures by means of an electron microscope. The length of time needed to confirm the diagnosis makes containment problematic, leading to relatively large outbreaks. Switzerland has yet to carry out any diagnostic procedures with regard to the Ebola virus due to a lack of the necessary biosafety infrastructure.

Therapy

Neither a vaccine nor specific medication currently exists to treat Ebola viral infections. New vaccine trials using artificially manufactured Ebola virus membranes (similar to the Marburg virus vaccine trials) have produced encouraging results in rodents. They revealed the protective effect of both humoral (B-lymphocytes) and cellular immune responses (CD8(+)-T-cells). Currently, therapy generally involves intensive medical care, during which time all measures must be taken to contain the spread of the disease. The antiviral drug Ribavirin is administered during the first week of infection to lower the mortality rate. However, its effectiveness is debatable. In 2005, scientists at the NIH (National Institute of Health) in the United States showed that Ebola viruses use two particular proteins found in their host to enter the cells: cathepsin L and cathepsin D (1). When these enzymes were blocked by pharmacological inhibitors, the Ebola virus was unable to enter human cells. These findings will make a valuable contribution to the development of medication to be administered during the postexponential phase of the disease.



Picture: Center for Disease Control and Prevention (CDC), Atlanta, USA.

Filoviruses as biological weapons

Filoviruses meet main bioweapon criteria. They are highly contagious (person-to-person transmission) and have a high mortality rate. There is currently no prophylaxis or therapy, and the diagnosis of filoviruses must be carried out under special conditions, such as level 4 biosafety laboratories. However, filoviruses have a limited ability to survive in the environment and the effectiveness of aerosol infection is unclear. Genetic engineering may make it possible to manufacture aerosolised filoviruses, thus underlining their bioweapon potential.

Literature

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