Canine Influenza Virus Backgrounder

(September 7, 2009)

Causative agent

Canine influenza virus (CIV) is caused by a highly contagious infection caused by a novel influenza A subtype H3N8 virus first discovered in 2004. The canine influenza virus has been classified as H3N8, based on the amino acid composition of the hemaglutinin (H) and neuraminidase (N) glycoproteins in the lipid outer layer of the capsid. These glycoproteins facilitate entry into and release from host cells, and are important targets for antibodies against the virus (generated as a result of infection or response to vaccination). The viruses are 80-120 nanometers (nm) in diameter, and consist of a core of eight separate pieces of single-strand ribonucleic acid (RNA) surrounded by a spiked arrangement of glycoproteins.

CIV represents a very rare event in adaptive evolution; the entire genome of the H3N8 equine influenza virus was transferred to dogs, and the virus adapted to the canine species to emerge as a new canine-specific virus.[1] Although the virus spreads readily from dog to dog, there is no evidence to support that it can be transmitted from dogs to humans.

Natural distribution

The first recognized outbreak of canine influenza is believed to have occurred in racing greyhounds in January 2004 at a track in Florida. From June to August of 2004, outbreaks of respiratory disease were reported at 14 tracks in 6 states (Florida, Texas, Alabama, Arkansas, West Virginia, and Kansas). Between January and May of 2005, outbreaks occurred at 20 tracks in 11 states (Florida, Texas, Arkansas, Arizona, West Virginia, Kansas, Iowa, Colorado, Rhode Island, and Massachusetts). Since then, canine influenza has been documented in 30 states and Washington, DC. At this time, CIV is endemic (very prevalent) in areas of in Colorado, Florida, New York, and Pennsylvania.[2] As of October 2, 2008, 1,079 cases of canine influenza were confirmed by the Cornell University College of Veterinary Medicine Animal Health Diagnostic Center.[3]

Transmission

Canine influenza is spread via aerosolized respiratory secretions and contaminated objects (kennel surfaces, food and water bowls, collars and leashes) and people moving between infected and uninfected dogs. The virus can remain viable (alive and able to infect) on surfaces for up to 48 hours, on clothing for 24 hours, and on hands for 12 hours.[4]

The incubation period is usually two to four days from exposure to onset of clinical signs. The highest amounts of viral shedding occur during this time; therefore, dogs are most contagious during this 2-4 day incubation period when they are not exhibiting signs of illness.[4] Virus shedding decreases dramatically during the first 4 days of illness but may continue up to 7 days in most dogs and up to 10 days in some dogs.[4]

Because this is a newly emerging pathogen, all dogs, regardless of breed or age, are susceptible to infection and have no naturally acquired or vaccine-induced immunity when first exposed to the virus. If the virus enters a kennel or other closed group, a high percentage of the dogs may become infected, and most of these dogs will be symptomatic.[2] Approximately 20-25% of infected dogs are expected to remain asymptomatic, but can still shed the virus and spread the virus. Although most dogs have a milder form of canine influenza and recover without complications, some may develop severe pneumonia.[1]

Pathology and Clinical Signs

The canine influenza virus infects and replicates inside the cells of the respiratory tract, from the nasal lining to the terminal airways. The inflammatory response results in rhinitis, tracheitits, bronchitis and bronchiolitis. The pathologic process also involves the death of the epithelial cells lining the respiratory tract, resulting in exposure of the underlying basement membrane. This, in turn, predisposes the respiratory tract to secondary bacterial infections that contribute to the nasal discharge and coughing.[4]

Virtually all dogs that are exposed become infected with the virus, but approximately 80% develop clinical signs of disease. The approximately 20% of infected dogs that do not exhibit clinical signs of disease can still shed the virus and can spread the infection.[5]

Like other mammalian influenza viruses, CIV causes an acute respiratory infection in dogs. However, unlike human influenza, CIV is not a "seasonal" flu – infections can occur year-round.[2,4] Canine influenza virus causes clinical disease that mimics kennel cough. As a result, infection with the virus is frequently mistaken for infections caused by *Bordetella bronchiseptica*/parainfluenza virus complex. Clinical disease may be mild or severe.[6]

The majority of infected dogs exhibit the mild form of CI. In the mild form, the most common clinical sign is a cough that persists for 10 to 21 days despite treatment with antibiotics and cough suppressants. Most dogs have a soft, moist cough, whereas others have a dry cough that is similar to that induced by *Bordetella bronchiseptica*/parainfluenza virus infection. Many dogs have a purulent nasal discharge and a low-grade fever. The nasal discharge is usually caused by secondary bacterial infections, including *Pasteurella multocida* and mycoplasma species.[7]

Some dogs are more severely affected with clinical signs of pneumonia, such as a high-grade fever (104°F to 106°F) and increased respiratory rate and effort. Thoracic radiography (chest x-rays) may reveal consolidation of lung lobes.[1]

Diagnosis

Canine influenza cannot be diagnosed solely by clinical signs because the clinical signs (coughing, sneezing and nasal discharge) are similar to those associated with all of the other respiratory pathogens and cannot be differentiated from them.[4].

