Leishmaniasis in Australian wildlife

Fact sheet

Introductory statement

Leishmaniasis describes a variety of syndromes caused by the protozoan parasite *Leishmania*. Australia was considered to be free of leishmaniasis until 2003, when the first case of locally acquired disease was diagnosed in a group of captive red kangaroos (*Macropus rufus*) in the Northern Territory [NT] (Rose 2004). Since then, it has been reported in other captive *Macropus* species in the same geographic area. Day-feeding midges may play a role in transmission of the parasite in the Australian context, in contrast to *Leishmania* transmission in other areas of the world (Dougall et al. 2011). Other aspects of the epidemiology of *Leishmania* in Australia, including the mammalian reservoir hosts, remain unclear. There have been no reports of locally acquired *Leishmania* in humans in Australia and the human health significance of this finding remains unclear.

Aetiology

Intracellular protozoan parasites belonging to the family *Trypanosomatidae*, genus *Leishmania* (Roberts 2006). There are at around 30 species with at least 20 species pathogenic to humans (CFSPH 2009). These organisms fall within two main groups; the Old World species occurring in Europe, Africa and Asia and the New World species occurring in the Americas (CFSPH 2009; OIE 2014).

The agent described in the NT is phylogenetically closely related to *L. enriettii* (Dougall et al. 2011). *L. enriettii* is found only in the Americas, has the guinea pig as a vertebrate host and is non-infectious for humans. Its suspected vector is *Lutzomyia monticola*, a phlebotomine sand fly (Machado et al. 1994; Paranalba et al. 2015).

Natural hosts

Cutaneous leishmaniasis (CL) was first described in captive red kangaroos in greater Darwin area, in the NT and has since been reported in captive northern wallaroos (*Macropus robustus woodwardi*), black wallaroos (*Macropus bernardus*) and juvenile agile wallabies (*Macropus agilis agilis*) from the same region (Dougall et al. 2009). One case has been reported in an adult, wild agile wallaby, living in close proximity to the fence of the
wildlife park where captive cases were seen (Grillo 2011). Anecdotal reports suggest clinical disease has also been seen antilopine wallaroos (*M. antilopinus*).\(^1\)

As red kangaroos are not native to this geographic area, and are unaccustomed to the tropical, wet climate it is suggested that they are an incidental host (Rose 2004). It has been suggested that one or more native macropod species, including the agile wallaby, may be natural reservoirs of Australian *Leishmania* in the NT (Dougall et al. 2009) (see below).

**World distribution**

In other parts of the world, rodents, small mammals and canids are common reservoirs of *Leishmania* infection in endemic countries. Domestic dogs also play a significant role in transmission in the urban environment (Bryceson 1996). There is evidence to suggest that marsupials (opossums) may be a significant natural host in the Americas (Schallig et al. 2007; CFSPH 2009) as may the red fox (*Vulpes vulpes*) in Europe (Mancianti et al. 1994; Dipineto et al. 2007).

The species of *Leishmania* isolated from macropods and midges in Australia has not been described elsewhere in the world (Menzies 2013).

**Occurrences in Australia**

The novel, unnamed *Leishmania* species has been isolated from skin lesions of captive red kangaroos, northern wallaroos, black wallaroo and agile wallabies in the NT. Lesions have primarily been reported in captive facilities, more than 20 km apart, with only one case being reported in a free-living agile wallaby in the same area (Rose et al. 2004; Dougall et al. 2009; Grillo 2011).

**Epidemiology**

Globally, *Leishmania* are transmitted between mammalian hosts by phlebotomine sand fly vectors. There may be one or more mammalian reservoir hosts for each species of *Leishmania*.

The epidemiology of *Leishmania* in Australian wildlife remains largely unknown, although it is considered likely that CL is endemic to the tropical region of the NT (Dougall et al. 2009). Previous risk assessments regarding incursions of exotic *Leishmania* into Australia were based on the premise that no suitable sand fly species existed in Australia to act as vectors. Studies undertaken in the NT to determine the vector for Australian *Leishmania* found no evidence that phlebotomine sand flies acted in this role. Rather, an unnamed species of day-feeding midge from the subgenus *Forcipomyia* (*Lasiohelea*), family *Ceratopogonidae* and possibly a similar species, *F. (L.) peregrinator*, show compelling evidence as vectors for Australian leishmaniasis. These species are known to bite humans, and these insects are considered to have the potential to act as vectors for other species of *Leishmania*, raising the possibility that imported pathogenic *Leishmania* could become endemic in Australia (Dougall et al. 2011).

