Bandicoot papillomatosis and carcinomatosis syndromes

Fact sheet

September 2023

Key points

- Papillomatosis and carcinomatosis syndromes in Shark Bay and southern brown bandicoots are caused by novel viruses.
- The syndrome (with associated disease) in Shark Bay bandicoots has been reported in both captive and wild animals. It can have negative health and welfare impacts on the individual and may have impacts at a population level.
- The syndrome can cause progressively debilitating skin and mucocutaneous papillomatosis masses.
- One case has been detected in a southern brown bandicoot.
- Similar viruses should be considered as a differential diagnosis for papillomas and carcinomas in other native species.

Aetiology

Bandicoot papillomatosis carcinomatosis viruses (BPCVs) are double-stranded DNA viruses and are founding members of a novel virus family. They demonstrate greatest genomic and morphologic similarity to papillomaviruses (*Papillomaviridae)* and polyomaviruses (*Polyomaviridae)* [1].

One Health implications

Wildlife and the environment: bandicoot papillomatosis carcinomatosis viruses appear to be species-specific and there is no known risk to other wildlife species. The syndrome may have a population level impact on Shark Bay bandicoots, which is an endangered species, although no population level changes have been attributed to this disease [2].

Domestic animals: there is no known risk to domestic animals.

Humans: there are no known human health implications.

Natural hosts and occurrences in Australia

Bandicoot papillomatosis carcinomatosis virus-1 (BPCV-1) is known only to affect the Shark Bay bandicoot (ShBB, *Perameles bougainville*; formerly known as western barred bandicoot) [3] which is listed as endangered and is extinct across much of its former range.

BPCV-2 is known only to affect the southern brown bandicoots (SoBB; *Isoodon obesulus*) [4].

The viruses are known only from Western Australia. The syndrome was first observed in 1999 in a captive colony of ShBB, and subsequently in wild and captive groups of ShBB in WA. A historical trace-back of museum specimens found similar lesions in ShBB specimens collected in 1982 and 1988 [5]. It is likely that BPCV-1 has been present in the ShBB population for at least 10 million years [6].

ShBB from Bernier Island, Dryandra Woodland, Peron Captive Breeding Centre and Kanyana Wildlife Rehabilitation Centre have been diagnosed with BPCV-1 infection. Papillomas or carcinomas have **not** been detected in ShBB from Dorre Island, Faure Island and the Arid Recovery Reserve at Roxby Downs [2, 7].

Only one case of BPCV-2 infection, in a southern brown bandicoot, has been detected [4].

Epidemiology

The BPCVs appear to be species-specific and are thought to be transmitted between individuals through direct and indirect contact e.g. mating, females raising offspring, territorial fighting and foraging behavior [2]. Based on the knowledge of the two most similar virus families, *Papillomaviridae* and *Polyomaviridae*, the BPCVs are likely to resist desiccation and persist in the environment for extended periods of time.

BPCV-1 and the accompanying syndrome were found to be present in the Bernier Island ShBB population and in captive populations derived from these animals, but not in wild ShBB from Dorre Island, Heirisson Prong or their captive descendants. However, no difference in genetic susceptibility to developing the syndrome was found between populations [8].

The prevalence of ShBB papillomatosis and carcinomatosis syndrome was higher in captive vs wild populations (although this may be due to observational bias) and highest in individuals >2 years. Lesions were also observed to be more severe in captive over wild individuals (perhaps because animals were less likely to succumb to negative impacts of the syndrome in captivity). The mean age at first lesion detection was 3.17 years and the proportion of affected individuals increased with age from 2.6% (animals aged between 0.5-1 year old) to about 75% (animals aged >4.5 years). The youngest recorded ShBB affected by the papillomatosis and carcinomatosis syndrome was around 10 months of age [8]. The comparatively higher prevalence of this syndrome in older animals may reflect a long incubation period, or long period of latent viral infection [7].

Immunosuppression of the host may activate infection in latently-infected individuals [2].

