Nidoviral Respiratory Disease in Australian Lizards

Fact sheet

March 2023

Key points

- "Blue-tongue nidoviruses", including *Shingleback nidovirus-1* have been associated with respiratory disease in wild and captive shingleback lizards in Western Australia, as well as in other blue-tongued and pink-tongued skinks in other parts of Australia.
- "Blue-tongue nidoviruses" have not been experimentally confirmed as the cause of the respiratory disease syndrome, but it is very likely that, when associated with other risk factors such as stress, pre-existing bacterial and fungal infections, poor nutritional state and reproductive activity, they can cause disease in some lizards.
- The virus appears highly contagious in captivity. Excellent husbandry and appropriate biosecurity management should be employed with sick reptiles in care.
- Most individuals respond well to supportive treatment but mortality rates without treatment may be high.

Introductory statement

A respiratory disease syndrome has been anecdotally reported in wild and captive shingleback lizards (*Tiliqua rugosa*) in Western Australia (WA) since the late 1990s. The syndrome was colloquially termed "bobtail flu", as well as "Upper Respiratory Tract Infection" (URTI). Since isolation of a virus (*Shingleback nidovirus-1*) associated with this disease, other nidoviruses have been detected and associated with this syndrome and in blue-tongued (*Tiliqua* spp.) and pink-tongued (*Cyclodomorphus gerrardii*) skinks. These viruses will be referred to in this Fact Sheet as "blue-tongue nidoviruses"[*]. A number of blue-tongue nidoviruses cluster within the single species known as *Shingleback nidovirus-1*. However, not all blue-tongue nidoviruses fall within this viral species.

Aetiology

A viral aetiology for the respiratory syndrome seen in shingleback lizards had been suspected for many years, due to the apparent contagious nature of the disease in captive environments, and lack of consistent evidence for a bacterial or fungal cause on cytology, culture and histopathological investigation.

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[*] not to be confused with blue tongue virus, a reovirus that infects a number of livestock species, see www.woah.org/en/disease/bluetongue

Since 2015, studies and diagnostic laboratory services have consistently correlated clinical respiratory disease with the presence of blue-tongue nidoviruses in a range of *Tiliqua* lizard species.

A novel nidovirus (family *Tobaniviridae*, subfamily *Serpentovirinae,* genus *Pregotovirus*[†]*),* species *Shingleback nidovirus-1*, was identified by next generation molecular sequencing of samples collected from wild shingleback lizards with respiratory disease in WA. Although there was a significant association between the presence of the virus and the presence of respiratory signs, causation has not been proven experimentally, and it is not known if this virus is an obligate pathogen, or if (as has been commonly demonstrated with respiratory disease in reptiles) it forms one component of a multifactorial disease syndrome [1, 2].

Since this study, diagnostic testing has identified other blue-tongue nidoviruses in association with similar upper respiratory tract disease [3].

In Australia, different reptile nidoviruses have been associated with severe disease and mass mortality in endangered, wild Bellinger River snapping turtles (*Myuchelys georgesi*) in NSW [4]. Globally, reptile nidoviruses (associated with respiratory disease) have been reported in veiled chameleon lizards (*Chamaeleo calyptratus*) [5], and in captive pythons in Europe and North America [6-11].

One Health implications

Wildlife and the environment: further work is needed to understand the conservation implications of blue-tongue nidoviruses, and their possible impact on free-ranging Australian lizards, included those already threatened.

Domestic animals: there is no evidence that blue-tongue nidoviruses of reptiles may cause disease in domestic animals.

Humans: there are no known human health implications, and it is unlikely that the virus would be zoonotic. Cross-species transmission of nidoviruses in general from reptiles to humans has not been documented or suspected. However, as with any wildlife species, appropriate biosecurity precautions should be adopted when treatment or post-mortem investigation of affected animals is undertaken. Due to the rate of carriage of enteric pathogens such as *E. coli* and *Salmonella* spp. in reptiles generally, basic personal protective equipment (hand hygiene and wearing of gloves) should always be employed when managing and handling reptiles.

