Lassa viruse fever structure

Lassa virus fever is a disease that is very common and endemic in West Africa which according to the CDC infects 100, 000-300, 000 per year with approximately 5, 000 deaths [1]. This highly contagious and extremely virulent viral disease was first discovered in a town in the Yedseram river valley called Lassa (which is where it got its name from) in Borno state, Nigeria. Its first case was recorded in 1969 after two nurses died in a hospital in Lassa town. It is an acute viral hemorrhagic fever that is endemic not only in Nigeria, but to other West African countries like Congo, Liberia, Sierra Leone and Guinea [2]. At least two cases have occurred in the United States, both of which of course both individuals traveled to countries endemic to this disease. Lassa virus is zoonotic but it can also be transmitted from person to person. No vaccine has been developed for this virus but only one drug is known and used to successfully treat the disease.

Lassa virus is a member of the Old World complex and is classified under the family of arenaviridae. The genus classification is arenavirus and its species is its name; Lassa virus. It belongs to Group five (V) in the Baltimore classification of viruses alongside Ebola, measles, rabies and influenza. Viruses in this category are negative-sense single stranded RNA genomes and have sandy appearances due to the presence of ribosomes [3]. The virions are spherical and comprise of an envelope and two nucleocapsids which have filaments that form a circle. The capsid is enveloped. The envelope contains glycoproteins that post translationally cleave to Glycoprotein1 and 2 (GP2). GP2 interacts with nucleocaspid protein to assemble virion. It also acts as the viral fusion protein under acidic conditions [4]. Other proteins found in the cell include nucleocapsid protein

which is the most abundant and the first protein that is expressed in an infected cell. The second protein that is expressed is the viral RNA-dependent- RNA polymerase which can be detected in virions. Its genome is composed of two strands namely S-RNA and L-RNA. S-RNA is ambisense and codes for two proteins; glycoprotein and nucleoprotein while L-RNA is a negative sense RNA and codes for Zinc RING-finger motif protein (Z) and Viral RNA dependent RNA polymerase (L) [4].

The life cycle of a typical Lassa virus starts when the virion comes in contact with the cell. The virus takes over the cell mechanism and uses it to its advantage by utilizing the cell's replication machinery to make more viruses that will cause infection in other cells. The cellular receptor called alpha-dystroglycan binds with the viral receptor called GP1 and infects the cell. The virus enters the cell through endocytosis which is rare with enveloped viruses [5]. The capsid is uncoated due to low Ph (acidity) of the endosome and then transported to the cytosol. Replication is very rapid. Copies of the mRNA minus sense genomes are made and these genomes then make viral complementary RNA copies of itself which are plus sense. Nuclear proteins are expressed in large quantities followed by the replication of L and S strands being ensued. Enveloped glycoprotein is expressed and this differentiates into GP1 and GP2 which then migrate to the surface of the cell. Nucleocapsid proteins combine with genomic RNA to form strings of bead-like structures. The nucleocapsid proteins cross-links to the carboxy terminus of GP2. The virus is assembled in the cytoplasm after which it egresses the cell by budding out [5].

Lassa virus is zoonotic which means that humans become infected when they come in contact with an animal that is infected. The animal in this case is a rodent called Mastomys natalensis commonly known as multimammate rat. Infected rats are asymptomatic to this disease but they shed it in their urine and droppings and also secrete it in their saliva, all which can be aerosolized [1]. Humans get infected from direct contact with these materials like consumption of contaminated food, touch infected objects and even inhalation of tiny infected particles. It can also be tramsmitted from person to person. This can occur if a person comes in contact with excretions, blood, and secretions of an infected person. Lassa virus affects nearly all the tissues in the human body, starting with the mucosa and eventually the vascular system. Arenaviruses are able to infect macrophages and possibly cause the release of mediators of cell and vascular damage. T-cell induced immunopathologic effects significantly exacerbate tissue destruction. Once infected, the virus can find its way into the human body through different mediums like the respiratory tract, the blood stream and/or lymph vessels. It then duplicates in the reticuloendolethial cells causing capillary lesions. These lesions further lead to platelet and erythrocyte loss and sometimes cause hemorrhage in various organs [6].

