

Crocodilepox virus (Papillomatosis in crocodiles) (Infection with)

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AETIOLOGY

Classification of the causative agent

The crocodile poxvirus is an enveloped, double-stranded DNA virus within the *Poxviridae* family that causes papillomatosis in crocodiles. It is of greatest concern to crocodile farms, where it is most often seen in hatchlings and juvenile crocodiles less than two years of age. It may present in adult crocodiles subjected to stressful conditions. While the disease is thought to be enzootic in wild crocodiles, poxvirus lesions have not been found and the virus has not been isolated from them. There are two genetically distinct strains of the virus: one primarily affects the Nile crocodile (*Nile crocodile poxvirus*) and the other primarily the saltwater crocodile (*Crocodylus porosus poxvirus*). No distinct viral strain has been classified for the freshwater crocodile.

Resistance to physical and chemical action

Temperature: Not well determined

pH: Not well determined

Chemicals/Disinfectants: Resistant to several disinfectants; 1% KOH, steam, 2% NaOH thought to be effective

Survival: Able to survive in organic and inorganic materials; environmentally stable

EPIDEMIOLOGY

Hosts

- Captive Nile, saltwater, and freshwater crocodiles (*Crocodylus niloticus*, *C. porosus*, *C. johnstoni*)
- Virus has not been isolated from wild crocodiles, but they are believed to be a natural reservoir
 - The virus has been identified using polymerase chain reaction (PCR) but not viral isolation

Transmission

- Contact with skin lesions
- Contact with contaminated fomites (including organic debris such as soil, insects, etc.) and swimming in contaminated water
 - It has been suggested that mosquitoes may transmit the virus, but the route (mechanical versus biological vector) is not clear.
- Ingestion of contaminated water and feed

Sources

- Infected crocodiles
- Environmental contamination (via exfoliated cells/tissue from lesions)

Occurrence

The virus has been reported on crocodile farms in Australia, southern Africa, and Southeast Asia. Due to the widespread nature of the virus in many different crocodile species, it is thought that the virus can be introduced

to farms from wild-caught crocodiles. Outbreaks in captivity have been associated with high-stress environments.

DIAGNOSIS

Not much is known about the pathogenesis of crocodile poxvirus, including incubation period and if immunity is conferred after infection. It is thought that poxviruses replicate in cytoplasmic viroplasm within the host's epithelial cells. The lesions undergo four stages of development: early active, active, expulsion, and healing (see **Lesions**).

Clinical diagnosis

Affected animals develop skin lesions characterised by round, raised, grey-white or brown, pruritic papules. This may lead to crocodiles scratching themselves on objects found in their pens. Lesions are typically found on the tail, abdomen, jaw, and eyelids and generally heal by themselves in weeks to months. If disease is severe, the virus may cause stunting, weight loss, and oedema; large facial lesions may lead to blindness and difficulty breathing.

Lesions

- *Early active stage:*
 - Grey-white foci approximately 0.5-1 mm in diameter
 - Henderson-Patterson-like inclusion bodies
- *Active stage:*
 - Raised, grey-white foci approximately 1-1.5 mm in diameter
 - Henderson-Patterson-like inclusion bodies
- *Expulsion stage:*
 - Foci are approximately 2-2.5 mm in diameter
 - Before viral expulsion, inflammatory cells form scabs
 - After viral expulsion, depressed foci are orange-brown in colour
 - Hyperkeratosis and/or parakeratosis
- *Healing stage:*
 - Foci are approximately 1.5-1.75 mm in diameter
 - Hyperkeratosis and/or parakeratosis
- Multifocal brown papules, 2-8 mm in diameter
- Eosinophilic intracytoplasmic inclusions
- Ballooning of epidermal cells
- Bollinger and/or Borrel bodies
- Another strain of the virus is thought to cause collapsed cysts that result in pitting, pinprick lesions in tanned crocodile skin (known as "atypical crocodile pox")

Differential diagnoses

- Lesions
 - Dermatophilosis (Brown Spot Disease)
 - Mycobacteriosis
 - West Nile virus ("atypical crocodile pox" presentation)
- Conjunctivitis
- Chlamydiosis (blindness)
- Respiratory infection
- Malnutrition

Laboratory diagnosis

Samples

For isolation of agent

- Skin sample of lesion (biopsy)

Serological tests

- No serological tests developed for diagnostic use

Procedures

Identification of the agent

- Histology of skin lesions
- Polymerase chain reaction (PCR)
- Definitive diagnosis with electron microscopy showing viral particles (dumb-bell shaped virions)

Serological tests

- No serological tests developed for diagnostic use

PREVENTION AND CONTROL

Sanitary prophylaxis

- Tools and equipment used in captive settings should be decontaminated between enclosures as well as before utilising them outside of the rearing facility. This prevents contaminating naïve or otherwise clean areas, including the environment.
 - During cleaning, take steps to reduce water aerosolisation
 - Disinfect water before draining a contaminated enclosure
- Maintain separate breeding and rearing facilities of captive and wild crocodiles
- The use of barriers to prevent interaction between wild and captive crocodiles is encouraged
- Utilise well or borehole water to ensure cleanliness
- If an outbreak is suspected, change water and disinfect pens daily

Medical prophylaxis

- Quarantines should be instituted any time new individuals are introduced to a captive population or when a captive animal develops clinical disease.
 - Debride and disinfect skin lesions (including antimicrobial ointment application) to reduce viral shedding and environmental contamination
 - Treat crocodiles as appropriate for secondary bacterial or fungal infections
- Maintain a low-stress environment, including reduction of heat stress, provision of high-quality feed, proper stocking density, et cetera
- Autogenous vaccines have been used in Nile crocodiles to facilitate recovery after infection. No commercially available vaccine exists, and caution should be taken regarding persistent viral shedding if modified-live autogenous vaccines are utilised.

POTENTIAL IMPACTS OF DISEASE AGENT BEYOND CLINICAL ILLNESS

Risks to public health

- There is a lack of evidence to suggest this virus poses a risk to human health.

Risks to agriculture

- Pox lesions affect the hide quality and therefore monetary value of individuals. Additionally, ill-thrift makes animals less suitable for consumption. These factors can have significant negative impacts on the economy of crocodile farms.

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 Science Department (scientific.dept@oie.int). Last updated 2020. Written by Samantha Gieger and Erin Furmaga with assistance from the USGS National Wildlife Health Center.