Natural hosts

The respiratory syndrome was initially primarily reported in wild and captive shingleback lizards. Further research and diagnostic testing of captive and wild skinks of the *Tiliqua* genus, as well as the pink-tongued skink, has provided evidence of a widespread distribution of this virus.

Blue-tongue nidoviruses have not been detected in other Australian reptiles. Limited screening of other reptiles, either housed with affected individuals, demonstrating clinical signs of respiratory

[†] Previously family *Coronaviridae*; subfamily *Torovirinae*

disease, or 'apparently healthy', has failed to find evidence of this virus outside of *Tiliqua*. and *Cyclodomorphus* genera. However, without appropriate surveillance using robust sample sizes, it is unknown if other species are affected, or may act as reservoirs in the wild. Given the finding in pink-tongued skinks, it is biologically plausible that other species in the subfamily *Egerniinae* are susceptible.

World distribution

The syndrome has only been reported in Australia.

Occurrence in Australia

Members of the *Tiliqua* and *Cyclodomorphus* genera are found in the wild across most of Australia, however the respiratory tract syndrome has primarily been reported in the wild in shingleback lizards in WA, with first reports in the 1990s. It is not certain when the syndrome first emerged, although records in wildlife centres document an increase in admissions with corresponding clinical signs during the 1990s.

Testing has confirmed the presence of blue-tongue nidoviruses in captive and wild *Tiliqua* spp. and pink-tongued skinks, from all states and territories in Australia (with the exception of the NT and Tas, noting the limited testing in these regions).

There are numerous anecdotal reports (e.g. herpetologist blogs) of the syndrome occurring in captive shinglebacks across Australia [12]. There are anecdotal reports of the syndrome in wild shinglebacks in SA and one published report of wild shingleback lizards with ocular and nasal discharge [13], from a SA location close to the NSW and Vic borders. There have been no published reports of the syndrome in wild shinglebacks outside of SA and WA.

Epidemiology

The syndrome has been described in adult and immature individuals of both sexes. Further epidemiological information will require ongoing studies.

The presence of blue-tongue nidoviruses in clinically healthy animals suggests a carrier status is possible, and that an absence of respiratory signs disease does not preclude infection.

It is believed that disease develops as a result of multiple factors, with stress, nutritional status, reproductive status and secondary bacterial and fungal infections interacting with nidovirus to result in disease.

Limited review of the age and sex associations of the virus in wildlife care facilities in WA, suggests that juveniles are more likely to test PCR-positive for the organism. However, the epidemiology of the disease and virus will be dependent on the study system (captive vs wild, barrier managed versus free contact), and so associations are likely to be location, species and context specific.

Clinical signs

Clinical signs include loss of body condition, lethargy, depression, inappetence, pale mucous membranes, increased amounts of clear to cloudy mucus in the oral cavity, nasal passages and choana, sneezing, watery and swollen eyes, and bubbling from the eyes and nostrils. In a few cases, a marked proliferative stomatitis has been observed grossly and on histopathology. Mortality rates are reportedly high in the absence of supportive treatment [1, 12].

Diagnosis

Diagnosis of blue-tongue nidoviral disease is based on the characteristic pattern of clinical signs, combined with confirmation of viral presence using PCR. Detection of virus to date has been from oral/tracheal and/or eye swabs [14].

Laboratory diagnostic specimens and procedures

A diagnostic service for this virus is available for **veterinarians only** through Murdoch University. For viral testing, aseptic technique is used to collect swabs of secretions from the conjunctiva and oral cavity at the level of the glottis, which are placed into sterile physiological saline [1]. The preferred sample type is either separate or a combined conjunctival-oral swab, to maximise likelihood of detecting the virus. A combined oral-conjunctival swab is appropriate if screening of two swabs is cost-prohibitive.

A full post-mortem examination should be undertaken and a range of samples, particularly upper respiratory tract (tongue, glottis, trachea, nasal turbinates) and conjunctival tissues, collected aseptically for culture and histopathology. Examination should include bacterial culture of aseptically collected lung samples and qRT-PCR of oral and eye swabs.

