

EXOTIC

Ferlavirus in snakes

Fact sheet

February 2023

Introductory statement

Ferlavirus infections have caused large mortalities in overseas captive snake collections. The status of this virus and its role in disease of Australian snakes still needs to be clarified, however there is currently no convincing evidence that the virus is present in Australia. As ferlavirus infection cannot be diagnosed on histology alone a reliable ante-mortem test is required that will accurately detect infected snakes, so that it can be determined whether or not the virus exists in Australian snake populations.

Aetiology

Ferlavirus is an enveloped RNA virus in the family *Paramyxoviridae*, order Mononegavirales. It grows optimally at 30°C and has restricted growth at 37°C (Lunger and Clark 1979).

Natural hosts

Reptiles are the natural hosts and Ferlavirus has been isolated from all the major snake families including elapids, boids, colubrids, viperids and crotalids (Bronson and Cranfield 2006).

World distribution

The disease has been described from snakes in Europe, the Americas and the Canary Islands but is likely distributed worldwide.

Occurrences in Australia

There is no convincing evidence that the disease is present in Australia (T Hyndman pers. comm. 2023).¹

Epidemiology

The shedding patterns of ferlavirus are unknown (Jacobson and Origgi 2007). There are no controlled studies to support any claims regarding the existence of persistently-infected shedding

¹ Sunshine virus, a novel paramyxovirus distantly related to *Ferlavirus*, is present in Australia. See WHA Fact Sheet "Sunshine virus in Australian snakes" www.wildlifehealthaustralia.com.au/FactSheets.aspx

state or of snakes that mount an appropriate immune response and have cleared the infection (Hyndman et al. 2013).

It is reasonable to assume that ferlavirus can be transmitted between snakes by both oral secretions and cloacal excretions. Ferlavirus has not yet been isolated, or detected by PCR, from fomites or ectoparasites (Hyndman et al. 2013). There are currently no reports concerning vertical transmission of ferlavirus (Pasmans et al. 2008).

The incubation period of ferlavirus in naturally acquired infections is unknown. There are claims that the incubation period for ferlavirus may be as short as 21 days (Hernandez-Divers 2006) but will generally exceed 90 days (Hernandez-Divers 2006; Ritchie 2006). However, these claims are not supported by controlled studies (Hyndman et al. 2013).

Clinical signs

Clinical signs are variable. In the peracute form the affected snake may simply be found dead with no previous signs. Acutely affected snakes may display anorexia, regurgitation, respiratory signs including gaping and blood or a brownish discharge emerging from the glottis, and terminally, neurological signs such as head tremors, flaccid paralysis or convulsions. Chronically affected snakes generally have a history of anorexia and regurgitation and are weak and emaciated and have poor muscle tone. Over a period of several months they may develop diarrhoea and respiratory and neurological signs (Bronson and Cranfield 2006; Hyndman et al. 2013).

Diagnosis

Diagnosis is based on a combination of histological lung changes and virus isolation. Negative staining electron microscopy of faeces or lung washes can be used to find virus and immunoperoxidase and immunofluorescence stains are also available (Bronson and Cranfield 2006).

A haemagglutination inhibition test is available in the USA. Seroconversion takes approximately eight weeks. Antibody levels decline after approximately six months. A single positive result is indicative of exposure only. To demonstrate recent infection a greater than two-fold increase in titre needs to be demonstrated over a two- to- three-month time period (Jacobson et al. 1999). However, a recent publication cast doubt on the accuracy of this test, with different laboratories yielding different results using the same blood samples (Allender et al. 2007).

Commercially available diagnostic tests - The diagnostic tests for ferlavirus that are available to the clinical practitioner are restricted to haemagglutination inhibition (HI), polymerase chain reaction (PCR) and virus isolation. Presently these tests are only offered on a commercial basis in Europe, the United States of America, and Australia. PCR is available through Tim Hyndman at the School of Veterinary and Biomedical Sciences, Murdoch University, South Street, Murdoch, Western Australia 6150. Tests have not been validated at this time (Hyndman et al. 2013).

Pathology

A review mentions the most commonly seen gross pathological changes: pulmonary congestion or oedema, haemorrhagic pneumonia, free blood in the oral cavity or coelom, mucoid or caseous exudate in the lung, diffuse to focal accumulations of caseous necrotic debris in pulmonary tissue (Hyndman et al. 2013).

