AFRICAN HORSE SICKNESS

Aetiology Epidemiology Diagnosis Prevention and Control References

AETIOLOGY

Classification of the causative agent

African horse sickness (AHS) is caused by a virus of the family *Reoviridae*, genus *Orbivirus.* There are 9 antigenically distinct serotypes of AHS virus (AHSV) identified by virus neutralisation, but some cross-reaction has been observed between 1 and 2, 3 and 7, 5 and 8, and 6 and 9. No cross-reactions with other known orbiviruses have been observed.

Resistance to physical and chemical action

Temperature:	AHSV is relatively heat stable, and it is not inactivated by heating in citrated plasma at 55–75°C for 10 minutes, but the virus can be inactivated at 72°C for 120 minutes. Minimal loss of titre when lyophilised or frozen at –70°C with Parker Davis Medium. Infectivity is remarkably stable at 4°C, particularly in the presence of stabilisers such as serum and sodium oxalate, carbolic acid and glycerine: blood in OCG can remain infective >20 years. Can be stored >6 months at 4°C in saline with 10% serum. Fairly labile between –20°C and –30°C.
pH:	Destroyed at pH < 6 or pH ≥ 12. Optimal pH is 7.0 to 8.5.
Chemicals/Disinfectants:	Inactivated by formalin (0.1%) for 48 hours, β-propiolactone (0.4%), binary ethyleneimine or radiation. Resistant to lipid solvents such as ether. Inactivated by acetic acid (2%), potassium peroxymonosulfate/sodium chloride – Virkon® S (1%), and sodium hypochlorite (3%).
Survival:	Putrefaction does not destroy the virus: putrid blood may remain infective for >2 years, but virus is rapidly destroyed in meat by rigor mortis (lowering pH). Vaccine strains survive well in lyophilised state at 4°C.

EPIDEMIOLOGY

- The disease has both a seasonal (late summer/autumn) and an epizootic cyclical incidence, with disease associated with drought followed by heavy rain. AHSV is capable of overwintering, at least in milder climates where *Culicoides* adults can survive.
- Major epizootics in southern Africa are strongly linked with warm (El Niño) phase of the El Niño/Southern Oscillation (ENSO)
- Mortality rate in horses is 70-95%, mules around 50%, and donkeys around 10%.
  - other than mild fever, infection in zebra and African donkeys is subclinical
  - viraemia may be extended in zebra (up to 40 days)

Hosts

- Usual hosts are equids: horses, mules, donkeys and zebra
- Reservoir host are believed to be zebras
- Dogs have peracute fatal infection after eating infected horsemeat, but are not a preferred host by *Culicoides* spp. and unlikely to play a role in transmission
- Seropositive animals have included various wild carnivores, such as hyenas (*Crocuta crocuta*), jackals (various *Canis* spp.), African wild dogs (*Lycaon pictus*), cheetahs (*Acinonyx jubutus*), lions (*Panthera leo*) and large-spotted genets (*Genetta maculata*), which might be exposed by feeding on infected zebras.
- Some authors have reported that carnivores may have antibodies to AHSV serotypes (e.g. serotype 4) that are not necessarily common among equids in the area.
- There are also reports of seropositive herbivores? including dromedary camels (*Camelus dromedarius*), sheep, goats, African elephants (*Loxodonta africana*), black rhinocerus (*Diceros bicornis*) and white rhinocerus (*Ceratotherium simum*).
- Attempts to establish experimental infections resulted in seroconversion with no evidence of virus replication in African elephants, and seroconversion in hyenas, while mink (*Mustela vison*) did not seroconvert or replicate virus.

- The significance of seropositive animals is still unclear, and no animals other than equids are thought to be important in maintaining or amplifying AHSV.
- African horse sickness is not zoonotic.

Transmission

- Not contagious by contact
- Usual mode of transmission is the biological vector *Culicoides* spp. *C. imicola* and *C. bolitinos* are known to transmit AHSV in the field; *C. imicola* appears to be the principal vector
    - Additional species of *Culicoides* might also be able to act as vectors. They include species found outside the endemic region, such as *C. variipennis,* which occurs in North America and is an efficient AHSV vector in the laboratory, and *C. brevitarsis*, which is common in Australia.
- Occasional mode of transmission: mosquitoes – *Culex, Anopheles* and *Aedes* spp.; ticks – *Hyalomma, Rhipicephalus*; and possibly biting flies – *Stomoxys* and *Tabanus*
- AHS virus was also isolated from the camel tick *Hyalomma dromedarii* in Egypt, and the dog tick, *Rhipicephalus sanguineus*, could transmit AHSV from dogs in the laboratory.
- Moist mild conditions and warm temperatures favour the presence of insect vectors
- Wind has been implicated in dispersal of infected *Culicoides* in some epidemics
- Movement of *Culicoides* spp. over long distances (700 km over water, 150 km over land) via wind has been postulated

Sources of virus

- Viscera and blood of infected horses
- Semen, urine and nearly all secretions during viraemia, but no studies have documented transmission
- Viraemia usually lasts 4–8 days in horses but may extend up to 21 days;
- In zebras viraemia may last up to 40 days. Donkeys are reported to remain viremic for up to 28 days.
- Dogs can be infected if they eat contaminated horsemeat, and experimental infections have been established by the oral route as well as by subcutaneous or intravenous inoculation.
- Recovered animals do not remain carriers of the virus

Occurrence

Owing to its vectorial transmission pattern, AHS appears seasonally when vectors are the most active (after the rainy season in the tropics, in the summer and autumn in temperate regions).

