Ranaviruses (Infection with)

AETIOLOGY

Classification of the causative agent

Ranaviruses belong to the *Iridoviridae* family and have become a significant agent of concern in amphibian, reptile, and fish populations in North and South America, Europe, Asia, and Australia. They are enveloped double-stranded DNA viruses, but an envelope is not necessary for the virus to be infectious. The genus *Ranavirus* is comprised of multiple viral species, some of which are listed in the OIE Aquatic Code (Chapter 1.3) and may therefore be notifiable agents (see ***Hosts*** below). These viruses are common causes of epizootic outbreaks and often cause massive mortality events, particularly in naive terrestrial populations.

For the purpose of voluntary reporting on non OIE-notifiable disease in wildlife, "infection with ranaviruses" refers to **reptilian** infections. Information on **amphibian** infections with ranaviruses must be submitted through the mandatory reports for the OIE-notifiable diseases. Additionally, epizootic haematopoietic necrosis virus infections in **fish** are reportable to the OIE as indicated in *The Aquatic Animal Health Code*.

Resistance to physical and chemical action

Temperature:	Evidence suggests warmer temperatures may limit pathogenicity in hosts. Heat inactivation at 60°C for 15 minutes is effective, but potentially less so if particles were previously dessicated.
pH:	Not determined
Chemicals/Disinfectants:	>3% bleach, >1% potassium peroxymonosulfate, >0.75% chlorhexidine, or 70% ethanol for greater than 1 minute contact time
Survival:	Resistant to drying. Some virus species can persist for months in water and over 2 years in frozen tissues.

EPIDEMIOLOGY

Hosts

- Amphibian populations in North America, South America, Europe, and Asia
  - Most species within orders *Anura* (frogs) and *Caudata* (salamanders) are susceptible
- Chelonians, lizards, and snakes worldwide
  - Most reports of reptilian outbreaks have involved North American box turtles (*Terrapene* spp.)
- Variety of fish species worldwide

Transmission

- Direct contact with infected animals
- Ingestion of viral particles
- Contact with contaminated surfaces, including bodies of water and soil
- The role of vertical transmission is not well understood

- Transmission of ranaviruses between amphibians, reptiles, and fish has been demonstrated experimentally and believed to occur naturally.

Sources

- Fomites (anthropogenic spread)
- Contaminated environment
- Other infected animals

Occurrence

Amphibian die-offs have been observed in Europe, Asia, South America, and most notably in North America where ranavirus is becoming a significant threat to biodiversity. Salamander mortality rates during epizootic mass mortality events in North America have been observed to be as high as 90%. These events typically occur seasonally when large numbers of non-immune young animals enter the population and become exposed. Hatchlings and metamorphs appear to be most susceptible, and eggs the least due to the capsule's protective properties. Adults are often more frequently reported than other age groups during die-offs, however.

Ranaviruses are known to cause mass mortality in aquiculture systems and wild fish populations alike, and have become a significant concern in Australia.

Reptilian infections are hypothesised to originate primarily from spillover events and yield a highly virulent, acute infection; population densities are typically low and free-ranging animal seroprevalence is low, but mortality rates for infected individuals and populations are high. Because of this, it is assumed interclass transmission is the primary source for reptiles and is believed to stem from shared environments and water sources and ingestion of infected prey.

Environmental conditions may play a role in ranaviral pathogenicity. There are data to suggest infected animals may be more likely to survive if exposed to warmer temperatures (26°C vs 18°C). Outbreaks typically occur during summer months and may be linked to host life cycles and seasonal behaviours.

Ranaviruses are not evenly distributed across landscapes; hotspots exist, which has proved to be a concern for conservation and reintroduction efforts. The commercial exotic pet trade is believed to contribute to the global spread of ranaviruses.

