CHAPTER 3.11

Hendra virus infection

Fast facts

Hendra virus (HeV) is a highly fatal zoonotic paramyxovirus primarily infecting horses which develop respiratory and neurological signs.

Organism

HeV:

- is susceptible to inactivation by desiccation, acidic conditions, heat and common disinfectants
- has an estimated maximum survival time in the environment of 5 days.

Susceptible species

- HeV affects dogs, flying foxes, horses and humans.
- HeV has infected pigs, cats, guinea pigs, hamsters, ferrets, and mice under experimental conditions.

Economic impact

There is potential for minor economic loss associated with disease control and fatalities.

Epidemiology

HeV causes high case fatality rates in horses and humans, and:

- flying foxes are the reservoir hosts
- outbreaks in horses (which may occur any time of year) have occurred annually since 2006
- incubation in horses lasts 4–16 days
- infection may occur anywhere horse and flying fox distributions overlap.

Transmission

Transmission occurs via:

- contact with pasture contaminated with infectious flying fox urine, saliva, faeces, and birthing fluids (**flying fox to horse**)
- direct or indirect transmission via contact with secretions and bodily fluids of affected horses (**horse to horse, human, dog**)
- fomite transmission possible (**horse to horse, human, dog**).

In addition:

- horses may transmit the virus before the onset of clinical signs
- endotracheal intubation, nasal lavage, endoscopy, and necropsy are high risk activities for vets
- transmission via respiratory droplets has not been evaluated and a 5-metre perimeter around infected horses is recommended.

Clinical signs

Clinical signs in horses include:

- acute-onset illness with rapid deterioration
- increased body temperature and heart rate
- pulmonary oedema and congestion, dyspnea, nasal discharge
- ataxia, altered consciousness, head tilt, circling, muscle spasms, seizures, recumbency
- colic-like signs
- facial oedema.

Post-mortem

Only perform post-mortem if strict biosecurity measures can be achieved. Field post mortems should not be attempted by untrained personnel.

Samples

Collect:

- blood samples (EDTA and plain tubes)
- nasal, oral and rectal swabs (in virus transport media)
- a blood clot from the jugular (if safe to do so) and a tissue sample from the mandibular lymph node from dead animals
- samples from in-contact horses and other susceptible animals.

Actions to take

If you suspect a case of HeV:

- call the Emergency Animal Disease Watch Hotline (1800 675 888) immediately or contact a government veterinarian in your state or territory
- isolate suspected cases and implement biocontainment protocols (including farm movement controls) until advised by government veterinary authorities
- minimise contact with suspected cases and wear personal protective equipment.

Public health considerations

- HeV infection is a zoonotic disease
- people may become infected after close contact with infected horses
- consult the relevant state or territory health authorities as soon as HeV infection is strongly suspected or confirmed.

Introduction

Hendra virus (HeV), previously known as equine morbillivirus, is a lethal zoonotic disease in Australia which primarily affects horses and people. To date, the disease has only been seen in the eastern states of Queensland and New South Wales.

Disease agent and susceptible species

HeV:

- is an enveloped RNA virus belonging to the genus *Henipavirus*, family *Paramyxoviridae*
- affects horses, humans, dogs and flying foxes
- is known to have naturally infected two dogs without causing clinical signs of illness. This has been confirmed experimentally. In one case, HeV genome was detected in bodily fluids and tissues by qRT-PCR, and in the other case the dog had seroconverted to HeV
- has infected pigs, cats, guinea pigs, hamsters, ferrets, and mice (rats seroconvert without the development of clinical signs) under experimental conditions
- a highly effective vaccine is available for use in horses.

Public health considerations

- people may become infected after close contact with infected horses
- use personal protective equipment such as gloves, disposable coveralls, rubber boots (or disposable boots), goggles or safety glasses, and P2 respirators or N95 masks when you are in close contact with infected horses
- consult the relevant state or territory health authorities in the case of a HeV outbreak.

Distribution

HeV has been found in flying fox populations in Australia and Papua New Guinea, and the closely related Nipah virus is found in flying fox populations in South-East Asia (please refer to the chapter on Nipah virus for more information).