AHSV is endemic in tropical and subtropical areas of Africa, south of the Sahara, from Senegal in the west to Ethiopia and Somalia in the east and extending as far south as South Africa.

The virus repeatedly spread out of its African basin during the last century and caused severe outbreaks in the newly infected territories: in 1943–1944 in Egypt, Syria, Jordan, Lebanon and Palestine, and in 1959–1960 outbreaks which caused the death of over 300,000 equids occurred in the Middle East and South-West Asia (Cyprus, Turkey, Lebanon, Iran, Iraq, Syria, Jordan, Palestine, Pakistan and India). In 1965, AHS was first reported in Morocco before reaching Algeria and Tunisia and crossing the Strait of Gibraltar into Spain in 1966. These latter outbreaks were all caused by serotype 9 viruses.

Europe faced a second AHS epizootic, this time due to serotype 4 virus, in 1987. It began in the province of Madrid, but although extensive control measures were taken (38,000 equids were vaccinated), AHSV successfully spread to southern Spain in 1988 and to Portugal and Morocco in 1989. The high mortality rate and the control measures implemented to limit AHSV circulation had a major impact on the international trade of horses and on the horse industry in infected countries and caused major economic losses. Over 2,000 horses died in 1989. Spain and Portugal were finally cleared of AHSV in 1991.

Since 2007, AHSV serotypes 2 and/or 7 have unexpectedly spread to several countries in West and East Africa where historically only serotype 9 had been isolated. They caused numerous outbreaks with mild clinical outcomes.

This recent expansion of AHSV is of great concern, in light of the experience with the closely related bluetongue virus (BTV), which have shown that BTV can easily and quickly spread in the Mediterranean Basin once it has reached North Africa.

AHS is one of the diseases for which the OIE has a procedure for the recognition of disease-free areas within a country or at national level. For more information, visit the status portal on the OIE website [http://www.oie.int/en/animal-health-in-the-world/official-disease-status/]

For more recent, detailed information on the occurrence of this disease worldwide, see the OIE World Animal Health Information Database (WAHID) interface [http://www.oie.int/wahis/public.php?page=home]

DIAGNOSIS

The incubation period in equids is approximately 3 days to 2 weeks (usually < 9 days), with the cardiac form typically developing later than the pulmonary form. Experimental infections suggest that the incubation period might is potentially be as long as 21 days.

For the purposes of the OIE *Terrestrial Code*, the infective period for AHSV is 40 days for domestic horses.

Clinical diagnosis

- There are four principal manifestations of disease.
- In the majority of cases, the subclinical cardiac form is suddenly followed by marked dyspnoea and other signs typical of the pulmonary form
- A nervous form may occur, though it is rare
- Morbidity and mortality vary with the species of animal, previous immunity and the form of the disease
    - Horses are particularly susceptible where mixed and pulmonary forms tend to predominate; mortality rate is usually 50% to 95%
    - Mules: mortality is about 50%; European and Asian donkeys: mortality is 5–10%; African donkeys and zebra: mortality is rare
- Animals that recover from AHS develop good immunity to the infecting serotype and partial immunity to other serotypes
- Sudden death can also occur without preceding signs.

Subclinical form (Horse sickness fever)

- Fever (40–40.5°C)
- Mild form; general malaise for 1–2 days
- Very rarely results in death

Subacute, oedematous or cardiac form

- Fever (39–41°C)
- Swelling of the supraorbital fossa, eyelids, facial tissues, neck, thorax, brisket and shoulders
- Mortality usually 50% or higher; death usually within 1 week

Peracute, respiratory or pulmonary form

- Fever (40–41°C)
- Dyspnoea, spasmodic coughing, dilated nostrils with frothy fluid oozing out
- Redness of conjunctivae
- Nearly always fatal; death from anoxia within 1 week

Acute or mixed form (cardiac and pulmonary)

- Occurs frequently
- Pulmonary signs of a mild nature that do not progress, oedematous swellings and effusions
- Mortality: about 70–80% or greater

Infection in dogs

- The pulmonary form is reported to be the most common form in dogs.
- Fatal cases have been described in dogs that ate infected meat during epidemics.

