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Ebola Pandemic

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EBOLA PANDEMIC

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Introduction to Ebola

Ebolavirus, or Ebola Virus Disease (EVD), is of the filovirus family causing hemorrhagic fever first discovered in the African country of Zaire in 1976 (Turner, 2014; Hampton, 2014) and has gained global concern and attention since the recent epidemic outbreak in West Africa.

There are five known species of Ebola: Zaire, Sudan, Ivory Coast, Bundibugyo and Reston, based on the region of origination. The Zaire species has been identified as the strain responsible for the current outbreak in West Africa, and has spread to Liberia, Sierra Leone, Nigeria and Senegal (Centers for Disease Control and Prevention,2014; Gostin, Lucey & Phelan, 2014).

The African fruit bat is most likely the carrier ,or vector, for the virus. Human infection results from direct contact and handling of the infected bushmeat of bats, primates, antelopes, rats and other wild animals . Transmission of the virus between humans occurs only through close contact with bodily fluids (blood, saliva, sweat, urine, vomit, breast milk, feces, and semen) of an infected individual (CDC, 2014; Gostin et al., 2014).

The mortality rate for contracting the virus may be up 90%, with the recent virus outbreak averaging 55-60%(Hampton, T., 2014; CDC, 2014). There is currently no known cure or vaccine.

2014 Outbreak

Currently there have been 4 lab-confirmed Ebolavirus cases in the United States: two imported cases, including 1 death, and 2 healthcare acquired cases (CDC, 2014).

The first U.S. case was a patient who had recently traveled from Liberia to Dallas, TX., developing symptoms four days after his arrival. Lab confirmation was received on October 30th, this patient died one week later. The following two cases were healthcare workers who provided direct care for this patient and tested positive for Ebola on October 10th and October 15th, respectively (CDC, 2014). Both have fully recovered and have been released from isolation (CDC, 2014). The most recent case is a healthcare worker in New York who had returned from Liberia and tested positive on Oct. 23th and remains under isolation precautions (CDC, 2014).

The 2014 Ebola outbreak is the largest outbreak in history. As of Nov 7, the total number of cases was 13,241; total lab-confirmed cases 8,142; and total death count of 4,950 (CDC, 2014).

Signs & Symptoms

Signs and symptoms of an Ebolavirus infection may include respiratory infection with pharyngitis and nonproductive cough, flu-like symptoms, fever greater than 101.5°F, severe headache, muscle pain/ myalgia, body aches, weakness/malaise, abdominal pain, nausea, vomiting, diarrhea, diffuse erythematous nonpuritic maculopapular rash(Bray et al, 2014), dermatitis, kidney and liver dysfunction(CDC, 2014; Turner, 2014). Hemorrhage may develop with petechiae, bruising, bleeding from mucous membranes, and internal bleeding; eventually progressing to multi-organ system failure and septic shock (CDC, 2014).

Lab findings include leukopenia as lymphopenia later followed by elevated neutrophil count with left shift; thrombocytopenia with platelet counts between 50,000 and 100,000; elevated AST and ALT, elevated PT/PTT consistent with disseminated intravascular coagulation; and proteinuria (Bray et al, 2014).

Symptoms may begin to develop 2-21 days from exposure to the virus, with average onset of 8-10 days. Between days 7-9 symptoms may include headache, fatigue, fever, and muscle soreness. Day 10- sudden high fever and vomiting blood. Day 11- Bruising, brain damage, bleeding from nose, mouth, eyes and anus. Day 12- Loss of consciousness, seizures, massive internal bleeding and death (CDC, 2014).

Infected individuals typically improve 6 days after the onset of symptoms(Bray et al, 2014). Antigen-antibody complexes formed during recovery may cause muscle and body aches. More severe, fatal cases will have more severe signs and symptoms initially and may quickly progress to multiorgan failure and septic shock, with death occurring between 6-16 days (Bray et al., 2014).

Pathophysiology of Ebolavirus

Ebolavirus is a single stranded RNA virus that enters the body through mucous membranes, breaks in the skin or intravenously and attacks many cells of the body including monocytes, phagocytes, macrophages, dendritic cells, endothelial cells, fibroblasts, hepatocytes, adrenal cortical cells and epithelial cells. (Yen et al., 2011, CDC 2014).

