The role of Grey-headed Flying-foxes in the ecology of Hendra virus, Menangle virus and Australian bat lyssavirus

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ABSTRACT

Three previously unknown viruses have been recently described in flying-foxes. Hendra virus, Menangle virus and Australian bat lyssavirus (ABL) are regarded as emerging diseases of potential importance to both animal and public health. While there is no evidence that Hendra or Menangle virus infections are transmitted directly to humans, direct contact with an ABL-infected flying-foxes presents a serious human health risk from a saliva-contaminated bite, scratch or mucous membrane. Fruit is not regarded as a mode of transmission, but for aesthetic and general hygiene reasons, eating fruit that has been damaged or partially eaten by any animal is not recommended.

Key words: flying-fox, emerging disease, zoonosis, Hendra, menangle, lyssavirus.

Introduction

Since the mid-1990s, three previously unknown zoonotic[1] viruses (Hendra virus, Australian bat lyssavirus and Menangle virus) have been identified in bats in Australia. All three appear to be endemic[2] in Australian flying-foxes (sub order Megachiroptera, genus *Pteropus*).

Previously unknown diseases which suddenly appear are described as emerging diseases. The reality is that these are often not new diseases at all, but diseases that have been dislodged from their normal niche as a result of (generally anthropogenic) changes. Such changes may be associated with the agent, the host or the environment, and can be broadly categorised as ecological changes, human demographic changes, increased international travel and commerce, changes in industry practices associated with advances in technology, microbial adaptation and change, and breakdown of public health measures (Morse 1995). Hendra virus, Menangle virus and Australian bat lyssavirus are regarded as emerging diseases of potential importance to both animal and public health.

Hendra virus

Hendra virus (formerly Equine morbillivirus) was first described in September 1994 in Australia, in an outbreak investigation of a previously undescribed disease in horses (Murray *et al.* 1995). Twenty horses and two humans were infected, 13 horses and one human fatally. A further two foci of infection were identified in August 1994 (retrospectively diagnosed) (Rogers *et al.* 1996) and January 1999 (Field *et al.* 2000). A total of three horses and one human were infected in these incidents, all fatally. The three human cases were attributed to exposure to infected horses. Serology, virus isolation, and epidemiological evidence have identified flying-foxes as the probable natural host of the virus (Young *et al.* 1996; Halpin *et al.* 2000; Field *et al.* 2001).

Serologic surveys of flying-fox populations in Queensland, New South Wales, Western Australia and the Northern Territory have revealed evidence of infection in all four Australian mainland species (the Black Flying-fox *Pteropus alecto*, the Grey-headed Flying-fox *P. poliocephalus*, the Spectacled Flying-fox *P. conspicillatus*, and the Little Red Flying-fox *P. scapulatus*).

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Hendra virus does not appear to cause clinical disease in flying-foxes, further supporting the contention that this is an endemic infection of Australian flying-foxes. The prevalence of antibodies to Hendra virus appears to vary with species. Of 326 Grey-headed Flying-foxes surveyed between April 1996 and December 1998, approximately 40% had neutralising antibodies to Hendra virus (Field, *unpubl data*). The presence of anti-Hendra antibodies is consistent with previous, non-fatal, infection with Hendra virus.

Menangle virus

Menangle virus was first described in June 1997 in the investigation of an outbreak of reproductive disease in an Australian piggery (Philbey *et al.* 1998). Two piggery workers were subsequently found to have high levels of neutralising antibody to Menangle virus. In the course of the outbreak, both suffered a severe febrile illness attributed to infection with the virus. The virus was believed to have been contracted from infected pigs.

Serological and epidemiological evidence suggests that Menangle virus infection is endemic in Black, Spectacled, and Grey-headed Flying-foxes, with seropositive flying-fox populations being found in Queensland, New South Wales, Western Australia and the Northern Territory (Field, *unpubl data*). A preliminary screening of Grey-headed Flying-foxes from Queensland and New South Wales found 26 of 79 (33%) had neutralising antibodies to Menangle virus (Philbey *et al.*1998). A similar seroprevalence was found in a subsequent, additional sample of about 150 Grey-headed Flying-foxes from primarily New South Wales (Tony Ross, pers. comm. 2001, NSW Agriculture).