Lesions

- Pulmonary form:
  - interlobular oedema of the lungs
  - hydropericardium, pleural effusion
  - oedema of thoracic lymph nodes
  - petechial haemorrhages in pericardium
  - sub capsular hemorrhages in the spleen, congestion in the renal cortex, edematous infiltration around the aorta and trachea, and petechial hemorrhages on various serosal and pleural surfaces.
  - gastrointestinal lesions can include hyperemia and petechiae in the small and large intestines, and hyperemia of the gastric fundus.

- Cardiac form:
  - subcutaneous and intramuscular yellow gelatinous oedema on the fascia of the head, neck and shoulders, and occasionally the brisket, ventral abdomen and rump.
  - epicardial and endocardial ecchymosis; myocarditis; hydropericardium is common
  - lesions may also be found in the gastrointestinal tract, resembling the pulmonary form. In addition, prominent submucosal edema may be noted in the cecum, large colon and rectum.
  - ascites can also be seen.
  - the lungs are usually normal or slightly edematous/engorged, and the thoracic cavity rarely contains excess fluid.

Differential diagnosis

- Anthrax
- Equine infectious anaemia
- Equine viral arteritis
- Trypanosomosis
- Equine encephalosis
- Piroplasmosis
- Purpura haemorrhagica
- Hendra virus

Laboratory diagnosis

Samples

Agent detection

- Unclotted whole blood collected in an appropriate anticoagulant at the early febrile stage and sent at 4°C to the laboratory
- Spleen, lung and lymph node samples collected from freshly dead animals are placed in appropriate transport media and sent at 4°C to the laboratory; do not freeze

Serology

- Preferably paired serum samples should be taken 21-days apart and kept frozen at –20°C

Procedures

Virus isolation

- Cell cultures, such as baby hamster kidney-21 (BHK-21), monkey stable (MS) or African green monkey kidney (Vero) or insect cells (KC)
- Intravenously in embryonated eggs
- Intracerebrally in newborn mice

Virus detection

- Real-time reverse-transcription polymerase chain reaction (RT-PCR) is a highly sensitive technique that allows the detection of a very low number of copies of RNA molecules
- Enzyme-linked immunosorbent assay (ELISA) – rapid detection of AHSV antigen in blood, spleen and supernatant from cell culture

AHSV typing

- VN test has been the method of choice for typing as well as the 'gold' standard test for identifying AHSV's isolated from the field using type specific antisera
- Development of a type-specific gel-based RT-PCR and real-time RT-PCR using hybridisation probes for identification and differentiation AHSV genotypes provides a rapid typing method for AHSV in tissue samples and blood. There is a good correlation between the results obtained with the type-specific RT-PCR and the VN test, however, the sensitivity of these assays is lower than that obtained with the diagnostic group-specific real-time RT-PCR Typing of nine AHSV types has also been performed with probes developed from a set of cloned full length VP2 genes

Serological diagnosis

Horses that survive natural infection develop antibodies against the infecting serotype within 8–12 days post-infection.

- Blocking ELISA
- Indirect ELISA
- Complement fixation
- Virus neutralisation

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 3.5.1 African horse sickness in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Diagnostic Techniques".

PREVENTION AND CONTROL

- No efficient treatment available

Sanitary prophylaxis

Free areas, regions and countries

- Identify the virus and serotype
- Establish strict quarantine zone and movement controls
- Consider euthanasia of infected and exposed equids
- Stable all equids in insect-proof housing, at a minimum from dusk to dawn when *Culicoides* are most active
- Establish vector control measures: destroy *Culicoides* breeding areas; use insect repellents, insecticides, and/or larvicides
- Monitor for fever at least twice daily: place pyrexic equids in insect-free stables or euthanise
- Consider vaccination
  - identify vaccinated animals
  - available vaccines are attenuated
    - produce viraemia, and may theoretically reassort with the outbreak virus
    - may be teratogenic

Affected areas, regions and countries

- Annual vaccination
- Vector control
- Movement restrictions

Medical prophylaxis

- Attenuated (monovalent and polyvalent) live vaccines for use in horses, mules and donkeys, are currently commercially available.
- The currently available vaccines are teratogenic in pregnant mares, and vaccine strains may be transmitted by *Culicoides* vectors.
- No killed or subunit vaccines are currently manufactured commercially.
- Vaccination of non-infected horses:
  - Polyvalent live attenuated vaccine – commercially available in certain countries
  - Monovalent live attenuated vaccine – after virus has been typed
  - Monovalent inactivated vaccine – no longer commercially available
  - Serotype specific subunit vaccine – currently in development

For more detailed information regarding vaccines, please refer to Chapter 3.5.1 African horse sickness in the latest edition of the *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animal*s under the heading "Requirements for Vaccines".

For more detailed information regarding safe international trade in terrestrial animals and their products, please refer to the latest edition of the OIE *Terrestrial Animal Health Code*.

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Science Department (scientific.dept@oie.int). Last updated December 2020.