The virus migrates from the initial infection site and infects macrophages and dendritic cells where viral replication occurs, causing cellular apoptosis and leakage of viral particles into the extracellular fluid. The replicated virus travels to regional lymph nodes for continued viral replication, and subsequently to dendritic cells and macrophages in the liver, spleen, thymus and adrenal glands(Bray, Hirsch & Mitty, 2014).The virus continues to spread systemically as inflammatory interferon is suppressed, infecting hepatocytes, adrenal cortical cells, fibroblasts etc. causing significant tissue necrosis.

The release of cytokines, chemokines, and other inflammatory mediators such as tumor necrosis factor, interleukins, and nitric oxide result in a systemic inflammatory response(Bray et al, 2014). Clinical manifestations of Ebola infection result from the body's response to the infection rather than toxicity caused by the virus(Bray et al, 2014). Infected macrophages with additional stimulation by inflammatory cytokines releases tissue factor and initiates the coagulation pathway causing impaired coagulopathy. In addition to hepatic injury, coagulation dysfunction may ultimately lead to hemorrhage (Bray et al, 2014).

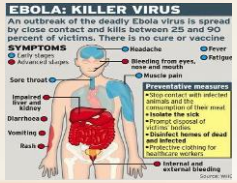
The body's adaptive immune system begins to fail as a result of impaired dendritic cellular function and lymphocyte apoptosis (Bray et al., 2014). This attack on adaptive immunity is how the Ebolavirus can cause such severe illness and fatality(Bray et al., 2014). Dendritic cells are a major site for viral replication, preventing maturation of the cells and their ability to present antigens to lymphocytes. There is also massive apoptosis of lymphocytes induced by inflammatory mediators and lack of dendritic signals (Bray et al, 2014).

Nursing Care Implications

There is no known cure or definitive vaccination. Currently the best treatment is supportive care in maintaining hemodynamic stability, intravenous treatment for fluid and electrolyte imbalances, respiratory support, blood product replacement for signs of hemorrhage, correcting coagulopathy and administering antibiotics for infection (Turner, 2014).

Healthcare workers and hospital personnel in direct contact with an infected patient MUST follow strict protocol to prevent personal exposure and further spread of infection. Universal precautions should be followed diligently, wearing personal protective equipment (PPE), handling blood or body fluids with extreme caution for potential exposure. The virus can survive on dry surfaces such as door knobs and counters for up to several hours , in semen for up to 3 months, and other body fluids anywhere from 1 week to 30 days(CDC, 2014; Bray et al. 2014). Hospital grade disinfectants such as bleach are effective for killing the virus from surfaces(CDC, 2014).

Strict isolation with "fever surveillance"(Hampton, 2014) of suspected or lab confirmed infected patients must be enforced. Hospitals and all healthcare personnel need education on correct application and removal of personal protective equipment (donning and doffing). It is important to be familiar with institutional regulations on infectious disease, and the plan of emergency action in case of a pandemic. There should be strict screening protocols of patients through hospital ERs with possible symptoms or virus exposure.



Prevention and Education!

Public education is paramount in preventing the spread of the virus. Education would include proper hand washing techniques and hygiene, what symptoms to monitor for, what to do if suspect exposure or infection, the severity/fatality risk of Ebola virus, risk factors for transmission, and preventative measures.

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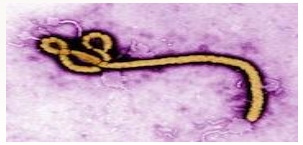

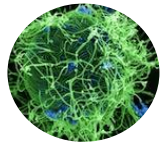

Recovered Ebola patients develop antibodies that may last up to 10 years. Convalescent therapy of whole blood or plasma transfusions from these individuals has shown promise for recovery(WHO,2014) of infected individuals.

The WHO has approved implementation of experimental therapies to treat Ebola individuals (Hampton, 2014) with projected availability by early 2015. There are several potential vaccines currently undergoing approval for clinical trials. The CAd3-ZEBOV vaccine developed by GlaxoSMithKline uses chimpanzee-derived adenovirus vector with an Ebola virus gene inserted(WHO,2014). The rVSV-ZEBOV vaccine developed in Canada is an attenuated vesicular stomatitis virus found in livestock with Ebola gene replacement(WHO, 2014). Additional potential treatments include an SiRNA compund (TKM-Ebola), and AVI-7537m, an antisense drug (Mullin, 2014; Jarvis, 2014). A recent media release from Japan announced a potential treatment Avigan, a polymerase inhibitor, is currently awaiting approval for treatment. The antibody compound Zmapp has already been used for treatment with both successful and unsuccessful outcomes.

