Hantavirus Pulmonary Syndrome

Summary

Hantavirus Pulmonary Syndrome (HPS)[1] is an acute zoonotic viral disease often characterized by fever, myalgia, and gastrointestinal complaints followed by the abrupt onset of respiratory distress and hypotension. The illness can progress rapidly to severe respiratory failure and shock. The reservoir for the virus in New Mexico is rodents of the genus *Peromyscus*, mainly the deer mouse *Peromyscus maniculatus,* which excretes the virus in its urine, feces, and saliva. Humans acquire infection primarily when they breathe in air contaminated with aerosolized virus particles from rodent urine, droppings, or saliva, and rarely through direct contact with infected rodents, rodent droppings, or nests.

Agent

Hantaviruses are ribonucleic acid (RNA) viruses of the *Bunyaviridae* family that cause HPS or hemorrhagic fever with renal syndrome (HFRS) in humans. Within the *Hantavirus* genus are the viruses that cause HFRS worldwide, particularly in Europe and Asia, and the viruses associated with HPS in the Americas. In the United States, five virus variants are known to cause disease in humans. The Sin Nombre virus (SNV) is responsible for the majority of HPS cases in the US and New Mexico. Bayou and Black Creek Canal viruses in the southeastern US and New York and Monongahela viruses in the eastern US have caused sporadic cases. Numerous hantavirus variants are also associated with HPS in South America.

Transmission

Reservoir:

> Rodents, the natural hosts for hantaviruses, acquire a lifelong asymptomatic, chronic infection with persistent viremia, viruria, and virus in their saliva. New World hantaviruses are associated with rodent species of the subfamily Sigmodontinae. Each hantavirus variant has a single primary rodent host. In New Mexico and the US, the deer mouse, *Peromyscus maniculatus*, is the reservoir of Sin Nombre virus. Prevalence of infection varies widely geographically and temporally. Other Sigmodontine rodent species are associated with additional hantaviruses that have yet to be implicated in human disease. Therefore, it is best to consider all wild mice and rats infected.

Mode of Transmission:

> Humans acquire infection most commonly through inhalation of aerosolized virus particles from rodent urine, droppings, or saliva. Transmission can also occur through direct contact with infected rodents, rodent droppings, or nests. The types of hantavirus that cause HPS in the United States cannot be transmitted person-to-person or via blood transfusion.

Clinical Disease

[1] Also known as Hantavirus Cardiopulmonary Syndrome (HCPS)

Incubation Period:

Usually two to four weeks with a possible range from one to eight weeks.

Illness:

The prodromal illness of one to seven days is often characterized by fever; chills; fatigue; headache; myalgia of the shoulders, lower back, hips, and thighs; nausea; vomiting; diarrhea; abdominal pain; and dizziness. Cough and other upper respiratory symptoms are not present in the prodromal phase but begin at the onset of the cardiopulmonary phase.

The transition from the prodrome to the cardiopulmonary phase four to ten days later is typically heralded by the abrupt onset of cough, shortness of breath, hypoxia, and the appearance of pulmonary edema on chest radiographs**.** The extensive bilateral interstitial and alveolar pulmonary edema and pleural effusions are the result of a diffuse pulmonary capillary leak and seem to be immune-mediated. Severe myocardial depression is also seen in some cases. The crude mortality rate is 40%.

Laboratory Diagnosis

Presumptive laboratory values on a complete blood count (CBC) include a neutrophilic leukocytosis with immature granulocytes, more than 10% atypical immunoblasts (basophilic cytoplasm, prominent nucleoli, and an increased nuclear-cytoplasmic ratio), thrombocytopenia (below 150,000), absence of toxic granules in neutrophils and elevated hematocrit.

Confirmatory diagnosis is made by the demonstration of hantavirus-specific IgM antibodies or rising titers of hantavirus-specific IgG antibodies using ELISA, Western blot, or strip immunoblot techniques. Most patients have IgM antibodies at the time of hospitalization. PCR of autopsy or biopsy tissues and immunohistochemistry are also established diagnostic techniques in specialized laboratories.

Preliminary screening diagnostic testing in New Mexico is done by several commercial laboratories including TriCore Reference Laboratories that test for generic anti-hantavirus IgM or IgG antibodies. If a preliminary positive or equivocal IgM or IgG result is obtained the specimen undergoes confirmatory testing at the state Scientific Laboratory Division. It is important for physicians with suspected cases to consult with the on-call infectious disease physician at the University of New Mexico Hospital in Albuquerque (1-888-UNM-PALS) to assist in diagnosis and treatment.