Australian bat lyssavirus

In October 1996, a rabies-like disease was responsible for the death of a wildlife carer in Australia (Allworth *et al.* 1996). The causative agent, Australian bat lyssavirus (ABL) was first described only months earlier in May 1996 in a Black Flying-fox (Fraser *et al.* 1996). Infection was also confirmed in a species of insectivorous bat (the Yellow-bellied Sheath-tailed bat *Saccolaimus flaviventris*) (Hooper *et al.* 1997). The human case was attributed to a bite from a bat of this species (Hanna *et al.* 2000). A second fatal human case of ABL occurred in December 1998, and was attributed to a bite from a flying-fox (Hanna *et al.* 2000).

ABL has strong serotypic, antigenic and sequence analysis similarities to classical rabies virus and to European bat lyssavirus, but is phylogenetically distinct (Gould *et al.* 1998). Epidemiological evidence based on the spatial pattern of occurrence and the existence of related but molecularly-distinct strains of ABL in mega- and microchiroptera (Gould *et al.* 1999) suggests that ABL is endemic in flying-fox populations in Australia (Field, *unpubl data*).

The prevalence of infection appears to be very low in *wild-caught* flying-foxes. None of a total of 500 wild-caught individuals from all mainland species and from multiple locations in eastern, western and northern Australia, sampled between April 1996 and December 1999, was positive for ABL antigen by fluorescent antibody test. However, a subset of nearly 900 sick and injured flying-foxes of the four mainland species sampled over that time had a crude infection prevalence of nearly 7% by the fluorescent antibody test. Of the 200 Grey-headed Flying-foxes in this sample, 4% were positive for virus antigen.

Because ABL causes clinical disease in infected flying-foxes, it follows that the prevalence of ABL infection should be higher in that subset of the general flying-fox population that *is* sick or debilitated, rather than in the subset of the population that is not. Thus, handling sick and injured flying-foxes poses a heightened risk of exposure to ABL. Health authorities strongly advise members of the general public to refrain from handling any bats, and at-risk groups such as bat carers, to obtain and maintain vaccination with rabies vaccine (Anon 1996).

Conclusion

In summary, three previously unknown viruses with serious animal and public health potential have been recently described in flying-foxes. Flying-foxes appear to be the natural host of all three. It is probable that all have existed in Australian flying-foxes historically, rather than being recent introductions. Infection with Hendra virus and Menangle virus is common in Grey-headed Flying-foxes (and others); Australian bat lyssavirus infection is rare in wild-caught Grey-headed Flying-foxes (and others), but more common in sick and injured individuals. While there is no evidence that Hendra or Menangle virus infections are transmitted directly from flying-foxes to humans, it is clear that direct contact with an ABL-infected flying-fox presents a serious human health risk from

a saliva-contaminated bite, scratch or mucous membrane. Fruit is not regarded as a mode of transmission, but for aesthetic and general hygiene reasons, eating fruit that has been damaged or partially eaten by any animal is not recommended.

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QUESTIONS & ANSWERS

PEGGY EBY: Thank you very much. Are there questions for Hume?

LES HALL: (University of Queensland). Hume, it might be useful to point out in terms of the focus of this conference that the death from a flying-fox bite was outside of the Grey-headed Flying-fox distribution.

PEGGY EBY: Hume, can you comment on the likelihood that contact between flying-foxes and fruit will present a health risk to consumers?

HUME FIELD: Yes, this is one that does get asked regularly, Peggy, and certainly the health authorities in Queensland advised that people shouldn't eat broken fruit, or fruit that's obviously been bitten and that if normal precautions in washing fruit are observed then there's no risk from lyssavirus or presumably either from any of these other viruses.

PEGGY EBY: Thank you very much.

[1] A zoonotic disease is a disease that can be transmitted to humans from animals.

[2] 'Endemic' is used in the epidemiological context to indicate the constant presence of an infection in a population, often with little disruption to the population. Endemic infections commonly reflect a mature host-agent relationship.