The mammalian reservoir host(s) for Australian *Leishmania* are yet to be identified, although it has been suggested that one or more species of macropod native to the Darwin area (including the most numerous

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\(^1\) If you have information that can be shared to enhance this fact sheet, please contact admin@wildlifehealthaustralia.com.au.
species, the agile wallaby) are likely to serve as natural reservoirs (Dougall et al. 2009). There is serological evidence of exposure in agile wallabies and antilopine wallaroos across the Darwin rural area of the NT (Pers. Comm. Annette Dougall).

It has been suggested that clinical disease may have manifest in captive macropods due to a naivety to infection and subclinical stress, related to the fact that the captive environment differed in habitat and microclimate to the typical indigenous environment of the red kangaroo, black wallaroo and northern wallaroo. Lesions were less severe and resolved more quickly in juvenile agile wallabies, suggesting this species may have a lower susceptibility to clinical disease (Dougall et al. 2009). Lesions were noted to be severe in the one case reported in a wild, adult agile wallaby (Grillo 2011). In general, clinical severity is noted to increase in the tropical wet season (Rose et al. 2004).

Morbidity rates in macropods have not been reported. Mortality related to Australian Leishmania has not been reported.

Given that marsupials and canids play a significant role in the transmission of Leishmania in endemic countries, it is possible that native marsupials, foxes, dingoes and domestic dogs may play a similarly important role in Australia.

Clinical signs

In macropods in Australia, clinical signs have been limited to skin lesions, consistent with CL. Affected animals typically exhibit areas of thickened skin or raised pale nodules, with variable degrees of crusting and ulceration. Lesions are reported to be restricted to the ears, tail, limbs with occasional cloacal lesions. Whilst chronic in nature, lesions are sometimes self-resolving (Rose et al. 2004; Dougall et al. 2009).

Outside Australia, most mammalian reservoirs of Leishmania are well adapted to infection, remaining asymptomatic or exhibiting only mild skin lesions that may persist for years, but cause little harm (Bryceson 1996). Dogs are an exception, as they develop visceral leishmaniasis (VL) and eventually die if left untreated. Clinical signs are dependent upon organ involvement but are often accompanied by lymphadenopathy, skin lesion, conjunctivitis and emaciation. Liver, spleen and kidney involvement are most common. There have been no reports of VL in Australian wildlife.

Diagnosis

Confirmation of leishmaniasis requires demonstration of the parasite. This may involve visualisation of organisms in stained smears of lesion scrapings, tissue biopsies and fine needle aspirates. In vitro culture of the parasite in Novy, McNeil and Nicolle (NNN) medium is the gold standard. In vivo isolation can also be performed if the appropriate animal model is available. Polymerase chain reaction (PCR) is used to detect parasite DNA within infected tissue or in the blood (VL). Serology can also be used to detect anti-leishmanial antibodies. The indirect fluorescent antigen test and enzyme-linked immunosorbent assay (ELISA) are most commonly used for this purpose (OIE 2014).

Clinical pathology

There is no published information available.
Pathology

Histopathology reveals a variable range of host inflammatory responses ranging from lympho-plasmacytic to granulomatous cellular infiltrates within the dermis. Other observations include epidermal hyperplasia, coagulation necrosis, ulceration and associated supplicative inflammation. Biopsies reveal infiltration of the superficial and/or dermis with clustering of macrophages, containing single celled organisms, confirmed to be Leishmania amastigotes (Rose et al. 2004; Dougall et al. 2009).

Differential diagnoses

Differential diagnoses of leishmaniasis in Australian wildlife are likely to include other causes of nodular, hairless skin lesions.

Laboratory diagnostic specimens

Skin scrapes, tissue biopsies and fine needle aspirates of the margins of suspect lesions should be taken for histopathologic examination. Biopsies taken for this purpose should be fixed in 10% formalin and embedded in paraffin. Diagnosis of VL and canine leishmaniasis can also be achieved through aspiration of the lymph nodes, spleen and bone marrow. Aseptically collected biopsies and fine needle aspirates are to be placed into an appropriate blood agar-based medium, such as (NNN) for culture (Rose et al. 2004; OIE 2014). If NNN medium is unavailable, then samples can be stored in the fridge and transported as soon as possible to a diagnostic laboratory. PCR can be undertaken on fresh, frozen or ethanol fixed tissue biopsies and fine needle aspirates. Serum should also be collected for serological detection of anti-leishmanial antibodies (Rose et al. 2004).

