Lyssavirus — an awareness imperative — the role of animal management in keeping Australia's community and its pets safe

Chris Bunn

HISTORY

A small outbreak of rabies occurred in Hobart in 1866 when a number of local dogs and one pig became infected and a child, who had been bitten by one of the dogs died. It was not until this human case occurred that investigations were made. It was found that for some time previously several dogs had become savage and had been destroyed. Fortunately the local municipal council carried out a general clean-up of stray dogs and this action no doubt was responsible for the successful eradication of the disease.

More recently there have been two confirmed cases of human rabies in Australia, where people had been bitten or scratched by rabid animals overseas. The first, a 10-year-old boy, had travelled to India, Pakistan, Nepal, Singapore and Thailand in 1986, but did not develop symptoms until June 1987. Twenty-three days after the onset of the illness he died. The Australian Animal Health Laboratory diagnosed the second case in March 1991. It is believed the infection was acquired overseas.

In May 1996, evidence of another 'new' virus, a lyssavirus (subsequently named Australian bat lyssavirus [ABL]), was found in a flying-fox in northern New South Wales.

WHAT IS LYSSAVIRUS?

Lyssavirus is the name for a group (or genus) of viruses. The viruses included in this group are shown in the following table.

Members of the genus *Lyssavirus*	
Name	**Reservoir**
Classical rabies virus	Found worldwide, except for a few island nations, Australia and Antarctica. Endemic and sometimes epidemic in a wide variety of mammalian species, including bats. >25,000 human cases/year almost all in areas of uncontrolled domestic dog rabies.
Lagos bat	Unknown, but probably fruit bats. Ten cases identified as at December 1995, including three in domestic animals, in Nigeria, South Africa, Zimbabwe, Central African Republic, Senegal and Ethiopia. No known human cases.
Mokola	Reservoir unknown but probably an insectivore or rodent species. Occurs in Africa. Seventeen cases known including nine domestic animals and two human cases.
Duvenhage	Reservoir unknown but probably insectivorous bats. Occurs in Africa. Four cases known, including one human death. No cases in domestic animals.
European bat lyssavirus	European insectivorous bats. More than 400 cases recorded in bats and a few human cases. One reported domestic animal case.
Australian bat lyssavirus	Fruit bats, recorded in one species of insectivorous bat.

WORLD DISTRIBUTION AND OCCURRENCE IN AUSTRALIA

Rabies in insectivorous bats is widely distributed throughout the United States with 759 cases being reported in 1993. Although sporadic transmission of rabies from bats to terrestrial mammals is known, there is no evidence that bats are a source of enzootic rabies in terrestrial animals.

A similar situation exists among European bats with European bat lyssaviruses. The role of bats in Africa, including fruit bats, in maintenance of the various Lyssaviruses present there is less clear.

ABL infection has been identified in the four flying-fox species (*P. alecto*, *P. scapulatus*, *P. poliocephalus*, *P. conspicillatus)* and in two species of insectivorous bat (*Saccolaimus flaviventris* and *Nyctophilus sp.*). ABL has been shown to be widely distributed in bats in eastern Australia.

Antigen-positive animals have been detected from Darwin to Melbourne and west to Mt. Isa and Narromine. To date sampling of flying-foxes in Western Australia has been limited, but it is not unreasonable to assume that equal sampling intensity will detect the virus there as well. Likewise it seems plausible that other insectivorous bat species (at least other tree-roosting species) will test positive given adequate sampling intensity.

The crude disease prevalence of ABL in flying-foxes is estimated to be 5%, based on the examination of brain tissue. This crude figure averages data from both wild-caught and 'sick and injured' animals. It needs to be interpreted with care, because the frequency of infection in these two groups is significantly different. Our estimate of the prevalence in the wild-caught sample is less that 1% — consistent with estimates of rabies disease in bats in the United States. In the 'sick and injured' sample, the estimate is 7%.

