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Hendra Virus Infection

Equine Morbillivirus Pneumonia
Acute Equine Respiratory Syndrome

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Overview

- Organism
- History
- Epidemiology
- Transmission
- Disease in Humans
- Disease in Animals
- Prevention and Control
- Actions to Take

In today's presentation we will cover information regarding the organism that causes Hendra virus infection and its epidemiology. We will also talk about the history of the disease, how it is transmitted, species that it affects (including humans), and clinical and necropsy signs observed. Finally, we will address prevention and control measures for Hendra virus, as well as actions to take if Hendra virus infection is suspected.[Photo: Horse. Source: www.public-domain-image.com]

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THE ORGANISM

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Hendra Virus

- Family Paramyxoviridae
  - Genus *Henipavirus*
  - Closely related to Nipah virus
- Enveloped, ss RNA virus
- Family includes:
  - Mumps and measles viruses
  - Rinderpest virus
  - Human parainfluenza virus
  - Canine distemper virus

Hendra virus, formerly known as Equine morbillivirus, is a relatively recently recognized member of the paramyxovirus family, genus *Henipavirus*. It is closely related to another recently discovered virus – Nipah virus. It is an enveloped, single stranded RNA virus. This family includes the viruses that cause mumps and measles, rinderpest virus infection, human parainfluenza virus infection, and canine distemper virus infection.[Photo: Electron micrograph of Hendra virus. Source: Howard Prior, Queensland Department of Primary Industries and Fisheries]

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HISTORY

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History

- 1994: First recognized outbreak
  - Brisbane, Australia
  - Respiratory and neurological disease in horses
    - 20 horses sick; 13 died
    - 2 humans sick; 1 died
    - 2 other horses died in a separate incident
- 1995: Second human fatality
  - Assisted in equine post mortem in 1994

Hendra virus was first isolated in 1994 from specimens obtained during an outbreak of respiratory and neurological disease in horses and humans in Hendra, a suburb of Brisbane, Australia. Of 20 horses that suffered from severe respiratory disease in September 1994, 13 died. Two people looking after the index horse case developed the disease; one of them died. Two other horses developed fatal infections in a separate location that same year. In 1995 a third human case was recorded and thought to be associated with an earlier outbreak in another part of Queensland. The patient, who later died, had assisted in the post mortem exam of two horses in August 1994. [Photo: Map of Australia with Brisbane identified in red text. Source: Discover Brisbane at http://www.discoverbrisbane.com/maps/australia.gif]

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History

- 1999: Horse fatality in Cairns, Australia
- 2004: Veterinarian infected; recovered
- Additional equine cases
  - June 2006
  - October 2006
  - July 2007

Another fatal case of a horse in Cairns was reported in January 1999. In 2004, a veterinarian was infected with Hendra virus after exposure to infected horses; he later recovered. Other cases of Hendra virus infection in horses were seen in June 2006, October 2006, and July 2007; all cases occurred in Queensland, except for the case in October, 2006, which occurred in New South Wales. [Photo: Horses. Source: U.S. Department of Agriculture]

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History

- Hendra cases continue to occur sporadically in Australia
- 2011
  - 23 confirmed equine cases
    - Queensland
    - New South Wales
  - One dog confirmed positive
    - No clinical signs observed
- Human cases: 7 total

According to Australian veterinary authorities, there were 23 confirmed cases of Hendra virus infection in horses in 2011; they occurred in Queensland (thirteen cases on ten properties) and New South Wales (ten cases on eight properties). In addition, one dog on one of the Queensland properties tested positive although it showed no signs of disease. This was the first time outside a laboratory that an animal other than a flying fox, horse, or a human has been confirmed with Hendra virus infection. As of October 2011, seven human cases have been documented. [Photo: Australian Kelpie. Source: Wikimedia Commons]

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History

- Prevalence in fruit bats
  - 47% of Australian fruit bats seropositive
    - *Pteropus* species
    - Asymptomatically infected
  - Four recently emerged viruses carried by fruit bats
    - Hendra, Nipah, Menangle, Tioman viruses

As many as 47% of fruit bats in Australia are seropositive, but the prevalence varies with the species. Seropositive fruit bats have also been found in Papua New Guinea. Fruit bats are considered to be the reservoir source of Hendra virus, although they appear to be asymptomatically infected. While it is thought that equine cases of Hendra virus infection have occurred from contact with bats, bat urine, aborted fetuses, placenta, or uterine fluid, human cases of Hendra virus infection are thought to occur from contact with infected horses, not from bats. [Photo: Black flying fox (*Pteropus alecto*). Source: Wikimedia Commons]

