Menangle virus

Fact sheet

Introductory statement

Menangle virus has occurred as a single outbreak in a piggery causing reproductive failure, and significant illness in two piggery workers. The natural host of the virus was identified as pteropid flying-foxes, and the outbreak occurred at Menangle, near Sydney in 1997. This outbreak occurred within a few years of the first cases of Hendra virus, Australian bat lyssavirus, Nipah virus and SARS coronavirus, all identified as novel zoonotic diseases from bats. Menangle virus is not known to be pathogenic to its bat hosts. The reason for the emergence of Menangle virus is unknown, although increased contact between bats, humans and livestock as a result of habitat destruction is likely to be a factor in some bat origin zoonoses and Australian flying-foxes have demonstrated a trend to urbanisation in recent decades (Hall and Richards 2000).

Aetiology

Menangle virus: family Paramyxoviridae, genus Rubulavirus

Menangle virus is a negative-sense single strand RNA virus, most closely related to Tioman virus, another rubulavirus, identified in flying-fox populations in Malaysia (in 2000) but not yet associated with any disease (Chua et al 2001). La Piedad Michoacan virus (LPMV) or "blue eye disease", first isolated in Mexico in 1980, is the only other known paramyxovirus which is associated with reproductive failure in pigs.

Natural hosts

Flying-foxes are believed to be the natural host of Menangle virus. Antibodies, but not virus, have been isolated from Australian flying-foxes of genus Pteropus. The collective natural range of the genus in Australia is predominantly coastal and monsoonal Qld, NT and northern WA, decreasing southwards in coastal NSW, Victoria and eastern SA. The highly mobile little red flying-fox also utilises inland regions (Strahan 1995):

- *Pteropus poliocephalus* grey headed flying-fox
- *Pteropus alecto* black flying-fox
- *Pteropus conspicillatus* spectacled flying-fox
- *Pteropus scapulatus* little red flying-fox.

In a preliminary study, 42 of 125 serum samples collected from grey headed and little red flying-foxes at a camp 200m from the affected piggery had antibodies that neutralised Menangle virus. In addition, antibodies
were found in sera collected in 1996, before the outbreak, and from a colony of flying-foxes 33 km from the piggery (Philbey et al 1998).

The flying-fox camp at Menangle is one of a number of camps in the Sydney region and is considered to be intermittently occupied by flying-foxes. Until recently (2000s), camps at this latitude have been primarily occupied by grey headed flying-foxes, which have now been joined by black flying-foxes expanding southwards; little red flying-foxes also transiently use camps in this region. At the time of the Menangle outbreak the Menangle camp was occupied, suggesting a local abundance of nectar and pollen, fruit or orchards (Hall and Richards 2000). For more information on the status of flying-fox camps, refer to the Australian Government Department of the Environment National Flying-Fox Monitoring Programme (including an interactive flying-fox web viewer) www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring

Subsequently, neutralising antibodies against Menangle virus were detected in 46% of black flying-foxes, 41% of grey-headed flying-foxes, 25% of spectacled flying-foxes and 1% of little red flying-foxes in a clustered non random sample of 306 flying-foxes sampled from northern and eastern Australia. Positive sera included samples collected from grey headed flying-foxes in the colony adjacent to the affected piggery. No virus was isolated from a sample of 215 flying-foxes collected in NSW despite the detection of virus-like particles in the faeces (Philbey et al. 2008).

**Affected hosts**

- Domestic pigs (*Sus domestica*); clinical disease has been observed in breeding female domestic pigs (expressed as reproductive failure).
- Human (adults, male, 2).

There was no evidence of infection in rodents (*n=19*), birds (*n=13*), cattle (*n=60*), sheep (*n=70*), cats (*n=25*) and dog (*n=1*) at the affected piggery (Philbey et al 1998).

**World distribution**

The disease is only known to occur in Australia.

**Epidemiology**

**Morbidity**

**Pigs:** Most pigs became infected at 12 to 16 weeks of age, after waning of colostral immunity. Among replacement gilts raised on the affected premises, approximately two-thirds were seropositive at entry into the breeding herd (Love et al 1998). The prevalence of high antibody titres to Menangle virus in finishing age and adult pigs exceeded 95% during the outbreak.

**Humans:** Seroprevalence and clinical disease was 5.26% (2/38) for individuals with high occupational exposure (workers at the swine operations), and if all individuals at risk are included, the seroprevalence was 0.78% (2/256) (Chant et al 1998). There was no evidence in infected humans of exposure to bats but unequivocal history of high exposure to infected pigs.

**Bats:** no clinical disease has been associated with serological evidence of infection with Menangle virus in bats.
Mortality
Farrowing rate in sows was reduced by up to 40%. No deaths in older pigs, humans or bats have been reported.

Incubation period
Incubation period is unknown but appears to be 10-14 days in pigs, where exposure results in strong immunity. Persistent infections have not been observed.

Transmission
Bat to pig: Transmission from flying-fox to pigs is hypothesized to have occurred by the faecal-oral route. Flying-foxes were observed flying over the farrow-to-weaning operation buildings when departing their roost at dusk and when returning to the roost at dawn. Paths around the buildings which housed the pigs were contaminated with flying-fox faeces and pigs moved on these paths (Love et al 1998).

Pig to pig: It is believed that the virus may be spread by the faecal-oral route, principally because respiratory transmissions would be expected to accompany faster spread than observed through the piggery (Love et al 1998). The two remote farms that experienced the disease received ‘finisher’ pigs from the index farm. Once the virus had spread through the breeding population, signs of reproductive disease and foetal infection were no longer apparent but the virus remained endemic in the population due to a continuous cycle of infection in young growing age pigs as they lost protection afforded by maternal antibodies.