Intuitively, an infection that causes clinical disease (such as ABL) will be more common in the 'sick and injured' subset of the population. Extending this line of reasoning, 'sick and injured' individuals pose a greater public health risk (at least to those who come in contact with them, such as veterinarians, wildlife carers, Parks & Wildlife personnel) than do wild-caught flying-foxes.

From a flying-fox perspective, 'species' appears to be an important risk factor for ABL infection. In preliminary analysis, little red flying-foxes (*P. scapulatus*) have a significantly higher disease prevalence than the other three species. Other variables such as age, sex, region and time of sampling are presently under consideration. The results for insectivorous bats are limited, although the small number of yellow-bellied sheath-tailed bats sampled demonstrated a surprisingly high prevalence.

WILDLIFE STUDIES

Clinical signs attributed to ABL include inability to fly, hindquarter paresis, apparent general weakness and, less commonly, aggression.

Clinical disease has been recorded in all age classes of bats. Recently confirmed disease occurred in an eight-week-old black flying-fox. This apparently healthy animal was found abandoned at the age of 2-3 weeks by a wildlife carer and was hand-raised. It was in care for five weeks before suddenly developing neurological signs reported as agitation, aggression toward its mate, persistent crying, back arching and frothing at the mouth. There was some temporary improvement before the animal died seven days after the onset of symptoms. Viral antigen was detected in the brain tissue and in salivary gland tissue.

The level of sub-clinical disease in bat populations is unclear at this time. One study indicating a level as high as 16%.

SPILLOVER HOSTS

There are no recorded cases of Australian bat lyssavirus infection in wildlife species other than bats. There are no recorded cases in domestic animals and only two recorded human cases. Nonetheless, because of the similarity of ABL to rabies, it is prudent to consider the possibility (and consequences) of ‘spillover’ from bats into a terrestrial host. Fortunately rabies and rabies-like viruses are known to be strain-specific and to establish within narrow host ranges.

So while it is possible for spillover to occur, it is unlikely that infection would establish and ‘cycle’ in the new species because, in abnormal hosts, rabies viruses don’t produce the behavioural changes to foster transmission. Further, as virus doesn’t establish in salivary glands, either at all or at the ‘right’ time for effective transmission to occur, any such spillover event would effectively be a ‘dead-end’.

How does one explain the apparent inconsistency between ABL disease prevalence in flying-foxes (based on ABL antigen in brain tissue) and only two human cases to date, when the level and frequency of contact in groups such as wildlife carers suggests the probability of a higher incidence in humans?

Preliminary evidence suggests that only a small proportion of infected flying-foxes may actually excrete virus in the salivary gland. This observation is consistent with epidemiological studies of rabies and rabies-like disease elsewhere. So while the history of attributable disease in humans is short, the epidemiological evidence in bats is consistent with a virus that has been present in Australian bat populations possibly for a considerable time.

FATAL HUMAN CASES

In October 1996, the zoonotic capability of the virus became apparent when a wildlife carer developed an illness which progressed (over a 10 day period), from pain and numbness in her left arm to a depressed conscious state. The patient died despite intensive medical care (Allworth *et al*, 1996). The patient had been caring for several flying-foxes and an insectivorous bat, a yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*), prior to becoming ill. There was a history of her being bitten by the yellow-bellied sheath-tail bat. Subsequent antigenic evidence supported a bat of this species, rather than a flying-fox, being the source of infection.

A second human case of lyssavirus disease occurred in December 1998 in central Queensland. A Mackay woman died after an apparent prolonged exposure, the only history of direct contact with bats having been over two years earlier when she was bitten by a flying-fox. It is reported that the flying-fox ‘landed’ on a child at a barbecue and that the woman was bitten when she attempted to remove the bat from the child. This incident occurred some months prior to the previously reported fatal human case. Post-exposure treatment was not received.

Infected bats present a direct health risk to humans bitten or scratched by them. Rabies vaccine and anti-rabies immunoglobulin protect against ABL infection and their use pre- and post-ABL exposure is recommended. Pre-exposure vaccination is recommended for those occupationally or recreationally exposed to bats, where there is a risk of being bitten or scratched. Appropriate post-exposure management is recommended where people are bitten or scratched.