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EPIDEMIOLOGY

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Epidemiology

- Human cases
  - Australia only
  - Close contact with infected horses
- Horse index cases
  - Female thoroughbreds
  - Over 8 years old
  - Infected while in a paddock

Human infection in every case has been in those having extensive close contact with infected horses, and all seven cases have occurred in Australia. In a study done to look at the outbreaks of Hendra virus infection in horses up until 1999, several features were similar among the horses infected. On all occasions the index cases were female thoroughbreds older than 8 years. The index cases were also out on the paddock for longer than the incubation period. Researchers thus concluded that each index case was exposed and infected in the paddock. [Photo: Horses in a field. Source: USDA]

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TRANSMISSION

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Transmission: Humans

- Likely mode of transmission
  - Direct contact with fluids from infected horses
- Unlikely modes of transmission
  - Respiratory
  - Human-to-human
  - Bat-to-human

The precise mode of virus transmission to the Australian human patients is not fully understood. All individuals appear to have acquired their infection as a result of close contact with body fluids of infected horses. Respiratory and person to person modes of transmission are not thought to occur at this time. Despite evidence that 47% of fruit bats have been infected with Hendra virus, it appears that they are not a significant risk to people. This is based on the negative results of testing of 130 people, all in close contact with fruit bats. Until the reasons for spillover of Hendra virus from bats to horses are better understood, it would be advisable for those handling fruit bats to observe normal good hygiene and care. Further studies to understand transmission of Hendra virus are underway.

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Transmission: Humans

- Infected humans had extensive contact with sick horses
  - No protective gear
- Not all exposed humans became sick
- Not all exposed horses became sick
- Research on-going

All seven individuals infected had extensive contact with infected horses. For example, they assisted in necropsies without protective clothing. Other people were also involved with such procedures but did not become infected. Several horses that were in close contact with infected horses did not become ill, and several horses that were exposed did acquire the disease. Additional controlled experiments are being carried out, particularly by the Commonwealth Scientific and Industrial Research Organization (CISRO).

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Transmission: Animals

- Mode of transmission from bats to horses unclear
  - Birth products (fetus, placenta)
  - Horse may contract by ingestion of contaminated feed
  - Virus excreted in urine and saliva?

Scientists have shown that Hendra virus is not highly contagious. The mode of transmission from bats to horses is unknown. Infected fruit bats may pass the virus in their urine and saliva like the closely related Nipah virus; however, Hendra virus has not yet been isolated from the urine or saliva of fruit bats. Research suggests that horses can be infected by eating material contaminated with the virus. Hendra virus is shed in birth products, including aborted fetuses and placenta; the fact that most equine cases have occurred during the birthing season for fruit bats seems to support this mode of spread. There is no evidence that the virus can be spread via inhalation. [Photo: Roosting grey-headed flying foxes (*Pteropus poliocephalus*). Source: Wikimedia Commons]

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Transmission: Animals

- Horse-to-horse
  - Not highly contagious
  - Close contact
  - Urine and oral cavity
  - Mechanical transmission
- Cat-to-cat, cat-to-horse (experimental)
  - Close contact
  - Urine

The Hendra virus does not appear to be highly contagious in horses, and close contact seems to be necessary for it to spread. Horse-to-horse transmission has been reported on two occasions. In one instance, the infected horses shared a paddock and one horse licked the muzzle of its sick companion at the time of death. In the other case, a sick mare was brought into a stable from an open paddock, and appears to have infected several other horses; the pattern of transmission is suggestive of mechanical transmission. In infected horses, Hendra virus has been isolated from the urine and oral cavity, but not from feces. Aerosol transmission appears to be inefficient, but horses can become infected by ingesting the virus in contaminated feed. Experimental infections have also been reported in horses after oronasal inoculation. Infections have been reported in cats only after experimental inoculation; routes of infection included intranasal, oral, and subcutaneous. Experimentally infected cats shed the virus in urine, but not in nasal secretions, oral secretions, or feces. Experimental cat-to-cat or cat-to-horse transmission has been reported among animals in close contact.[Photo: Group of horses. Source: USDA]