About 80% of people infected with this virus are asymptomatic. After and incubation period of about 21 days, symptoms that are not specific like fever, chest pain, nausea, vomiting malaise, abdominal pain and coughing begin to occur. Some patients experience symptoms like diarrhea, protein in the urine, facial swelling, encephalitis, seizures, facial swelling, tremor and disorientation may occur in the late stages. If fetal or left untreated, it can

lead to death. Mortality rate is about 15-20% among hospitalized patients and about 95% among pregnant women. However, abortion reduced death among pregnant women because the virus has a high affinity for the placenta and the survival of the fetus in 10% regardless of any measure taken [1]. The most common long term consequence of Lassa fever after recovery is deafness which occurs in one-third of the cases. Deafness could range from mild to severe and could become permanent. Spontaneous abortion is another common consequence. It is often diagnosed by using ELISA which detects IgG, IgM antibodies and also Lassa antigens. This viral infection cannot be cleared by the immune system because it is systemic and cause hemorrhagic fever.

Ribavirin, an antiviral drug is the only drug that is used to treat Lassa virus in its early stages. It works by interfering with the viral replication by blocking RNA-dependent nucleic acid synthesis [7]. Patients should receive supportive care which includes maintenance of appropriate body fluid, oxygenation and treatment of opportunistic and complicating infections. No vaccine is available for this diease. Lassa virus can be prevented if contact can be avoided between humans and the multimammate rat especially in regions when outbreaks are known to occur. Proper storage of food in rodent-proof containers is highly recommended. Also, keeping homes clean, disposing trash far away from household, keeping cats and using rat traps in order to avoid attraction of these vectors can greatly reduce susceptibility [2]. The complete eradication of Mastomys is almost impossible because these rodent reservoirs are widely distributed and are very abundant in endemic areas. People caring for patients with Lassa fever should avoid direct person

to person contact especially with blood and bodily fluids of patients. Other precautions like using sterilized equipments, wearing masks, protective clothing, gloves, face shields, closed-toe shoes and goggles should be worn before coming in contact with infected patients. Infected patients should be isolated from uninfected patients as well. Educating people in endemic areas on ways to reduce rodent population in their homes and surroundings, personal hygiene, developing more rapid diagnostic tests and also making Ribavirin readily available to the population can help to address the threat of this disease.

Lassa virus infects males, females and even children of all age groups. People who are at risk of contracting the infection include those that live in or frequently visit areas that have a high population of Mastomys who are infected with the virus. This includes places with poor sanitation and/or overcrowded living conditions. Those that work at health care facilities are also at risk if proper precautional measures are not taken. Studies show that 300, 000 – 500, 000 cases of Lassa fever occur annually and out of which 5, 000 deaths are recorded. Death usually occurs with 14 days of occurrence in fetal cases. This disease is fetal in women who are late in pregnancy and mortality rate is as high as 80% in the third trimester. In Liberia and Sierra Leone, 10-16% of patients that are admitted in their hospitals suffer from Lassa fever which expresses the impact of this dieases in those areas. The most promising approach to developing a vaccine so far is Vaccinia vectored Lassa genes. They have been successfully tested on guinea pigs and primates but it has not been tested on humans.

Lassa virus is an acute viral hemorrhagic fever that is highly endemic in West Africa. It is a zoonotic disease that is transmitted to humans when they come in contact with urine, droppings or excretion of waste products from Mastomys Natalensis commonly known as the ‘ multimammate rat’. The virus does not affect the rats. Infected rats serve as carriers of the Lassa virus because they are asymptomatic throughout their life time. Lassa virus affects nearly all the tissues in the human body. Person to person transmission can also occur if proper caution is not maintained. Symptoms of this disease range from fever to encephalitis and if fetal, death can occur. Mortality rate is from 15-20%, however, it is significantly higher in pregnant women. Deafness is a common long term consequence of this disease after recovery. Ribavirin is the only drug that is known to treat this disease and it is only successful if used when the infection is in its early stages. No vaccine is available. Preventive measures to avoid this being infected this disease include avoiding contact with rodent vectors, proper storage of food and water, isolation of infected patients and taking proper precautionary measures when health care workers treat infected patients. Lassa virus affects people of all ages. It is almost impossible to eradicate this viral infection because the multimammate rat is abundant in endemic areas.