

EXOTIC

Australian seals and influenza viruses

Fact sheet

Introductory statement

Influenza viruses can cause disease in a wide variety of avian and mammalian hosts and are recognized as significant human pathogens. Influenza A viruses have caused significant mortality events in seals in the northern hemisphere (Callan et al. 1995). The effective conservation management of Australian seals depends on a sound knowledge of potential population regulatory factors such as infectious disease. Assessment of the risk and consequence of pathogen introduction to Australian seals will enable infectious disease threats to be incorporated into their larger management plan.

Aetiology

Influenza viruses belong to the family *Orthomyxoviridae* and are classified into three types: A, B and C. Influenza A viruses are further characterised according to the antigenic properties of their surface glycoproteins, haemagglutinin (H) and neuraminidase (N) (Webster et al. 1992). Influenza A viruses isolated from seals includes subtypes H7N7, H4N5, H3N3 and H4N6 (Geraci et al. 1982; Hinshaw et al. 1984; Callan et al. 1995). To date there is no evidence of infection in marine mammals with highly pathogenic avian influenza (HPAI).

Natural hosts

The natural hosts of influenza A viruses are wild, aquatic birds and in these species the viruses they carry usually do not cause clinical disease. However, virus originating in these natural hosts can infect a wide range of domestic and wild avian and mammalian species and produce disease (Webster et al. 1992). The natural host of influenza B viruses are humans but in 2000, an influenza B virus was isolated from two European harbour seals (*Phoca vitulina*) with respiratory disease (Osterhaus et al. 2000). In 2009, serological evidence of exposure to influenza B viruses was found in South American fur seals (*Arctocephalus australis*) in Uruguayan waters (Blanc et al. 2009).

World distribution

Influenza viruses have a world-wide distribution. In seals, isolation of influenza viruses or serologic evidence of their presence has been reported from North and South America, Japan, Canadian Arctic waters and the Caspian Sea (Callan et al. 1995; Nielsen et al. 2001; Ohishi et al. 2002; Fujii et al. 2007; Blanc et al. 2009).

Occurrences in Australia

There have been no reports of disease caused by influenza viruses in Australian seals. A serologic survey of Australian fur seals (*Arctocephalus pusillus doriferus*) in northern Bass Strait found no evidence of exposure to influenza A viruses (Lynch et al. 2011).

Epidemiology

The pathogenicity of influenza viruses varies between subtypes and strains and between host species. In seals, some influenza types have been associated with significant epidemics causing mortality of up to 20% of the in-contact population (Geraci et al. 1982; Hinshaw et al. 1984; Callan et al. 1995). However, it could be presumed that infection with influenza A or B viruses may also produce no disease or mild morbidity. For example, respiratory disease in two harbour seals infected with an influenza B virus was of a moderate nature and some doubt existed as to whether the virus was the actual cause of the animals' clinical signs (Osterhaus et al. 2000).

Avian species represent a major reservoir for influenza A viruses with the potential to infect seals. There is often close association between aquatic birds and seals at resting and breeding sites providing opportunities for virus transmission. The route of transmission from birds to seals is unknown but may be by both the faecal-oral and aerosol routes. In aquatic birds, influenza A viruses replicate in the gut and the faecal-oral route is thought to be the predominant means of transmission (Webster et al. 1978). Aerosol transmission is also possible in birds and is the predominant route for virus transmission during epidemics in mammalian species (Belser et al. 2010). There is evidence that some influenza viruses found in seal populations originated from humans (Ohishi et al. 2002) and presumably were transmitted to seals by aerosol. The incubation period of influenza viruses in seals is largely unknown but would be expected to vary with virus strain and subtype and the host species. In one outbreak it was estimated that the incubation period was in the order of three days or less (Geraci et al. 1982).

Clinical signs

Seals infected with pathogenic influenza A viruses present with signs of severe, acute pneumonia. Therefore animals in well nourished condition may be observed to be weak in their movements, lack coordination and be exhibiting respiratory distress (Geraci et al. 1982). Frothy white or bloody discharge may be observed at the mouth or nares. Subcutaneous emphysema, particularly of the cervical region is another commonly observed clinical sign. This results from air escaping from damaged lung tissue, through the thoracic inlet and into the subcutaneous tissues of the neck and back (Callan et al. 1995).

Diagnosis

Serologic evidence of exposure to influenza viruses can be provided by application of enzyme-linked immunosorbent assays (Ohishi et al. 2002). Definitive diagnosis of the presence of virus in tissues or swabs requires PCR and/or virus isolation.

