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AN UPDATED REVIEW ON HANTAVIRUS

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ABSTRACT

Hantaviruses are zoonotic infections that are extremely hazardous to humans. They are rodent-borne viruses and hence belong to a separate genus in the Bunyaviridae family. They have a long life cycle in their main hosts and do not cause illness; nevertheless, they can infect people if they come into touch with rodents or inhale aerosolized infected rodent droppings and saliva. Hantavirus has a wide geographic distribution and is found on all continents except Antarctica. Since its initial contact in the 1950s during the Korean War, it has posed a menace to mankind. Hantavirus syndrome can cause either hemorrhagic fever with renal syndrome (HFRS), which is more common in the United States, or Hantavirus Cardiopulmonary Syndrome (HCPS), which is more common in Eurasia. In recent years, these viruses have infected around 2,000,000 people throughout the world. In this review, we present an overview of the advances achieved in understanding hantavirus epidemiology, various vaccines, medications, pathogenesis, clinical aspects, model systems utilized for hantavirus research, therapies, and preventions connected with the virus.

INTRODUCTION

Any member of the genus Hantavirus, which belongs to the family Bunyaviridae that causes acute respiratory diseases in humans, is referred to as a hantavirus. Rodents are the hosts of hantaviruses, which are viruses that have evolved to suit certain rodent hosts. Human infection happens when individuals have unexpected and close contact with colonies of infected rodents; this is primarily due to dust in the home and surrounding areas that contains dried rat excrement inhaled. Numerous distinct hantaviruses exist, each with a unique rodent carrier, and they cause two main categories of illness. The term hemorrhagic fever with renal syndrome (HFRS) refers to the first group. These infections usually appear within 1 to 2 weeks of exposure (occasionally later) and are marked by an intense fever, severe headache, impaired vision, and nausea. Severe cases, such as those involving Dobrava virus or Hantaan virus, can cause internal bleeding and kidney failure. Korean hemorrhagic fever (also known as hemorrhagic nephroso-nephritis) was one of the first HFRS infections to be identified during the Korean War (1950–1953). Korean hemorrhagic fever is deadly in 5 to 15% of cases. It is caused by the Hantaan virus and transmitted by the striped field mouse (Apodemus agrarius), a kind of wood mouse found in Asia and Eastern Europe. Nephropathia epidemica, a secondary HFRS illness, is rarely deadly. It is caused by the Puumala virus, which is transmitted by the bank vole (Myodes glareolus). Nephropathia epidemica has spread throughout Scandinavia, western Russia, and other parts of Europe.

Mild hemorrhagic sickness can also be caused by infection with the Seoul virus, which is carried by the Norway rat. Seoul virus infections are most common in Asia, but they have also been seen in Brazil and the United States. The second group of hantavirus disorders is hantavirus pulmonary syndrome (HPS), which is seen in a variety of locales across the Western Hemisphere. HPS diseases are characterized by a quick onset of muscle aches and fever, which leads to abrupt respiratory distress. These infections are fatal approximately 50% of the time. The first case of HPS was discovered in the southwestern United States in 1993, and it was linked to the Sin Nombre virus, which is spread by Peromyscus maniculatus, the deer mouse. Additional cases of HPS have been reported from the following locations: Florida, where the Black Creek Canal virus (carried by the hispid cotton rat, Sigmodon hispidus); Louisiana, where the Bayou virus (carried by the marsh rice rat, Oryzomys palustris); Chile and Argentina, where the Andes virus (carried by the pygmy rice rat species, Oligoryzomys longicaudatus); and Central America, where the Choclo virus (carried by Oligoryzomys fulvescens, another pygmy rice rat).[1, 2, 3, 4, 5, 6, 7, 8]

Structure of Hanta virus:

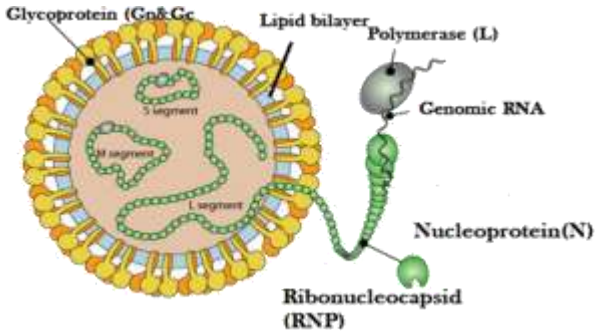

Figure 1: Structure of Hantavirus

Hantavirus belongs to the Bunyaviridae family. The virion has a spherical or pleomorphic form with a diameter of approximately 120-160 nm. The virus capsid is protected by a single-layer envelope. The envelope contains three nucleocapsids and has surface projections. Surface projections are characteristic spikes encircled by a conspicuous fringe buried in a 5-nm-thick lipid bilayer. These projections are 5-10 nm long and form a grid-like pattern. The capsid or nucleocapsid is elongated and has helical symmetry. The ribonucleocapsid is filamentous, measuring 200-300 nm long depending on the arrangement and 2-2.5 nm broad.[9, 10, 11]

Replication: Hantavirus genomic RNAs are expected to interact with the N protein to create helical nucleocapsids that circularise due to sequence complementarity between the 5′ and 3′ terminal sequences of each genomic segment. Hantaviruses only replicate in the host cell's cytoplasm.[11, 12]