Clinical signs
Pigs
Reproductive failure and congenital defects characterised by:

- reduced conception rates; reduced farrowing rates.
- reduced litter size (live piglets) in 45% of sows.
- delivery at term of a large number of mummified and stillborn foetuses including some with severe skeletal and craniofacial defects.

There was no evidence of disease in pigs of any age after birth.

Human
Illness lasting 10-14 days, characterized by fever, rigors, sweats, malaise, headache and rash.

Bats
No clinical disease has been associated with Menangle virus. It is believed that bats are asymptomatic.

Pathology
Pigs
Gross pathology included mummified and stillborn piglets, some with pulmonary hypoplasia arthrogryposis, marked reduction in size of the cerebral hemispheres, cerebellum, brain stem and spinal cord as well as hydranencephaly. The most frequent change was reduced size or absence of the cerebellum.
Histologically, there was severe non-suppurative encephalomyelitis with extensive degeneration, necrosis, infiltration of macrophages and gliosis. Perivascular cuffs of lymphocytes and macrophages were also evident in the brain and spinal cord. Intranuclear and intracytoplasmic eosinophilic inclusion bodies were observed in neurones and other cells in the brain and spinal cord. Intranuclear inclusions tended to be single, small and centrally placed. Intracytoplasmic inclusions tended to be large and refractile, occupying most of the cytoplasm, and were often crescent shaped, enveloping the nucleus. Typical pleomorphic paramyxovirus particles with herringbone-shaped nucleocapsids were observed in these inclusions.

**Differential diagnoses**

Other cause of infectious reproductive failure in sows; other causes of fever and flu-like illness in humans.

**Laboratory diagnostic specimens**

The virus neutralisation test (VNT) is the preferred method to detect antibodies to this virus in all species. Virus isolation in cell cultures has been used to isolate the virus in situations where serological tests are not useful or possible.

Serum samples for VNT can be stored for about four weeks at 4°C without significant decline in antibody titre. Freezing at -20°C or lower is preferred for longer storage. Best results are achieved with serum from sows that have reduced reproductive performance or have produced affected piglets. The virus neutralisation test can be used on any species.

Virus isolation is more likely to be successful from freshly aborted or stillborn pig foetuses with gross and/or histological evidence of degeneration of the brain. In such animals, virus has been consistently isolated from brain, lung and myocardium.

**Laboratory procedures**

**Pigs**

Serology (VNT); virus isolation in cell culture and histopathology.

**Humans**

Comparative serological tests on acute and convalescent sera (=4 weeks post illness).

**Bats**

Serology (VNT). To date virus has not been isolated from tissues but transmission EM following routine negative staining and immunogold labelling of bat faeces has demonstrated virus-like particles (Philbey et al 2008).

**Treatment**

Disease in pigs was controlled, not treated. No specific treatment for humans is discussed. Treatment for bats is not considered.
Prevention and control

In the single outbreak disinfection and temporary depopulation of individual units of the piggery was successful. A brief period of depopulation of an individual unit was followed by restocking with pregnant sows that were expected to be immune. The only young animals then raised in this environment were the progeny of these sows protected by maternal antibodies for a period of at least 6 weeks. Collectively these measures were believed to provide a period of several months in which the virus would need to survive in the environment before susceptible piglets would become available for infection and continuation of the endemic cycle. The disinfectant susceptibility of Menangle virus has not been published; however, the related Newcastle disease virus is inactivated by formalin, phenol, or acid pH.

Surveillance and management

Menangle virus is listed in Australia as a National Notifiable Animal Disease (suspected or confirmed cases must be reported to the local vet or state or territory’s department of primary industry. Phone the Emergency Animal Disease Watch Hotline: 1800 675 888).


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@wildlifediseaseaustralia.com.au.

No records are maintained in the National Wildlife Health Surveillance Database relating to serological evidence of Menangle virus in flying-foxes and it is not offered as a differential diagnosis in the search directory.

Research

Mode of transmission from flying-foxes to pigs is not fully understood. The circumstances that precipitated the single known outbreak of this disease in pigs is unclear particularly in light of the high seroprevalence of the virus in three pteropid flying-foxes in eastern and northern Australia (Philbey et al. 2008). Pigs and flying-foxes would have had opportunity for contact in the Sydney region, and elsewhere, since around European colonisation. Factors relating to virus ecology in the increasingly urban flying-fox population or in the intensive piggery population structure are likely to be important.

Human health implications

Menangle virus causes flu-like disease in humans. The two known human cases of Menangle had no known exposure to bats but high-level exposure to infected pigs.
Conclusions

Despite the single, self-limiting outbreak of this disease in pigs, Menangle virus remains a disease of concern to the domestic and export pig industry in Australia. Whilst it would appear that the risk of infection from bats to pigs is very low, once infected it appears that pigs are efficient and susceptible amplification hosts capable of infecting other pigs and humans. There has been no public discussion regarding the zoning of piggeries with regards to flying-fox camps and foraging areas, but this may become a consideration in the future. At present key areas of overlap of commercial piggeries and flying-foxes are from Sydney to the NSW central coast, and SE Qld.

References and other information


Further information

For further information on Menangle virus see the CFSPH Fact sheet Menangle Virus Infection (November 2007) [www.csfph.iastate.edu/Factsheets/pdfs/menangle.pdf](http://www.csfph.iastate.edu/Factsheets/pdfs/menangle.pdf).


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To provide feedback on this fact sheet

We encourage those with laboratory confirmed cases of this condition in native Australian animals to submit this information to the national system for consideration for inclusion in the national database. 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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