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A Review on Orthohantavirus (Hantavirus)

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ABSTRACT

This study is the review on orthohantavirus or hantavirus. The hantaviruses are a relatively newly discovered genus of viruses. The term hantavirus refers to a genus covering several tens of species or genotypes globally; six so far in Europe, differing in their virulence to humans. Hantaviruses are rodent-borne viruses causing clinical illness in humans of varying severity. There are several different hantaviruses, with a different geographical distribution and causing different clinical diseases. Hantavirus Pulmonary Syndrome (HPS) is a severe, sometimes fatal, respiratory disease in humans caused by infection with hantaviruses. Anyone who comes into contact with rodents that carry hantaviruses is at risk of HPS. Avoidance of virus-contaminated dust during work or leisure time is of prime importance; for people with underlying disease, face masks could be used. The diagnosis of hantavirus disease mainly relies on the detection of antibodies, through immuno-fluorescent assays (IFA) or Enzyme Immuno Assays (EIA). The treatment of hantavirus disease is mainly symptomatic. Maintaining the fluid balance, while avoiding over-hydration in a potentially oliguric patient is of critical importance. In conclusion Hantaviruses are enzootic viruses that maintain persistent infections in their rodent hosts without apparent disease symptoms.

Keywords: Review, orthohantavrius, hantavirus.

INTRODUCTION

Hantaviruses are rodent-borne viruses causing clinical illness in humans of varying severity. There are several different hantaviruses, with a different geographical distribution and causing different clinical diseases. Each hantavirus is specific to a different rodent host. Transmission of the virus to humans occurs through the inhalation of infected rodent urine, droppings, or saliva. Orthohantavirus is a genus of single-stranded, enveloped, negative-sense RNA viruses in the family Hantaviridae of the order Bunyavirales. Members of this genus may be called orthohantaviruses or simply hantaviruses. They normally cause infection in rodents, but do not cause disease in them. Humans may become infected with hantaviruses through contact with rodent urine, saliva, or feces. Some strains cause potentially fatal diseases in humans, such as hantavirus hemorrhagic fever with renal syndrome (HFRS), or hantavirus pulmonary syndrome (HPS), also known as hantavirus cardiopulmonary syndrome (HCPS), while others have not been associated with known human disease.[5] HPS (HCPS) is a "rare respiratory illness associated with the inhalation of aerosolized rodent excreta (urine and feces) contaminated by hantavirus particles."

Hantavirus Pulmonary Syndrome (HPS) is a severe, sometimes fatal, respiratory disease in humans caused by infection with hantaviruses. Anyone who comes into contact with rodents that carry hantaviruses is at risk of HPS. Rodent infestation in and around the home remains the primary risk for hantavirus exposure. Even healthy individuals are at risk for HPS infection if exposed to the virus [1] [2] [3]. To date, no cases of HPS have been reported in the United States in which the virus was transmitted from one person to another. In fact, in a study of health care workers who were exposed to either patients or specimens infected with related types of hantaviruses (which cause a different disease in humans),

none of the workers showed evidence of infection or illness. In Chile and Argentina, rare cases of person-to-person transmission have occurred among close contacts of a person who was ill with a type of hantavirus called Andes virus. Human infections of hantaviruses have almost entirely been linked to human contact with rodent excrement; however, in 2005 and 2019, human-to-human transmission of the Andes virus was reported in South America.[4] Hantavirus is named for the Hantan River area in South Korea where an early outbreak was observed,[5] and was isolated in 1976 by Ho Wang Lee.

Three main clinical syndromes can be distinguished after hantavirus infection: haemorrhagic fever with renal syndrome (HFRS), mainly caused by Seoul, Puumala and Dobrava viruses; nephropathia epidemica, a mild form of HFRS caused by Puumala virus; and hantavirus cardiopulmonary syndrome, which may be caused by Andes virus, Sin Nombre virus, and several others. There is no curative treatment for hantavirus infection, and eliminating or minimising contact with rodents is the best way to prevent infection [6] [7].