Treatment

There is no specific treatment or cure for hantavirus infection. Patients with suspected HPS should be rapidly transferred to a tertiary care facility. Supportive management of pulmonary edema, severe hypoxemia, and hypotension during the first 24 to 48 hours is complex and critical for recovery. Overhydration must be avoided or pulmonary edema can be exacerbated. A flow-directed pulmonary catheter for monitoring fluid administration and use of inotropic support, vasopressors, and careful ventilatory control are important. Extracorporeal membrane oxygenation (ECMO) may provide important short-term support for the severe capillary leak syndrome in the lungs. Careful monitoring of cardiac function

should be included. Ribavirin, though active *in vivo* against SNV, has not been shown to be effective in the treatment of HPS.

Surveillance

Case Definition:

Laboratory criteria - Detection of hantavirus-specific IgM antibody or rising titers of hantavirus-specific IgG antibody; or detection of hantavirus-specific ribonucleic acid sequence by polymerase chain reaction (PCR) in clinical specimens; or detection of hantavirus antigen by immunohistochemistry.

Confirmed – a clinically compatible case that is laboratory confirmed.

Reporting:

Report all suspected or confirmed cases of hantavirus within 24 hours to the Epidemiology and Response Division (ERD) at 505-827-0006. Information needed includes: patient's name, age, sex, race, ethnicity, home address, home phone number, occupation, and health care provider.

Case Investigation:

Complete the CDC Hantavirus Pulmonary Syndrome Surveillance Report form and mail to the Epidemiology and Response Division P.O. Box 26110, Santa Fe, New Mexico 87502-6110, or fax to 505-827-0013. Investigation information should also be entered in NM-EDSS per established procedures.

Control Measures

1. Case management
    1.1. Isolation: None required.
    1.2. Prophylaxis: Not applicable.
2. Contact management
    2.1. Isolation: None required
    2.2. Prophylaxis: Not applicable.
3. Prevention
    3.1. Environmental control: Infections with HPS are associated with domestic, occupational, or leisure activities bringing humans into contact with infected rodents, usually in a rural setting. Eradicating the host reservoir is neither feasible nor desirable. The best approach for disease control and prevention is risk reduction through environmental hygiene practices that discourage rodents from colonizing the home and work environment and that minimize aerosolization and contact with virus in saliva and excreta. The hantavirus has a lipid envelop which makes it susceptible to most disinfectants, including 10% bleach solution, detergents, and most general household disinfectants. Depending on environmental conditions, these viruses probably survive <1 week in indoor environments and much shorter periods when exposed to sunlight outdoors. Measures to decrease exposure in the home and workplace include:

- Eliminating food sources, limiting possible nesting sites, sealing holes and other possible entrances (mice can squeeze through a hole the size of a dime), and using snap traps.
- Rodenticides can be effective but need to be used carefully to prevent poisoning of children and pets.
- Rodents killed with snap traps should be disinfected with 10% bleach solution and disposed of in the garbage. Do not reuse the traps. Rubber, latex, nitrile, or vinyl gloves should be worn and disinfected or discarded after use. Wash hands after removing gloves.
- Before entering areas with potential rodent infestations, doors and windows should be opened for at least 30 minutes to ventilate the enclosure. Persons entering these areas should avoid stirring up or breathing potentially contaminated dust.
- Dusty or dirty areas should be moistened with 10% bleach or other disinfectant solution and left to soak for five minutes before being cleaned.
- Upholstered furniture or carpet should be steam cleaned. Clean machine-washable fabrics with laundry detergent in hot water. Dry on high heat or air-dry in sun when possible.
- Brooms and vacuum cleaners should not be used to clean rodent-infested areas. A dust mask does not provide protection against viruses.
- For heavy rodent infestations use of disposable coveralls, rubber boots or disposable shoe covers, goggles, and an appropriate respiratory protection device such as a half-mask air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter or a powered air-purifying respirator (PAPR) with HEPA filters are recommended. Pulmonary function and fit testing must be performed before beginning any work requiring the use of a respirator.

3.2. Immunization: Not applicable.

Management of HPS in Child Care Centers

Person-to-person transmission of the viruses in the United States has not been demonstrated; therefore, no specific intervention is required.

References

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See Hantavirus Pulmonary Syndrome Fact Sheets (English) (Spanish).