Small Animal *Review*

Summary: Canine influenza virus (CIV) H3N2 is a highly transmissible virus with the potential to cause significant respiratory disease in dogs, and occasionally death. Sources of the virus are predominantly rescue dogs imported from endemic regions e.g. Asia. Outbreaks have major economic implications for kennels and veterinary practices.

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Canine influenza virus

Canine influenza virus (CIV) developed from other influenza A viruses as a result of adaptation, then spread within naive dog populations causing respiratory disease. Initially the H3N8 strain of equine origin appeared followed by a the H3N2 that originated in Asia from avian influenza virus. It was imported into the USA via infected dogs, where it was associated with respiratory disease and sporadic deaths.

A report from Weese et al describes the consequence of the virus's introduction into Canada (Emergence and Containment of Canine Influenza Virus A(H3N2), Ontario, Canada, 2017–2018. Emerg Inf Dis.2009;25:1810–1816. https://doi.org/10.3201/eid2510.190196). Influenza virus (CIV) A(H3N2) was found in 104 dogs in Ontario, between December 2017 and October 2018, in four primary epidemiological clusters.

Outbreak one involved two dogs imported from South Korea at the end of December, both of which presented with pyrexia, productive cough, and purulent nasal discharge on arrival, and from which CIV H3N2 was identified. They were sent to separate foster homes, following which all six canine contacts in those premises were infected within 1 week. Following a 28-day isolation period no further cases were identified. In outbreak two, a dog that belonged to a veterinary clinic employee developed upper respiratory illness. The owner had handled a dog that died with severe infectious respiratory tract disease a few days earlier. Two other canine contacts subsequently developed respiratory disease confirmed as CIV H3N2. The index case dog also had contact with a group of other dogs; of these, one was infected and developed mild respiratory disease. A 28-day confinement order was issued for the affected dogs.

Outbreak Cluster 3a related to a high-morbidity respiratory disease outbreak in a boarding kennel, affecting 14 dogs. Tracing of infected dogs identified a rescue facility (rescue A) that had recently imported dogs from China as the source. A dog from rescue A had been fostered by the owner of three dogs that went to the affected boarding kennel. They developed upper respiratory tract disease 4 days after contact with the imported dog. A separate dog walked by rescue A became infected, transmitting infection to a household canine contact, which then transmitted the virus to two further dogs at a grooming centre, one of which died because of the severity of the disease Eight other cases linked to the rescue facility were identified. A linked case was identified in a city about 300 km, away in a dog imported from China in the same shipment that went to rescue A where respiratory disease subsequently developed in an unknown number of contacts. At rescue A respiratory tract disease was reported in 42/64 (66%) dogs over February/March with one death reported. As in other outbreaks a 28-day isolation period was recommended and the affected boarding kennel and grooming facility closed until all dogs tested negative and the facilities had been cleaned and disinfected. A secondary cluster (3b) was identified about 250 km away and was linked to the importation of infected dogs from China. In this outbreak, infection spread from a rescue kennel through a veterinary premises to a dog day care centre where many dogs were affected.

In outbreak 4, two infected dogs that had contact with rescue A were identified. The kennel had imported another group of dogs from China 3 weeks earlier and seven cases were confirmed, along with five additional in-contact dogs.

Overall, 104 infected dogs were identified between 28 December 2017 and 30 October 2018. Morbidity rates were high and dogs typically presented with nasal discharge, sneezing, and coughing. Death due to CIV infection was reported in 2/104 diagnosed cases, both of which were older dogs with underlying diseases. Canine influenza virus was suspected as the cause of one further death, but this was not confirmed. No human illnesses were reported from the human contacts. Molecular techniques demonstrated that isolates from outbreaks 1 and 2 were caused by identical viruses, and that all isolates from outbreak 3a were identical; outbreak 3a isolates were 99.7% identical to the virus involved with outbreaks 1 and 2. Five samples from cluster 3b were identical and were 99.5% identical to clusters 1 and 2, while three samples from cluster 3b were identical to those from cluster 3a.

These outbreaks demonstrate the risks of importing dogs from rescue centres in Asia and emphasises the importance of quarantining such animals. The virus would spread rapidly in a naive population such as the UK, where vaccination against CIV is not carried out. Unfortunately the clinical signs, of CIV infection are non-specific but if any link to an imported dog or group of dogs (e.g. a rescue kennel) can be identified, then infection with this virus should be considered. Suspect cases should be home-confined for 28 days. The clinical signs vary from mild to severe and the 2% mortality rate in the Canadian outbreak is similar to that seen in the USA; death is more common in dogs with underlying health issues. It is recognised that influenza virus can readily mutate to more virulent forms. The authors report that in the ongoing CIV H3N2 outbreak in the USA no human cases have been identified, but it is known that pandemic influenza A H1N1 can infect dogs, raising concerns about re-assortment of genes between H1N1 and H3N2 potentially leading to a strain virulent to humans.

This Canadian experience shows that eradication of the virus is achievable from a naive population if confirmed early. CA