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DISEASE IN HUMANS

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Human Disease

- Incubation period 4 to 18 days
  - May be up to a year
- Flu-like symptoms
  - Fever
  - Myalgia
  - Headaches
  - Vertigo
- Pneumonitis
  - Rapid progression to respiratory failure
- Meningoencephalitis

The incubation period for Hendra virus in humans is generally believed to be 4 to 18 days, but some reports suggest it may, in exceptional circumstances, be up to 12 months. During the first outbreak, two people infected with Hendra virus experienced a flu-like illness with fever and myalgia but gradually recovered. A third patient also experience flu-like illness, but rapidly progressed to respiratory failure and death. A fourth patient developed mild meningoencephalitis which initially improved with treatment. However, signs of encephalitis reappeared one year later and the patient died. Tests of autopsy specimens confirmed infection with Hendra virus.

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Diagnosis: Humans

- ELISA
- Immunoperoxidase
  - Formalin-fixed tissues
- Virus isolation
- Virus neutralization
  - Detect antibodies
- PCR

As a result of work at the Australian Animal Health Laboratory since the outbreak in 1994, regional veterinary laboratories and hospitals around Australia now have an ELISA diagnostic test. Other tests developed include an immunoperoxidase test for use on formalin-fixed tissue, virus isolation, virus neutralization, and polymerase chain reaction tests (PCR). Virus isolation on fresh tissues is the method of choice for diagnosing Hendra virus. Electron or immunoelectron microscopy can also be helpful in identification. Hendra virus is a biosafety level 4 (BSL4) pathogen and culture is conducted under high-security conditions.

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Treatment and Prognosis

- Intensive supportive care
- Ribavirin
  - May decrease duration and severity of disease
  - Clinical usefulness uncertain
- Prognosis uncertain due to low number of cases

Treatment is generally a matter of intensive supportive care. There is some evidence that antivirals, such as Ribavirin, may decrease duration and severity of the disease. Maximum precautions should be used if Hendra virus is suspected.

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DISEASE IN ANIMALS

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Horses and Hendra Virus

- Incubation: 8 to 16 days
  - Can be asymptomatic during incubation, but shed virus
- Depression, pyrexia, dyspnea, tachycardia
- Initial nasal discharge
  - Clear to serosanguinous
- Sudden death 1 to 3 days after onset

Horses have shown similar clinical signs among the outbreaks. The incubation period is from 8 to 16 days (4 to 10 days after experimental inoculation), the horses may be asymptomatic during this period but are able to shed the virus. Clinical signs consisted of anorexia, depression, sweating, and a fever of up to 105.8˚F. Most horses showed elevated respiratory rates with a clear to serosanguinous nasal discharge during the initial course of the disease. Sudden death of horses was often seen 1 to 3 days after onset of clinical signs. Some convalescent horses may develop neurological signs, but others seem to recover fully.

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Horses and Hendra Virus

- Injected mucous membranes, cyanotic border
- Dependent edema
- Head pressing
- Ataxia
- Frothy nasal discharge

As the disease progresses, mucous membranes may become injected with a cyanotic border. Horses may show dependent edema, ataxia, and head pressing. The nasal discharge may become frothy and red just prior to death. Sudden death of horses was often seen 1 to 3 days after the onset of initial signs. Diagnosis of Hendra virus in animals is the same as in humans.[Photo: Horse eye with injected mucous membranes. Source: WikiVet.net (Creative Commons)]

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Species Affected

- Naturally
  - Horses and humans
  - Dogs
- Experimentally
  - Cats, pigs, guinea pigs, ferrets
- No signs of infection
  - Dogs, chickens, rats, mice

In addition to horses and people, it has been shown that cats, pigs, guinea pigs, and ferrets can be infected with Hendra virus experimentally, resulting in severe clinical disease. There have been no cases of natural disease in cats; serological surveys of cats throughout Queensland have yielded no positive cases. Other animals that have been exposed to the virus experimentally include dogs, chickens, rats, and mice, although none have shown any signs of infection. [Photos: (Top) Horse. Source: www.flickr.com (Creative Commons); (Bottom) Australia kelpie. Source: Wikimedia Commons]

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Sampling

- Before collecting or sending any samples, the proper authorities should be contacted
- Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease

Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease.