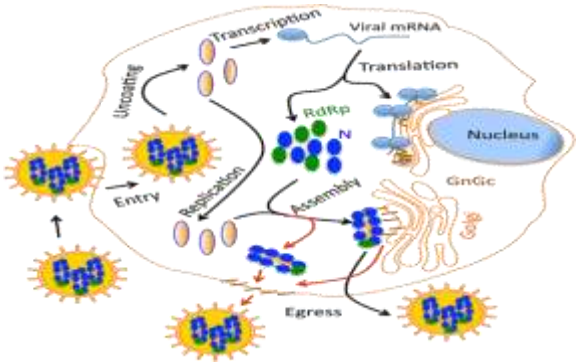

Figure 2: Replication of Hantavirus

Signs & symptoms: Early symptoms include weariness, fever and muscle aches, particularly in the major muscles of the thighs, hips, back and on a few occasions shoulders. These symptoms are universal. Headaches, dizziness, chills, and stomach pain are all possible symptoms. Approximately half of all HPS patients have these symptoms. The late symptoms of HPS emerge four to ten days after the first illness. These include coughing, shortness of breath, pulmonary edema etc.[13, 14, 15]

Incubation period: Since there are so few HPS instances, it is impossible to determine the incubation time with certainty. However, based on the scant information available, it appears that symptoms could arise 1 to 8 weeks after coming into contact with newly contaminated rodent saliva, droppings, or urine.[15, 16]

Risk: Anybody who comes into contact with infected rodent droppings, urine, saliva, nesting materials, or particles from these may get the hanta virus illness. The greatest risk factor for infection is exposure to homes with active rat infestations that are poorly ventilated. Entering buildings with mouse activity that are seasonally closed or open seldom might also spread illness. Additionally, campers, hikers, and other outdoor activity participants who visit rural areas and nature resorts may contract the virus. Patients with possible occupational exposures among documented cases of HPS in the United States include field biologists, grain farmers, extension livestock specialists, and workers in the agriculture, mill, construction, utility, and feedlot industries. A large number of these people were also exposed in their homes.[17, 18]

Transmission: Hantavirus is mostly spread through direct contact with infected rodents' feces, saliva, or urine, or via inhalation of the virus in their aerosolized excreta.

People may also become infected via:

- Being bitten by diseased rodents.
- Consuming food contaminated with an infected rodent's urine, droppings, or saliva.
- Touching the eyes, nose, and mouth after handling objects contaminated with an infected rodent's urine, droppings, or saliva.

Human-to-human transmission is quite rare. [18, 19]

Prevention: Lowering your risk of exposure to rodents and the different methods they spread disease is the best strategy to prevent infection with the Hanta virus.

Here are some tips: Wash your hands after being outside, as when hiking. Frequently wash clothes when engaging in extended outdoor activities, including camping.

- ✓ When camping, keep food and food supplies, as well as trash, contained and covered.
- ✓ Avoid touching rodents or their urine or droppings.
- ✓ Make sure to wash your hands after any touch.

You can also take precautions to safeguard your house:

- ✓ Seal off any possible openings for rodents to enter your house.
- ✓ Set traps or hire a pest control professional if you have a rodent infestation.
- ✓ When cleaning an area potentially occupied by rodents, wear a properly fitting respirator mask (such as an N95) and gloves.
- ✓ To prevent rodents, keep your kitchen clean and put food away from counters.[20, 21, 22]

Diagnosis: The primary method for diagnosing hantavirus disease is antibody detection using immunofluorescent assays (IFA) or enzyme immunoassays (EIA). Antibodies are not selective when the hantavirus infection is in its acute stage. Granular fluorescence in IFA of acute sera and low avidity of IgG antibodies can be utilized to distinguish between new and old infections. Immunochromatographic IgM assays have been created recently as a point-of-care diagnostic that uses an optical reader. Patient blood is being used for RT-PCR.[3, 18]

TREATMENT:

Hantavirus infection can lead to serious illness. The goal of hantavirus treatment is to control your symptoms and reduce the danger of lung and heart damage. Because of the severe pulmonary (lung) symptoms, many people will require assistance breathing. Approximately 40% of those who visit the hospital with hantavirus symptoms require mechanical breathing. If your symptoms do not improve, your medical team may consider extracorporeal membrane oxygenation (ECMO). Individuals who develop HFRS may require hemodialysis. This is a method for filtering your blood while your kidneys recuperate. A doctor may recommend antiviral medicine to help eliminate the virus from your

system. No large-scale human research has demonstrated that any antiviral is effective in treating various hantavirus strains. However, several investigations have seen positive results.

Ribavirin: According to some research, ribavirin is a good treatment for the Andes and hantaviruses. However, these benefits only seem to be beneficial prior to the onset of pulmonary symptoms. It has noteworthy adverse effects as well. Combining ribavirin and favipiravir to treat the hantavirus had favorable outcomes, according to a 2021 research conducted on animals.
Chloroquine: Known as an antimalarial medication, it has been shown in rat trials to be effective against the Andes and hantaviruses. No human trials have been conducted.

Monoclonal antibodies: According to recent reliable study, rats may not become infected with the Andes and Puumala viruses if they have human-made monoclonal antibodies.[23, 24]

CONCLUSION:

Hantavirus infections are among the growing number of new zoonotic infectious illnesses. Over the last few decades, global awareness and detection of hantavirus infection has increased dramatically. Both the amplitude and size of hantavirus epidemics have increased. This might be explained by increased clinical awareness, the development of sensitive diagnostic tests, extensive reservoir study, and changing climate circumstances. Although some hantaviruses are freshly discovered, they are ancient viruses. However, environmental changes may impact the geographic distribution, abundance, and dynamics of the carrier rodent species, and therefore the epidemiology of the disease. Although we can only hypothesize about the extent of environmental and climatic changes, hantavirus infections will continue to pose a public health risk. Therefore, further research on hantavirus pathogenesis, diagnostics, antivirals and vaccine development is required.

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