Histological lesions may be classified according to organ systems (Hyndman et al. 2013):

- Respiratory - the lung is usually full of macrophages, exudate and cellular debris. Epithelial cells undergo hypertrophy, hyperplasia and metaplasia. Pale eosinophilic intracytoplasmic inclusion bodies are occasionally detected within these cells. Pulmonary septa are thickened with oedema fluid and infiltrated with mixed inflammatory cells. Giant cells are occasionally seen. Varying amounts of mixed inflammatory cells occur in the interstitium.
- Neurological - occasionally demyelination, degeneration of axon fibres and ballooning of axon sheaths occurs in the brainstem and upper spinal cord. Eosinophilic intracytoplasmic inclusions have been found in glial cells, while eosinophilic intranuclear inclusions have been seen in neurons. Perivascular cuffing in the brain may also occur. Lymphohistiocytic neuritis of the oesophagus has also been recorded.
- Other tissues - if the pancreas is grossly enlarged hyperplasia of acinar cells and terminal duct epithelium is usually detected microscopically. Pancreatitis, pancreatic necrosis and fibrosis may also occur. Intracytoplasmic inclusion bodies may occur in the liver. Pyogranulomatous hepatitis has been reported in some cases (Jacobson 2007; Hyndman et al. 2013).

Differential diagnoses

Differential diagnoses include infectious agents and toxins that can cause respiratory or neurological signs, or chronic debilitation.

Laboratory diagnostic specimens

- Cloacal, oral and combined oral/cloacal swabs
- Fresh samples of brain, lung, liver and kidney
- Archival formalin-fixed paraffin-embedded tissue-sample quality is often badly degraded so negative results carry less weight than positive results

Sampling protocol

Oral swabs

- Moisten a cotton-tipped sterile swab with sterile saline. Rub the swab around the mouth paying particular attention to the glottis. If possible, advance the swab down into the trachea before sampling the rest of the mouth.

Cloacal swabs

- Moisten a cotton-tipped sterile swab with sterile saline. Advance the swab through the vent and swab the colon and cloaca.

Combined oral/cloacal swabs

- Moisten a cotton-tipped sterile swab with sterile saline. Swab as for the oral swab and then, using the same swab, sample as for the cloacal swab.

All swabs

- Break off swab-tip into small sterile container (e.g. plain blood tube) where no more than 5mLs of sterile saline would cover the swab even when the container is inverted. The combined oral/cloacal swab is preferred. Do not use bacterial culture swabs as these will facilitate bacterial growth.

Fresh tissue samples

- Small samples (pinhead size) of (in order of preference) brain, kidney, lung and liver can be collected into small sterile containers, and like the swabs, immersed in sterile saline. Pooling these samples is preferred to submitting them individually.

Laboratory procedures

PCR testing, gross pathology and histopathology.

Treatment

There is no treatment available.

Prevention and control

Snakes should be quarantined for a minimum of 90 days. Good mite control is advised. Sodium hypochlorite is an effective disinfectant for cleaning utensils and cages that have contained infected snakes (Bronson and Cranfield 2006).

No vaccine is currently available. A vaccine trial demonstrated seroconversion in western diamondback rattlesnakes (*Crotalus atrox*) when treated with a killed paramyxovirus vaccine. However, results were variable and transient, 17 of the 18 snakes having become seronegative 296 days after vaccination (Jacobson et al. 1991).

Surveillance and management

Wildlife disease surveillance in Australia is coordinated by the Wildlife Health Australia. The National Wildlife Health Information System (eWHIS) captures information from a variety of sources including Australian government agencies, zoo and wildlife parks, wildlife carers, universities and members of the public. Coordinators in each of Australia's States and Territories report monthly on significant wildlife cases identified in their jurisdictions. NOTE: access to information contained within the National Wildlife Health Information System dataset is by application. See the WHA website for more information:

<https://wildlifehealthaustralia.com.au/ProgramsProjects/eWHIS-WildlifeHealthInformationSystem.aspx>

There are no confirmed cases of ferlavirus in eWHIS. WHA would be interested in receiving any reports of suspected or confirmed cases in Australian reptiles.

Research

As ferlavirus infection cannot be diagnosed on histology alone research is required to develop a reliable ante-mortem test that will accurately detect infected snakes and determine whether or not the virus exists in Australian snake populations. Research focusing on this problem is currently being conducted through Murdoch University, Western Australia. There are still important gaps in the knowledge concerning these viruses and their associated infections. For example, the incubation periods and shedding kinetics of the paramyxoviruses from reptilian hosts, and the survivability of the virus once outside the host, are all poorly understood and as consequences, choosing appropriate quarantine periods, proper sampling times and suitable sample types is problematic. Researchers need to identify these gaps of knowledge and describe how ferlavirus behaves in the host and the environment (Hyndman et al. 2013).

Human health implications

It is unlikely that ferlavirus would pose a serious zoonotic risk to human health (Hyndman 2013).

Conclusions

Given the large snake mortalities seen in overseas collections affected by ferlavirus the potential exists for Australian snakes to be similarly affected. To date this has not occurred but, in order to establish practical safeguards, the availability of accurate ante mortem testing is urgently required.

References and other information

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To provide feedback on this fact sheet

We are interested in hearing from anyone with information on this condition in Australia, that could be added to the National Wildlife Health Information System. If you can help, please contact us.

Wildlife Health Australia would be very grateful for any feedback on this fact sheet. Please provide detailed comments or suggestions to admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and would like to produce a fact sheet (or update current sheets) for WHA. A small amount of funding is available to facilitate this.

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