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PREVENTION AND CONTROL

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Recommended Actions

- IMMEDIATELY notify authorities
- Federal
  - Area Veterinarian in Charge (AVIC)
  http://www.aphis.usda.gov/animal_health/area_offices/
- State
  - State veterinarian
  http://www.usaha.org/stateanimalhealthofficials.aspx
- Quarantine

If you suspect Hendra virus infection, state or federal authorities should be notified immediately. Animals suspected with Hendra should be isolated, and the farm should be quarantined until definitive diagnosis is determined.

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Prevention and Control

- Difficult to assess risk
  - Sick horses in endemic areas
  - Areas inhabited by fruit bats
- In suspect cases
  - Do NOT handle:
    - Infected tissues
    - Blood
    - Urine

The risk of transmission of Hendra virus from sick animals to humans appears to be low. Because of the scarcity of information, it is difficult to adequately assess risk. Sick horses in endemic areas or in areas inhabited by fruit bats may be at increased risk. If infections with Hendra virus is suspected, do not handle infected tissues or waste products, particularly blood or urine. [Photo: Veterinary responders handling a horse during a recent Hendra outbreak. Source: healthmapblog.blogspot.com]

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Prevention and Control

- Preventing bat-to-horse transmission
  - Stable horses at night and during high risk months
  - Do not use paddocks with access to roosting trees used by fruit bats
  - Secure feed bins and water troughs
  - Remove and destroy dead bats or birth products
    - Call proper authorities for removal

In horses, prevention is based on minimizing exposure to infected bats, their tissues, and secretions. All index cases, to date, have occurred in horses stabled in open paddocks. In areas where Hendra virus infections may occur, horses should be stabled at night, and horse paddocks should not contain food or roosting trees favored by fruit bats. Horses may also be stabled full-time, or moved away from areas of high bat activity during the highest risk months (August to January). Feed bins and water troughs should not be placed under trees where bats might be found. Any dead fruit bats should be removed and destroyed by burning or burial; however, horse owners should never touch or pick up a flying fox. In Australia, the Wildlife Information Rescue and Education Service should be contacted for more information.

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Prevention and Control

- Prevent virus spread on fomites
- Rigorous hygiene
- Quarantine
  - Low rate of horse-to-horse transmission

Horses that develop severe respiratory disease should be considered contagious, and standard infection control measures should be taken to avoid spreading the virus on fomites. Quarantines and rigorous hygiene have been effective in containing past outbreaks. The low rate of horse-to-horse transmission also aids control.[Photo: Quarantine signe on gate of horse farm. Source: www.sunshinecoastdaily.com.au]

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Left Photo: Project leader Dr. Peter Hooper, a pathologist for the Australian government, handling a virus-infected fruit bat. These animals were very good at biting and scratching, which is a potentially very dangerous situation if it is later determined that Hendra virus can be isolated from the saliva of these animals. Thus, heavy gloves and positive pressure suits were required clothing to work with these animals. (http://www.usyd.edu.au/su/rirdc/articles/disease/hendra.htm)

Right Photo: In 1996 the Hendra virus was classified as requiring Biosafety Level-4 security. All people working with Hendra virus, either in the laboratory or with live animals, must wear a positive pressure suit with its own air supply (Self-Contained Breathing Apparatus [SCBA], or work under an enclosed cabinet known as a flexible film isolator. This photo is also of Dr. Hooper, working with a horse infected with Hendra virus. (http://www.usyd.edu.au/su/rirdc/articles/disease/hendra.htm)

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Prevention and Control

- Sensitive to heat and chemical disinfection
- Directly contaminated objects
  - Autoclave or boil
- 1% sodium hypochlorite solution
- NaDCC granules

Disinfect all articles or instruments used to treat patients with known or suspected infection. Those in contact with sick horses in endemic areas or in areas inhabited by fruit bats may be at greater risk. The virus appears to be sensitive to heat and chemical disinfection. Directly contaminated objects can be autoclaved or boiled. Disinfection with 1% sodium hypochlorite or NaDCC (sodium dichloroisocyanurate) granules are effective.

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Use as Biological Weapon

- Relatively little is known about disease transmission
- Serious consequences if outbreak occurs
  - High mortality rate likely
  - No treatment options

There is relatively little known about Hendra virus infection, including the transmission routes in humans and animals. Based on the limited data available, it is suspected that mortality rates could be very high. Effective treatment for the disease is also unknown at this time. Its use as a biological weapon is unknown, as are the consequences.

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Additional Resources

- Center for Food Security and Public Health
  - www.cfsph.iastate.edu
- USAHA Foreign Animal Diseases ("The Gray Book")
  - www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

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