Occurrences in Australia

HeV is endemic in most flying fox populations throughout Australia. To date we have seen more spillover events in northern New South Wales and South East Queensland. An observation is that spillover events have only occurred in regions where the spectacled flying fox and/or the black flying fox is present.

Epidemiology

Modes of transmission

No human-to-human transmission has been reported. However, human-to-human transmission has occurred with the closely related Nipah virus. Transmission occurs via:

- **spillover from flying fox populations**—infection in horses most likely occurs after close contact with bat urine, faeces and birthing fluids. This is thought to be due to contact with contaminated pasture, and transmission risk may be increased in horses fed under trees that bats roost in. It is also plausible that horses may become infected by inhaling droplets via the nasal route. Serological studies of bat carers suggest that bat-to-human direct transmission has not occurred.
- **direct contact** with the nasal secretions and excretions (urine, blood) of affected horses may cause horse-to-horse and horse-to-human spread of HeV. Horse-to-human transmission has only occurred with very close, prolonged contact during invasive procedures. HeV shedding, and therefore transmission, can occur before clinical signs are evident
- **airborne spread**—inhalating infected aerosols may be a method of transmission to horses and humans. No definitive studies have been performed to describe the distance over which respiratory droplets can spread from horses. For biosecurity measures, a distance of 5 metres is used to define an at-risk area
- **fomites**—HeV may survive on fomites for hours under mild climatic conditions and horse-to-horse transfer via fomites may occur.

Disease dynamics

There are no reports of relapsing disease in animals, but there has been one case of relapsing disease in humans. HeV infection in horses:

- is thought to occur through the naso-oral route, where a local replication in the nasal cavity or nasopharynx is followed by systemic spread of the virus
- has an incubation period of between 4–16 days. Horses may shed virus in nasal secretions before the onset of clinical signs, and are therefore a transmission risk
- causes damage to vascular endothelium, and subsequent vasculitis is thought to precipitate disease in the various organ systems (e.g. respiratory, neurologic, gastrointestinal)
- pyrexic and clinically affected horses shed virus from the nasal secretions and excretions such as urine and blood
- the case fatality rate is difficult to assess as it is likely that mild cases or cases of sudden death are not diagnosed
- humans have only been infected after exposure to HeV infected horses.

Persistence of the agent

The virus:

- has a lipid-envelope and outside the host is susceptible to desiccation and changes in temperature
- may survive from several hours to several days in the environment, depending on the environmental conditions (for disease control purposes, 5 days is presumed to be the maximum survival time under optimal environmental conditions)

- is inactivated by disinfectants, including soap and detergents, Virkon®, hypochlorites, iodophors/iodine, biguanidines (e.g. chlorhexidine), and quaternary ammonium compounds
- a subunit vaccine is available for use in horses and is highly effective.

Diagnosis and pathology

Clinical signs

In humans, HeV infection causes an influenza-like illness and/or encephalitis.

In horses, the disease presents with a wide range of clinical signs and a definitive diagnosis requires laboratory testing. In fatally infected horses, illness typically lasts just over 48 hours from first clinical signs to death. An elevated body temperature or increased heart rate should be an early warning for possible HeV infection.

Common clinical signs in horses include:

- acute onset of illness with rapid deterioration, usually with respiratory and/or neurological signs
- pyrexia
- tachycardia
- discomfort/weight shifting between legs
- depression.

Respiratory signs include:

- pulmonary oedema and congestion
- respiratory distress (tachypnea)
- terminal nasal discharge which may be a stable white or blood-stained froth
- pulmonary disease leading to terminal weakness, ataxia and collapse.

Neurological disease signs include:

- ataxia
- abnormal behavior (for example, loss of vision in one or both eyes, aimless walking)
- head tilting, circling
- muscle twitching
- urinary incontinence
- recumbency with inability to rise
- facial paralysis and/or locked jaw
- spasms of the jaw or involuntary chomping
- opisthotonus
- seizures.