The blue-tongue nidoviruses are yet to be isolated and grown in cell culture.

Pathology

Changes seen at post-mortem include poor body condition, thick mucus in upper respiratory tract, sometimes blocking the glottis, and hyper-inflated lungs occupying much of body cavity, which remain inflated during post-mortem examination. In advanced cases, the liver may be pale [12]. There is no published information on histopathological changes. There is no information available on clinical pathology changes seen with blue-tongue nidovirus infections.

Differential diagnoses

Other reported causes of respiratory disease in reptiles include viral, bacterial and fungal infections (such as adenovirus, herpesvirus and *Mycoplasma* spp.) and non-infectious causes [2]. A full diagnostic work-up to exclude other agents of disease should be included in any investigation that involves the blue-tongue nidoviruses, to rule out co-infections and develop a greater understanding of potential mixed infections.

Treatment

Supportive treatment is recommended, including warmth, parenteral or oral fluid therapy, and nebulisation with distilled water. Affected lizards have been found to have relatively higher loads of gastrointestinal tract parasites (coccidia, *Trichomonas* and oxyurids) and individuals may require treatment for these conditions [15]. A broad-spectrum parenteral antibiotic treatment and administration of an antiprotozoal treatment may be considered, although this should be decided by the veterinarian on a case-by-case basis‡. The majority of treated individuals respond well to therapy [1]. Euthanasia should be considered for individuals with severe or chronic disease, very poor body condition and a failure to respond to preliminary supportive therapy [12]. Mortality rates without treatment may be high [1, 12]. Due to the potential for carrier status and spread to natural environments or other individuals, asymptomatic or recovered individuals that are due to be housed with others or released should be serially tested negative, e.g. using a combined oral-conjunctival swab once every 2 weeks for a period of 6 weeks.

Prevention and control

The (anecdotal) epidemiology of the respiratory syndrome seen in correlation with blue-tongue nidoviruses indicates that the disease is highly contagious in a captive management situation. Excellent husbandry and appropriate biosecurity management should be employed including: dedicated equipment for each enclosure, barrier management, attention to shared air spaces or ability for direct contact between enclosures, daily cleaning of the environment and equipment with detergents and then disinfecting with agents such as Virkon or F10, and use of gloves and hand hygiene when handling and treating affected lizards.

Research

Further work is recommended in the following areas:

- Confirm the aetiology of the syndrome and its epidemiology including transmission pathways, presence of a carrier state and geographic and host range and risk factors.
- Prevalence of shingleback nidovirus in wild individuals of the *Tiliqua* genus.
- Surveillance of sympatric *Egernia* species to determine if more widespread in these individuals
- Optimal treatment, including assessment of long-term response and fate in the wild following rehabilitation.
- Description of the disease at a histological level through detailed investigation of confirmed cases by histopathology and immunohistochemistry.
- Assessment of conservation implications, including for captive management, release to wild and population viability of threatened species.

‡ enrofloxacin is NOT recommended as a first line treatment in these host species due to antimicrobial stewardship concerns and the apparently high carriage of *Salmonella* and *E.coli* in shingleback lizards (see www.ncas-australia.org/animal-antimicrobial-stewardship)

Surveillance and management

Wildlife disease surveillance in Australia is coordinated by 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

Most cases seen in WA are presented for care to Kanyana Wildlife Rehabilitation Centre (www.kanyanawildlife.org.au), although other wildlife rehabilitation centres in WA, including Native Animal Rescue (https://nativeanimalrescue.org.au) and WA Wildlife (https://wawildlife.org.au) also treat affected individuals.

Suspect cases should be reported to your state or territory WHA Coordinator.

References and other information

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Acknowledgements

We are grateful to the people who contributed to this fact sheet and would specifically like to thank Dr Bethany Jackson, Dr Tim Hyndman, Dr Mark O'Dea and the staff and volunteers at Kanyana Wildlife Rehabilitation Centre.

Updated: March 2023

To provide feedback on fact sheets

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