FACTORS ABOUT THE DISEASE

There is little information available on incubation period of lyssaviruses other than classical rabies. For rabies, the incubation period is generally of the order of 4 to 8 weeks in the natural host, but can vary from 4 days to six months or even longer.

Information on incubation period for Australian bat lyssavirus will not be known until experimental infections have been undertaken, although with the human cases in Australia an incubation period of 6-8 weeks occurred for the first case and more than two years for the second.

There is little or no information available on persistence of lyssaviruses, other than classical rabies. The classical rabies virus is comparatively fragile and does not survive for long periods outside the host. Environmental contamination, other than aerosol contamination in bat caves, is of very little significance in transmission of rabies virus.

HUMAN HEALTH RISKS

Based on overseas and limited Australian experience it is assumed that lyssaviruses are transmitted by contamination of a fresh wound, usually a bite or scratch (sometimes very small) with infected saliva. Recently, scientists detected lyssavirus in the salivary glands of Australian bats, Although it has not been a consistent finding in animals tested to date.

There have been recent observations in the United States of human cases without known bites. Aerosol dispersal of infected saliva has been considered a possibility. There have been cases in bat caves in the USA. The small number of cases suggest it is possible, but rare, to get rabies from aerosol. However, further studies are needed to confirm this and exclude other possible modes of transmission.

Other contact by itself, such as petting a rabid animal and contact with blood, urine or faeces, does not constitute an exposure. In general, if an object such as fruit has been contaminated, if it is dry it can be considered non-infectious.

OVERALL POLICY FOR LYSSAVIRUS

If lyssavirus is confirmed by post mortem in a domestic animal, the following would occur:

- isolate and monitor any in-contact animals and destroy any in-contact animals that develop suspicious clinical signs and submit them for post-mortem examination at an approved laboratory;
- provide a public information campaign. Include information that an isolated case does not mean the virus is cycling in the domestic animal population. Additional actions will however be taken to eliminate the possibility of further transmission. Request people to report suspicious cases promptly to their private veterinarian, government veterinarian, or disease watch hotline;
- post-exposure prophylactic procedures as advised by the health authority should be undertaken by any persons thought to have been exposed to the case;
- increase (if necessary) the control of stray carnivores (foxes and cats) in the immediate vicinity;
- maintain a surveillance program in the area, primarily by keeping local veterinary practitioners, council dog control officers, pound officers, RSPCA inspectors, and police well informed and asking them to report immediately any suspicious clinical cases;
- limited use of vaccine for domestic animals would only be with Chief Veterinary Officer approval and under strict supervision.

Overall policy for exposure of people to bats

Currently the case for routine vaccination of captive bats or other animal species with rabies vaccine in Australia is not yet established and cannot be recommended.

The general public should be advised not to handle bats. Bat carers and people occupationally exposed to bats should be vaccinated, use protective equipment and avoid bites and scratches from bats. Strictly limit direct access to captive bat colonies to trained, vaccinated people.

The risk of lyssavirus infection in captive bat colonies can be reduced by serial blood testing of flying foxes to establish serological freedom and isolation of the colony from all other bats. Cavers and other people frequenting enclosed areas occupied by captive bats should receive rabies vaccination.

Our strategy for classical rabies

The AUSVETPLAN disease strategy for rabies is that when a rabid animal is discovered, every effort is made to locate all animals that were exposed to it so that they may be either destroyed, or vaccinated and quarantined. Stray animals are to be impounded, ownerless ones destroyed and all others kept under secure restraint. A compulsory mass vaccination program of all domesticated carnivores in designated areas would be instituted. Thus Australia's overall policy is to eradicate rabies quickly for public health reasons and to prevent spread to both domestic and wild animals.

Strategies if the disease becomes established

ABL infection is established in the Australian bat population across a wide area of Australia. In the unlikely event that ABL established a cycle in domestic or wild terrestrial animals, vaccination strategies would be implemented.

Acknowledgement

I would like to acknowledge the information provided by Dr Hume Field in the preparation of this paper.

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