Other clinical signs that may be seen include:

- previous unexplained horse deaths, or a high case fatality rate where there are multiple cases
- colic-like signs (rolling, thrashing, quiet abdominal sounds on auscultation of the abdomen, teeth grinding, straining to pass manure)
- facial oedema
- wide-based stance

- anorexia
- congestion of oral mucous membranes
- stranguria
- protruding penis.

Pathology

This may be found:

- enlarged and oedematous submandibular, bronchial and/or sternal lymph nodes
- dilated pulmonary lymphatics
- pulmonary oedema and congestion with gelatinous distension of the subpleural lymphatics
- petechial haemorrhages on the pleural surfaces
- (less frequently) oedema of the mesentery, increased pleural and pericardial fluid and thick stable foam in the airways.

Differential diagnosis

There are no pathognomonic signs for horses with HeV infection. Affected horses display a large number of often vague clinical signs, resulting in a large number of differential diagnoses. Only a brief list is included here for reference. Consider in the differential diagnosis:

- exotic diseases
  - African horse sickness
  - equine influenza
  - equine protozoal myeloencephalitis
  - Japanese encephalitis
  - rabies
- endemic diseases
  - anthrax
  - bacterial infection
  - botulism
  - equine herpesvirus EHV-1 (while the neuropathogenic strain of EHV-1 is considered exotic to Australia, the abortigenic strain is endemic in certain areas)
  - inflammatory airway disease
  - Australian bat lyssavirus infection
  - tetanus
  - West Nile virus infection (Kunjin virus)
- non-infectious causes
  - snake bite
  - toxicity
  - trauma.

Samples required

Take stringent precautions during sampling. Wear full personal protective equipment with a P2 respirator for anyone in contact with the horse. Only perform post-mortem and tissue collection if you have appropriate workplace health and safety controls in place. Do not perform routinely.

Sample collection

Collect:

- **serum**, both plain and clotted whole blood
- **EDTA blood**, 7–10ml per animal
- **swabs**, nasal, oral, rectal and urogenital or urine
- **fresh tissue** in the form of a blood clot from a dead horse (collected by jugular cut-down, if safe to do so) and sample of mandibular lymph node.

Transport of samples

For transport:

- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- place swab samples in virus transport media containing antibiotics and antifungals (or saline if other media is unavailable)
- DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days.

Sample submission

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.

Diagnostic tests

For HeV:

- the most rapid, sensitive and specific diagnostic procedure is the detection of viral nucleic acid in blood or swabs by qRT-PCR
- virus isolation is also conducted, but takes several days or more to complete
- serological tests, such as ELISA and virus neutralisation test are available for the detection of antibodies which have been produced through natural infection or via vaccination.

Reporting requirements

HeV infection is a notifiable disease in Australia and we have a legal obligation to report cases. If you suspect HeV infection, report the disease immediately by phoning the **Emergency Animal Disease Watch Hotline on 1800 675 888,** wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

Biocontainment and personal protective equipment

HeV infection is a serious public health risk. Human infections are due to close contact with infected horses. Post-mortem examinations of horses that have died from acute HeV infection are high-risk for horse-to-human transmission. Therefore it is important for you to seek advice from government veterinary authorities, noting:

- stringent biosecurity procedures must be enforced to protect human health
- sick/dead horses should be isolated from people as soon as possible. Limit human and other susceptible animal (e.g. dog/cat) contact with the sick/dead horse and other horses on the property until HeV diagnostic testing has been performed
- establish 'clean' and 'dirty' areas to reduce transmission of disease throughout the property
- people in the dirty area must wear personal protective equipment, including impervious rubber boots, splash-proof overalls, disposable impermeable gloves, face shield or safety eyewear and a particulate respirator
- on leaving the dirty area, remove the personal protective equipment and double bag it in clinical waste bags with Virkon® disinfectant. You must disinfect all equipment thoroughly, and wash your hands and other exposed skin thoroughly. Ensure you shower and change clothes before coming into contact with other horses
- people who have had unplanned or accidental close contact with a suspect HeV case should wash with soap and water and seek medical advice as soon as possible
- for more information see: www.daf.qld.gov.au/__data/assets/pdf_file/0005/126770/2913_-Guidelines-for-veterinarians-handling-potential-Hendra-virus-infection-in-horses-V5.1.pdf.