Pathology

Seals infected with pathogenic influenza A viruses displayed histologic lesions of severe pneumonia characterised by necrotising bronchitis and bronchiolitis and haemorrhagic alveolitis (Geraci et al. 1982). Subcutaneous emphysema of the tissues of the neck and back were also observed.

Differential diagnoses

Infection with seal morbilliviruses can produce significant mortality events. Affected animals may demonstrate respiratory and CNS abnormalities and subcutaneous emphysema (Di Guardo et al. 2005). Coinfection with *Mycoplasma* sp may exacerbate the severity of disease produced by influenza viruses in seals (Geraci et al. 1982). Some mycoplasmas may also act as primary pathogens and severe pneumonia has been observed in Californian sea lions (*Zalophus californianus*) infected with *M. zhalophi*. Other bacteria capable of causing disease of the respiratory tract in seals include *Mycobacterium pinnipedii* (Cousins et al. 2003), *Klebsiella pneumoniae* (Castinel et al. 2007) and *Nocardia* sp. (Leger et al. 2009).

Laboratory diagnostic specimens

- Blood for serologic investigation
- Pharyngeal swabs from live animals for PCR and/or virus isolation
- Formalised tissues from dead animals including lung, brain, spleen, liver, kidney and lymph nodes
- Fresh tissues stored frozen at -70°C

Laboratory procedures

- ELISA as screening serologic test.
- Haemagglutination inhibition assay using reference influenza viruses as antigens
- PCR
- Virus isolation

Treatment

There is no specific treatment for seals suffering from influenza infection. Animals suspected of suffering from severe influenza should be euthanatized and thoroughly investigated.

Prevention and control

The control of the introduction of influenza A virus from wild birds to seals is not possible. Seals diagnosed with influenza virus infection should be regarded as potentially infectious to humans (see below) and other mammals. Control of the public health risk centres around appropriate personal protection equipment for groups likely to be exposed to respiratory tract secretions from diseased animals.

Influenza viruses can survive for some hours outside the host in favourable environmental conditions (Bean et al. 1982). Therefore, infection via fomites should be considered when working with seals suspected as being

infected with influenza. In addition, people with flu-like symptoms should be aware of the possibility of transmission of influenza virus from humans to seals.

Influenza viruses are sensitive to most antiseptics and washing of hands with chlorhexidine gluconate and chemical sterilisation of equipment should be practiced as a minimum standard after handling free-ranging marine mammals.

Surveillance and management

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.

Increased surveillance of Australian seals for influenza viruses may be warranted if HPAI was detected in wild birds within the foraging, pupping or haul-out ranges of Australia seals. There is a national surveillance program for avian influenza viruses in wild birds in Australia.

Statistics

There are no cases of influenza-associated disease in seals listed on the National Wildlife Health Information System.

Research

- They key research question is whether Australian seals have influenza viruses circulating within their populations or have had exposure to these potential pathogens. While one limited serological survey has been conducted in Australian fur seals, one of the authors recommended that this research activity should be extended to seal populations throughout Australia (Lynch pers comm.).
- Investigation of unusual mortality events in seals and exclusion of influenza virus infection in seals suffering from respiratory disease would be worthwhile.

Human health implications

There is no evidence of influenza viruses from seals causing severe disease in humans. However, an H7N7 subtype isolated from Harbour seals showed potential to cause conjunctivitis in humans but did not spread from person to person (Webster et al. 1981). Although disease was mild and infected people did not develop serum antibodies this instance highlights the potential of influenza viruses to cross between mammalian species. Therefore, at risk groups should be aware of disease issues associated with handling seals suffering from respiratory illness. These groups include staff working in facilities holding captive marine mammals particularly those that accept wild individuals for treatment and rehabilitation. Other groups potentially at risk are research scientists, wildlife officers and members of the public and wildlife carer groups who assist at marine mammal strandings. Appropriate personal protection (gloves, protective clothing and mask) should be employed when conducting post mortem examinations on pinnipeds.

Conclusions

Influenza viruses have a world- wide distribution can cause disease in a wide variety of avian and mammalian hosts. Influenza viruses have caused mortality events in seals in the northern hemisphere and therefore Australian seal species are potentially at risk from this pathogen. Knowledge of whether Australian seals have been exposed to influenza viruses capable of infecting them is incomplete. Influenza viruses should always be regarded as potential zoonoses so appropriate protective measures should be taken when handling seals exhibiting respiratory disease.

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