A Brief History

The hantaviruses are a relatively newly discovered genus of viruses. An outbreak of hemorrhagic fever among American and Korean soldiers during the Korean War (1950–1953) was caused by a hantavirus infection. More than 3000 troops became ill with symptoms that included kidney failure, generalized hemorrhage, and shock. It had a 10% mortality rate. Hantavirus was named for the Hantan River area in South Korea.[8] [9] [10] [11] This outbreak sparked a 25-year search for the etiologic agent. Ho-Wang Lee, a South Korean virologist, and his colleagues isolated Hantaan virus in 1976 from the lungs of striped field mice. In late medieval England a mysterious sweating sickness swept through the country in 1485 just before the Battle of Bosworth Field. Noting that the symptoms overlap with hantavirus pulmonary syndrome (see above), several scientists have theorized that the virus may have been the cause of the disease.[12] [13] The hypothesis was criticized because sweating sickness was recorded as being transmitted from human to human, whereas hantaviruses were not known to spread in this way.[14] Limited transmission via human-to-human contact has since been shown in Hantavirus outbreaks in Argentina.[15]

In 1993, an outbreak of hantavirus pulmonary syndrome occurred in the Four Corners region in the southwestern United States. The viral cause of the disease was found only weeks later and was called the Sin Nombre virus (SNV), or in Spanish, "virus sin nombre", meaning "nameless virus". The host was first identified as the deer mouse (Peromyscus maniculatus) by Terry Yates, a professor at the University of New Mexico.[16]

Nature of Infecting Organisms

The term hantavirus refers to a genus covering several tens of species or genotypes globally; six so far in Europe, differing in their virulence to humans. Each hantavirus has a specific rodent host species, or a group of closely related host species. Hantaviruses are expanding in Europe: they are found in new areas and the incidence has increased in several established endemic regions. The most common European hantavirus disease is caused by Puumala hantavirus, carried by the bank vole (Myodes glareolus). The virus is widespread across most of the continent, except for the UK, the Mediterranean coastal regions and the northernmost areas [17] [18]. Dobrava hantavirus, carried by the yellow-necked mouse (Apodemus flavicollis), is found only in south-east Europe, as far as the Czech Republic and southernmost Germany in the north, though the carrier species has a much wider distribution in Europe to the west and north. Other hantaviruses in Europe, but with less public health importance, include Saaremaa hantavirus, carried by the striped field mouse (Apodemus agrarius) and found in eastern and central Europe and the Baltic states; Seoul hantavirus, carried by rats (Rattus norvegicus, R. rattus); Tula hantavirus, carried by Microtus voles; and Seewis hantavirus,

common in shrews (Sorex araneus), and only recently found in Europe. Clinical illness results in haemorrhagic fever with renal syndrome (also called "nephropatia epidemica") and causes less than 0.5% mortality.

hortness of breath with rapidly evolving pulmonary edema that is often fatal despite intervention with mechanical ventilation and potent diuretics. The fatality rate is 36%.

Hantavirus pulmonary syndrome was first recognized during the 1993 outbreak in the Four Corners region of the southwestern United States. It was identified by Dr. Bruce Tempest. It was originally called "Four Corners disease," but the name was changed to "Sin Nombre virus" after complaints by Native Americans that the name "Four Corners" stigmatized the region.[19] It has since been identified throughout the United States. Rodent control in and around the home remains the primary prevention strategy.

Classification

Hantaviruses are bunyaviruses. The order Bunyavirales is divided into twelve families. Like all members of this order (except for the Arenaviridae), hantaviruses have genomes comprising three negative-sense, single-stranded RNA segments, and so are classified as negative sense RNA viruses. Members of other Bunyavirales families are generally arthropod-borne viruses, [20] but hantaviruses are thought to be transmitted to humans mainly through inhalation of aerosolized rodent excreta, or rodent bites.

Signs and symptoms

The symptoms and signs of HPS fall into early and late stages.

Early HPS signs and symptoms begin about one to five weeks after the person contacts hantavirus associated with rodent urine, feces, or saliva. The early symptoms are flu-like, last about four to 10 days, and include

- Fatigue,
- Fever, and
- Muscle aches, especially large muscles in the legs, back, and hips).

Almost every infected person develops these symptoms. Other symptoms of HPS that may occur in about half of infected patients include

- Abdominal pain (with nausea, vomiting, and diarrhea),
- Headaches,
- Chills, and
- Dizziness.

Early symptoms of can cause diagnostic confusion. In 2018, Kiley Lane, a 27-year-old mother who lived in New Mexico, was diagnosed as having the flu but her symptoms got worse. She was diagnosed with having hantavirus about a month after her flu diagnosis and died about one month later of the disease.

Late symptoms of HPS occur about four to 10 days after the early symptoms and include;

- Coughing,
- Chest pain, and
- Shortness of breath that can become severe.

Some infected people may develop hemorrhagic fever and kidney failure that may require dialysis (HFRS or hemorrhagic fever with renal syndrome or Hantavirus pulmonary syndrome).