Further information

Ball MC, Dewberry TD, Freeman PG, Kemsley PD, Poe I. (2014) Clinical review of Hendra virus infection in 11 horses in New South Wales, Australia. Australian Veterinary Journal. 92(6):213-8.

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Middleton DJ, Riddell S, Klein R, Arkinstall R, Haining J, Frazer L, Mottley C, Evans R, Johnson D, Pallister J. (2017) Experimental Hendra virus infection of dogs: virus replication, shedding and potential for transmission. Australian Veterinary Journal. 95(1-2):10-18.

FIGURE 3.11.1 Severe interlobular oedema of the lungs

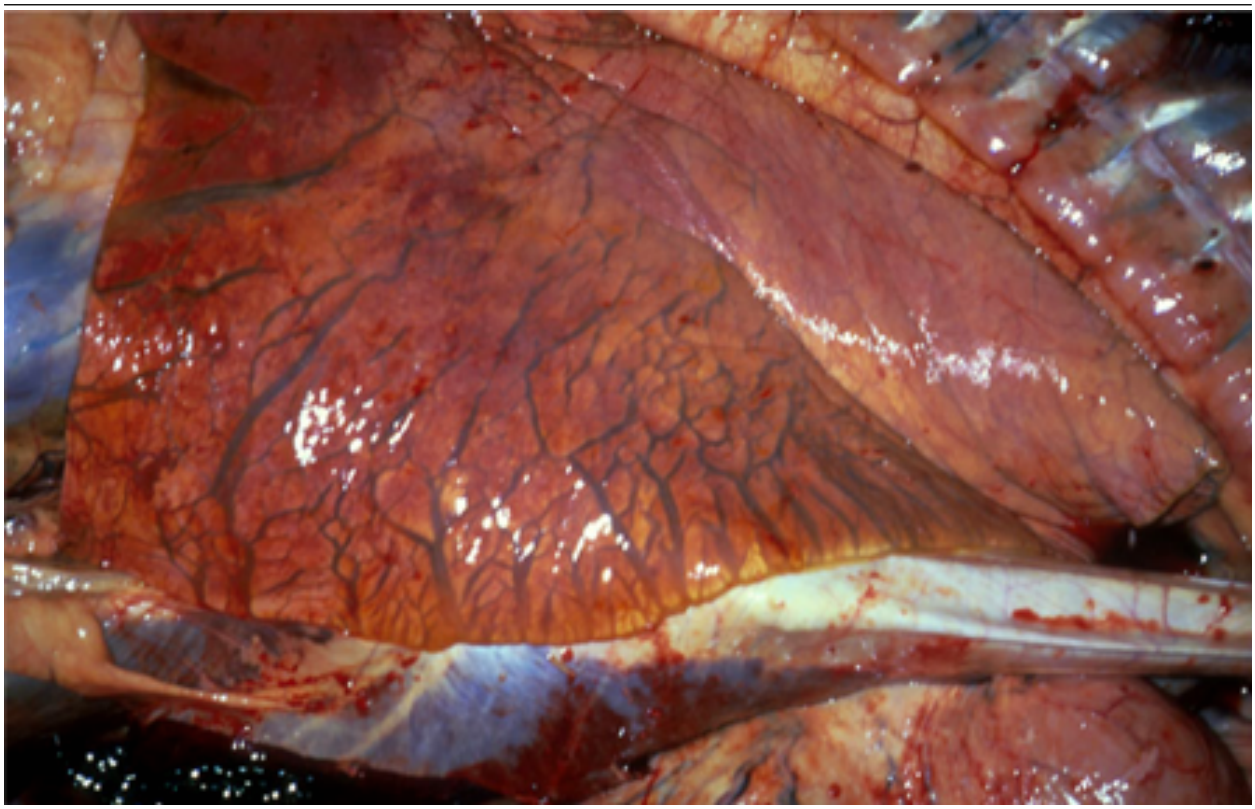

Image credit: Dr M Williamson, CSIRO, and CFSPH