DIAGNOSIS

Ranaviral pathogenesis is not well understood, but it is believed to infect epithelial cells and spread systemically. Experiments have shown infection takes only seconds of contact, but clinical disease may take days to weeks to develop pending host factors, viral pathogenicity, and infectious dose of the virus. The course of disease is typically rapid and may result in death with few presenting clinical signs. Animals may recover and be subclinical carriers.

Subclinical infections are possible.

Clinical diagnosis

- Animals may die suddenly with few clinical signs.

- Lethargy
- Erratic swimming patterns
- Moribund fish are often found floating at the water surface.
- Chelonians may gasp for air.
- Amphibians present with reddening of the ventrum, inguinal area, and legs.

Lesions

- Localised cutaneous haemorrhage and ulceration +/- skin sloughing, polyps
- Oedema, haemorrhage, and necrosis in multiple organs, particularly the spleen, liver, pancreas, kidney, GI tract
- Tan, friable organs
- Inflammatory exudate at vent
- Necrotic, tan plaques in the oral cavity of chelonians
- Fish present with reddened and enlarged swim bladders with yellow exudate.
- Intracytoplasmic inclusion bodies have been documented but are rarely seen.
- Carcasses may lack gross lesions if the course of the disease was rapid.

Differential diagnoses

- Amphibians
    - Chytridiomycosis (*Batrachochytrium dendrobatidis* or *B. salamandrivorans*)
    - Algal bloom neurotoxicity
    - Septicaemia
- Reptiles
    - Chelonian herpesvirus
    - Ophidian paramyxovirus (OPMV)
    - Algal bloom neurotoxicity
    - Septicaemia
- Fish
    - Viral hemorrhagic septicemia
    - Furunculosis (*Aeromonas salmonicida*)
    - Whirling disease (*Myxobolus cerebralis*)
    - Spring viraemia of carp (carp sprivivirus)
    - Algal bloom neurotoxicity
    - Septicaemia

Laboratory diagnosis

Samples

For isolation of agent

- If the animal is:
    - >60mm in length: kidney, spleen, liver +/- lung, skin
    - 30-60mm in length: collect all viscera
    - <30mm in length: remove head and tail, test remaining body

Serological tests

- Serum

Procedures

Identification of the agent

- Cell culture is considered the gold standard.
    - Immunostaining of cell cultures
    - Enzyme-linked immunosorbent assay (ELISA) of cell cultures
- Microscopy
- Polymerase chain reaction (PCR)

Serological tests

- There are few established protocols for detecting host antibody to ranavirus, and availability varies by reference laboratory.

For more detailed information regarding sampling and laboratory diagnostic methodologies, please refer to Chapter 2.1.2 and Chapter 2.3 of the latest edition of the OIE Manual of Diagnostic Tests and Vaccines for Aquatic Animals.

PREVENTION AND CONTROL

Sanitary prophylaxis

- Quarantine newly acquired animals and test for ranaviruses before introduction to captive groups.
- If a captive facility has virus positive individuals, disinfect all waste water before discarding to prevent contamination; utilise different water sources for each enclosure to minimise colony risk.
- Disinfect all enclosures and instruments after and between uses. Similarly, disinfect all tools/equipment and personal protective equipment if moving between field locations.
- Avoid animal translocation between habitats. If necessary, test animals for ranavirus before placing into a new environment.

Medical prophylaxis

- There are currently no vaccines or effective medical treatments for ranavirus infections

POTENTIAL IMPACTS OF DISEASE AGENT BEYOND CLINICAL ILLNESS

Risks to public health

- There are no identified direct risks to human health

Risks to agriculture

- Ranavirus outbreaks in fish hatcheries or farmed fish populations may have significant implications for aquaculture by impacting general animal health, production capabilities, and population mortality rates

REFERENCES AND OTHER INFORMATION

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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 Scientific Department (scientific.dept@oie.int). Last updated 2019. Written by Marie Bucko and Samantha Gieger with assistance from the USGS National Wildlife Health Center.