Laboratory procedures

Leishmania can be identified through stained smears of fine needle aspirates, skin scrapings and tissue biopsies when characteristic lesions are present. In the case of low grade infection, the organism is most successfully isolated through in vitro and in vivo isolation or PCR. The most significant advantage of in vitro isolation is the rapid time frame in which a positive culture can be obtained. In the case of primary isolation of an unknown organism, this technique is best undertaken using a blood agar-based medium such as NNN. In vivo isolation is accomplished through intradermal inoculation of mice with infected tissue suspension or aspirate material. Serology is most commonly used to diagnose cases of VL or canine leishmaniasis. Whilst a number of serological tests have been trialled, IFA and ELISA are most suited to this purpose. Despite being of less use in the diagnosis of CL and muco-cutaneous leishmaniasis (MCL) (OIE 2014), ELISA was used to demonstrate the presence of anti-leishmanial antibodies in all cases of CL in Australia (Rose et al. 2004; Dougall et al. 2009). Detailed information on diagnostic laboratory procedures can be obtained through the Manual of diagnostic tests and vaccines for terrestrial animals (OIE 2014).

Treatment

Treatment is available for leishmaniasis in humans and dogs. Safety and efficacy of treatments for Australian leishmaniasis in kangaroos is not known.
Prevention and control

Prevention focuses on avoidance of bites from insect vectors in known *Leishmania* localities. Global methods of control are largely limited to treatment or destruction of animal reservoirs, treatment of infected humans and management of sand fly populations. Development of an effective vaccine against leishmaniasis has been largely unsuccessful.

Surveillance and management

*Leishmania* is an OIE-listed disease and a nationally notifiable animal disease (DAWR 2016; OIE 2016).

Statistics

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. Please contact admin@wildlifehealthaustralia.com.au.

Reports in eWHIS include those mentioned above.

Research

Ongoing research is being conducted at the Menzies School of Health Research in the Northern Territory to confirm the vector and identify reservoir species of Australian *Leishmania*.

Research questions include:

- What is the ability of *Lasiohelea* spp. to act as vectors for other species of *Leishmania*?
- What is the potential for an introduction of an exotic species of *Leishmania*, given the presence of an apparently novel vector in the NT?
- What is the potential for zoonotic transmission of *Leishmania* in Australia? (Menzies 2013).
- What is the natural host range, and geographic extent of *Leishmania* infection in Australian wildlife?

Human health implications

Globally, humans are generally considered to be accidental hosts of *Leishmania* spp. However, leishmaniasis is considered to be one of the world’s most significant parasitic diseases, with approximately two million new cases occurring in humans around the world each year. Human leishmaniasis is endemic in 88 countries around the world and is present on all continents except Australia and the Antarctic (Roberts 2006; WHO 2017). It is particularly evident in developing countries of Africa, Asia and South America (Gonzalez et al. 2009; Khanjani et al. 2009).

Parasitism in humans can cause a chronic spectrum of disease including VL, CL or MCL and may lead to death if left untreated. *Leishmania* is of particular importance to Australian travellers entering regions where the parasite is endemic. Australian travellers can best prevent leishmaniasis by avoiding endemic regions.
(Bryceson 1996). Sand fly bites can be minimised by using mesh sleeping nets impregnated with permethrin, applying skin repellent and wearing long sleeved clothing.

To date, there have been no reports of human disease locally acquired within Australia (Dougall et al. 2009), although members of the day-feeding midge subgenus *Lasiohelea*, the putative vector for Australian leishmaniasis, are known to bite humans (Dougall et al. 2011). A small number of cases of leishmaniasis have been diagnosed in immigrants, travellers and their pets, but these cases are not related to the novel species of *Leishmania* identified in the NT.

A local health care professional or the state or territory Health Department should be consulted for information on *Leishmania* in people in Australia. Leishmaniasis is not nationally notifiable in humans.

**Conclusions**

The significance of locally acquired leishmaniasis in macropods in the Northern Territory of Australia is not known. It is of importance to confirm the vectors and identify the mammalian reservoir hosts involved in transmission. It is recommended that research continue to better understand the potential for zoonotic transmission of Australian *Leishmania* and risk factors associated with the potential for exotic *Leishmania* spp. to establish in Australia.

**References and other information**


Updated: Jan 2017

**To provide feedback on this fact sheet**

We are 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.

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 sheets) for the network (or update current sheets). A small amount of funding is available to facilitate this.
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