Hemorrhagic fever with renal syndrome

Hemorrhagic fever with renal syndrome (HFRS) is a group of clinically similar illnesses caused by species of hantaviruses from the family Hantaviridae. It is also known as Korean hemorrhagic fever, epidemic hemorrhagic fever, and nephropathia epidemica. The species that cause HFRS include Hantaan, Dobrava-Belgrade, Saaremaa, Seoul, and Puumala. It is found in Europe, Asia, and Africa. [21] In hantavirus-induced hemorrhagic fever incubation time is two to four weeks in humans before symptoms develop. Their severity depends on the viral load.

Hantavirus pulmonary syndrome

Hantavirus pulmonary syndrome (HPS) is found in North, Central and South America. [22] It is an often fatal pulmonary disease. In the United States, the causative agent is the Sin Nombre virus carried by deer mice. Prodromal symptoms include flu-like symptoms

such as fever, cough, muscle pain, headache, and lethargy. It is characterized by a sudden onset of shortness of breath with rapidly evolving pulmonary edema that is often fatal despite intervention with mechanical ventilation and potent diuretics. The fatality rate is 36%.

Hantavirus pulmonary syndrome was first recognized during the 1993 outbreak in the Four Corners region of the southwestern United States. It was identified by Dr. Bruce Tempest. It was originally called "Four Corners disease," but the name was changed to "Sin Nombre virus" after complaints by Native Americans that the name "Four Corners" stigmatized the region.[11] It has since been identified throughout the United States. Rodent control in and around the home remains the primary prevention strategy.

HPS risk factors

The major risk factor for HPS is association with

- Rodent infestation.
- Rodent saliva.
- Rodent urine.
- Feces or with dust, dirt.
- Surfaces contaminated with such rodent excretions, either by direct contact or by aerosol.
- Barns, sheds, homes, or buildings easily entered by rodents (for example, deer mouse or Peromyscus maniculatus) are potential places for hantaviruses to come in contact with humans.
- Rural areas that have forests and fields that can support a large rodent population are areas that increase the risk of exposure to hantavirus.
- Camping and hiking in areas known to have a high rodent population and occupying areas where rodents may seek shelter increase one's risk.
- Working in areas that may be shelter for rodents (for example, crawl spaces, vacated buildings, construction sites) may also have increased risk of hantavirus syndrome.
- The risk is higher in people who work in areas known to have produced hantavirus pulmonary syndrome infections.

Preventing Measures

Avoidance of virus-contaminated dust during work or leisure time is of prime importance; for people with underlying disease, face masks could be used. Creation of air-borne dust should be avoided when areas containing rodent droppings are cleaned, and moist cleaning with disinfectants is recommended. Wild rodents taken into homes as pets or to laboratories for research purposes have caused infections.

Since Puumala virus remains infective outside the host for an unexpectedly long period (for two weeks at room temperature), the risk of infection can persist after rodents have been removed.

Diagnosis

The diagnosis of hantavirus disease mainly relies on the detection of antibodies, through immuno-fluorescent assays (IFA) or Enzyme Immuno Assays (EIA). In the acute phase of the hantavirus infection, antibodies are not specific. Low avidity of IgG antibodies and granular fluorescence in IFA of acute sera can be used to separate old from new infection. In recent years, immuno-chromatographic IgM assays as a point-of-care test with an optical reader, has been developed. RT-PCR from patient blood is coming into use [23].

Management and Treatment

The treatment of hantavirus disease is mainly symptomatic. Maintaining the fluid balance, while avoiding over-hydration in a potentially oliguric patient is of critical importance. In case of renal insufficiency, dialysis may be required. Because European hantaviruses do not spread from human to human, no isolation is needed. Ribavirin is the only drug used in severe hantavirus infections in Europe. There is currently no vaccine available in Europe [24].

CONCLUSION

In conclusion Hantaviruses are enzootic viruses that maintain persistent infections in their rodent hosts without apparent disease symptoms. The spillover of these viruses to humans can lead to one of two serious illnesses, hantavirus pulmonary syndrome and hemorrhagic fever with renal syndrome. In recent years, there has been an improved understanding of the epidemiology, pathogenesis, and natural history of these viruses following an increase in the number of outbreaks in the Americas. In this review, current concepts regarding the ecology of and disease associated with these serious human pathogens are presented. Priorities for future research suggest an integration of the ecology and evolution of these and other host-virus ecosystems through modeling and hypothesis-driven research with the risk of emergence, host switching/spillover, and disease transmission to humans.

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