Genetic diversity levels in the ShBB were found to be amongst the lowest ever recorded for a marsupial species [9] and it has been suggested that this low genetic diversity of the ShBB may increase the susceptibility of the species to BPCV [8].

The evolutionary divergence of BPCV-1 and BPCV-2 is thought to have occurred 10.2 million years ago, at the time of divergence of the bandicoot genera *Isoodon* and *Perameles* [4, 6]. It is not known why clinical disease has only been observed in recent years, however changes in environmental stressors, immune function or co-infection may be playing a role [8].

More recent small scale studies indicate prevalence (judged by clinically obvious lesions) in wild populations of 0% to 42%. Although population declines have not been linked to the presence of the virus, or the presence of active lesions, more surveillance work is required to better assess the population impacts of the virus, and the risks of the pathogen when bandicoots are translocated for conservation purposes [2].

Clinical signs

Affected individuals display single or multiple thickenings of the skin, muco-cutaneous junctions and/or mucosal surfaces; lesions are proliferative and increase in size over time. The paws, distal limbs, eyelids and lips are most commonly affected. Lesions cause difficulties for affected individuals in terms of vision, locomotion and ability to eat and drink, depending on the anatomic location of the lesions. The lesions may also become abraded, ulcerated and secondarily infected, leading to sometimes fatal complications [4, 7, 10].

Diagnosis

Diagnosis is based on clinical signs as described above, along with histopathology, *in situ* hybridization of biopsied lesions, PCR testing of superficial skin swabs, demonstration of the virus DNA or virions in fresh (frozen) lesions [3, 4, 6, 7, 10]. Other differential diagnoses (such as fungal, parasitic and bacterial causes of epidermal/mucosal hyperplasia) should be ruled out.

Clinical pathology

There are no specific haematologic, biochemical, or urine changes associated with bandicoot papillomatosis and carcinomatosis syndromes.

Pathology

The syndrome is characterised by multicentric proliferative lesions [8]. Grossly and histologically, the smaller lesions resemble papillomas, whereas the larger lesions are most commonly carcinoma in situ and squamous cell carcinomas [7, 10]. Distant metastases of squamous cell carcinomas have been observed in lymph nodes, lungs and the liver [10]. *In situ* hybridization tests demonstrated BPCV nucleic acids within affected epidermis, mucous membranes and muco-cutaneous junctions [4, 6].

Laboratory diagnostic specimens

Superficial skin swabs: sterile saline moistened cotton-tip swab rubbed firmly over the papillomatous lesion and immersed in 1 ml sterile saline in an Eppendorf tube will enable PCR-based detection of BPCVs.

Formalin-fixed papilloma biopsies: tissue samples collected into 10% neutral buffered formalin can be processed for histopathology and *in situ* hybridization.

Fresh/frozen biopsies: tissue collected into RNAlater®, frozen or refrigerated can be processed to extract total DNA. Molecular biology techniques (e.g. PCR) can then be used to detect BPCV DNA.

Novel BPCVs: if a novel BPCV isolate is suspected (e.g. collected from a host species other than *P. bougainville* or *I. obesulus*), all 3 diagnostic specimens described above should be collected.

Treatment, prevention and control

There are few options for treatment. Surgical resection of papillomas leads to prompt local recurrence [11].

The debilitating effects of BPCV infection can only be prevented in captive breeding programs if animals that are known to be BPCV-free are included. Detection of latently-infected animals does not appear possible. Prevention and control in the wild is not likely to be feasible.

Research

Ongoing research is required to better understand the epidemiology of BCPS and to develop options for safe and effective treatment for lesions as well as a safe and effective prophylactic vaccine. Surveillance is recommended for similar wart-like lesions in other Australian native mammals.

Surveillance and management

There is no formal surveillance program for BPCS and surveillance is currently being conducted on an *ad hoc* basis.

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information: https://wildlifehealthaustralia.com.au/ProgramsProjects/eWHIS-WildlifeHealthInformationSystem.aspx.

WHA is interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Acknowledgments

We are grateful to the people who contributed to this fact sheet and would specifically like to thank Mark Bennett who developed the first edition of this sheet.

Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.

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References and other information

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