Conclusion

The current Ebola outbreak has been declared an international public health emergency(WHO,2014). The CDC reports the risk of an Ebola outbreak in the U.S. is low, recommending limited travel to West African countries. However, currently there is no ban on travel (Gostin et. al, 2014).

With no known definitive cure or vaccination to prevent the Ebola virus, strict adherence to preventing the spread must be continued. Hospitals must maintain strict screening protocols of all patients who are at risk for exposure.

International efforts to prevent the spread of the virus have been implemented in major US and West African airports through entry and exit screening of travelers for infectious signs and symptoms (CDC, 2014).

The CDC states the rapid identification of Ebola infection is key to preventing the spread of the virus. "Contact tracing" is currently a method used by CDC teams to track down infected persons and is described in the following chart from the CDC website (2014).

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Obama administration is working with specialists on setting healthcare policy to support potential experimental treatment therapies for clinical trials (Hampton, 2014). A major influence on the deployment of treatment relies highly on international funding. This certainly would be a major issue in providing potential treatments for thousands of Ebola infected people. See additional information regarding international funding for Ebola treatment in Africa: http://www.who.int/tdr/news/2014/ebola-treatment-trials/en/.

Ethical considerations exist concerning using experimental drugs. There will be limited supplies, many of which are still awaiting approval for clinical trials (Gostin et al., 2014). Ethical questions remain as to who would have priority for treatment, and how and who would make these decisions. There can be serious, even fatal risks with experimental therapies and prospective recipients would need to be educated and understand these risks.

References Cited

Bray, M., Hirsch, M., & Mitty, J. (2014). Epidemiology, pathogenesis and clinical manifestations of Ebola. Published online October 2014. Retrieved from http://www.uptodate.com/contents/epidemiology-pathogenesis-and-clinical-manifestations-of-ebola-and-marburg-virus-disease

Centers for Disease Control and Prevention. (2014). Ebola virus disease. Retrieved from http://www.cdc.gov/vhf/ebola/index.html

Gostin, L., Lucey, D., Phelan, A.,(2014). The Ebola epidemic: A global health emergency. *JAMA*, 2014, 312(11), 1095-1096. doi:10.1001/ jama. 2014.11176.

Green, Andrew. (2014). WHO and partners launch Ebola response plan. *The Lancet*, S0140-6736(14) 61322-2.

Hampton, T. (2014). Largest ever outbreak of Ebola Virus Disease thrusts experimental therapies, vaccines into spotlight. *JAMA. Sept 10, 2014, 312 (10), 987-989.*

Jarvis, L. (2014,August 8). Treating Ebola. Retrieved from http://cen.acs.org/articles/92/i32/Treating-Ebola.html

Mullin, R. (2014, Sept 1). Japan proposes influenza drug to treat Ebola. Retrieved from http://cen.acs.org/articles/92/i35Japan-Proposes-Influenza/-Drug-Treat.html

Turner, C. (2014). Ebola virus disease: An emerging threat. *Nursing2014, Sept, 68-69.*

World Health Organization. (2014). *Ebola Virus Disease.* Retrieved from http://www.who. int/media-centre/factsheets/fs103/en/

Yen, J., Garamszegi, S., Geisbert, J., Rubins, K., Geisbert, T., Honko, A., Xia, Y., Connor, J., & Hensley, L. (2011). Therapeutics of Ebola hemorrhagic fever: Whole-genome transcriptional analysis of successful disease mitigation. *Journal of Infectious Disease,* (2011), 204 (3), S1043-S1052. doi:10.1093 infdis/jir345

Additional Sources

Feldman,H. (2011). Ebola hemorrhagic fever. *Lancet, 2011, 377: 849-862*

Kortepeter, M., Bausch, D., & Bray, M. (2011). Basic clinical and laboratory features of filoviral hemorrhagic fever. *Journal of Infectious Diseases,* 2011, 204(3), s810-

McElroy, A., Erickson, B., Flietstra, T., Rollin, P., Nichol, S., Towner, J. & Spiropoulou, C. (2014). Ebola hemorrhagic fever: Novel biomarker correlates of clinical outcome. *Journal of Infectious Diseases, 2014, 210, 558-566.*

Sobarzo, A., Ochayon, D., Lutwama, J., Balinandi, S., Guttman, O., Marks, R., Kuehne, A., Dye, J., Yavelsky, V., Lewis, E., Lobel, L. (2013). Persistent immune response after Ebola virus infection. *The New England Journal of Medicine*. August 2013, 369(5), 492-493.

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