Antibodies to canine influenza virus may be detected in the blood as early as seven days after onset of clinical signs, and the virus may be identified in nasal or pharyngeal swabs during the first 4 days of illness. The most reliable and sensitive method for confirmation of infection is serologic testing. Paired acute serum samples (taken within the first 7 days of illness) and convalescent serum samples (taken 10-14 days later) are necessary for diagnosis of recent infection. If an acute sample is not available, a convalescent sample will indicate whether a dog has been exposed to the virus at some point in the past.

A diagnosis of CI is made based on a four-fold increase in antibody titer from the acute to the convalescent sample.[7]

If a dog has been ill for less than 4 days, nasal and pharyngeal swab submission for Polymerase Chain Reaction (PCR) testing can be performed. If the PCR indicates a positive result, the dog is most likely infected. Negative PCR results may be falsely negative if the swabs are not collected during the time of peak virus shedding. After 4 days of illness, PCR results are less likely to be reliable.[4,8] Serology should be performed to confirm infection, especially if the PCR results are negative and the case is highly suspicious for CI infection.[4]

Other diagnostic options applicable to dogs that have died from pneumonia are viral culture and PCR analysis using fresh (not formalin-preserved or frozen) lung and tracheal tissues. Virus detection in respiratory secretion specimens from acutely ill animals by use of viral culture, PCR analysis, or rapid chromatographic immunoassay is possible, but usually unrewarding. The Cornell Animal Health Diagnostic Center is currently accepting samples for analysis.

Treatment

As for all viral diseases, treatment is largely supportive. Good husbandry and nutrition may assist dogs in mounting an effective immune response. In the milder form of the disease, a thick green nasal discharge most likely represents a secondary bacterial infection that usually resolves quickly after treatment with a broad-spectrum bactericidal antimicrobial. Pneumonia in more severely affected dogs responds best to a combination of broad-spectrum bactericidal antimicrobials (to combat secondary bacterial infections) and maintenance of hydration via intravenous administration of fluids. Most dogs recover from canine influenza within 2-3 weeks.[4]

Currently available antiviral drugs are approved for use in humans only and little is known about their use, efficacy and safety in dogs. Veterinarians who use approved drugs in a manner that is not in accord with approved label directions (e.g., use of an antiviral drug only approved for use in humans) must follow the federal extralabel drug use regulations of the Animal Medicinal Drug Use Clarification Act (AMDUCA).

Morbidity and Mortality

The morbidity rate (the number of exposed animals that develop disease) associated with canine influenza is estimated at 80%. Deaths occur mainly in dogs with the severe form of disease; the mortality rate is thought to be 1-5% or slightly higher. Higher case fatality rates have been reported in small groups of greyhounds that developed hemorrhagic pneumonia during outbreaks.[5]

Prevention and Control

In veterinary, boarding and shelter facilities, the canine influenza virus appears to be easily killed by disinfectants commonly used in these facilities, such as quaternary ammonium compounds (eg, benzalkonium chloride) and bleach solutions.[4] Protocols should be established for thoroughly cleaning and disinfecting cages, bowls and other surfaces between uses. The virus may persist in the environment for approximately 2 days, and be viable on hands and clothing for up to 24 hours

Employees should wash their hands with soap and water:

- before and after handling each dog
- after coming into contact with dogs' saliva, urine, feces, or blood
- after cleaning cages
- upon arriving at and before leaving the facility.

Isolation protocols should be rigorously applied for dogs showing clinical signs of respiratory disease. Sick or exposed dogs should be isolated for two weeks. Clothing, equipment, surfaces and hands should be cleaned and disinfected after exposure to dogs showing signs of respiratory disease.[2] Dog owners whose dogs are coughing or exhibiting other signs of respiratory disease should not participate in activities or bring their dogs to facilities where other dogs can be exposed to the virus.[7]

In May 2009, the USDA approved the licensure of the first influenza vaccine for dogs developed by Intervet/Schering Plough Animal Health Corporation. The canine influenza vaccine contains inactivated whole virus.[8,9]

The vaccine is intended as an aid in the control of disease associated with CI virus infection. Although the vaccine may not prevent infection altogether, efficacy trials have shown that the vaccination may significantly reduce the severity and duration of clinical illness, including the incidence and severity of damage to the lungs.[4] In addition, the vaccine reduces the amount of virus shed and shortens the shedding interval; therefore, vaccinated dogs that become infected develop less severe illness and are less likely to spread the virus to other dogs.[9] These benefits are similar to those provided by influenza vaccines used in other species, including humans.

The canine influenza vaccine is a "lifestyle" vaccine, and is not recommended for every dog.[4] In general, the vaccine is intended for the protection of dogs at risk for exposure to the CI virus, which include those that either participate in activities with many other dogs or are housed in communal facilities, particularly where the virus is prevalent. Dogs that may benefit from canine influenza vaccination include those that receive the kennel cough (*Bordetella*/parainfluenza) vaccine, because the risk groups are similar.[5] Dog owners should consult with their veterinarian to determine whether their dog's lifestyle includes risks for exposure to the CI virus, and if the vaccine is appropriate for their dog.[6, 9]

We would like to thank Dr. Cynda Crawford from the University of Florida College of Veterinary Medicine for her contributions to the AVMA's canine influenza resources.

Links to more information about canine influenza

Control of Canine Influenza in Dogs: Questions, Answers and Interim Guidelines (AVMA)

Canine Influenza: Podcast by Dr. Cynda Crawford (AVMA)

Key Facts about Canine Influenza (Centers for Disease Control and Prevention)

Canine Influenza: Frequently Asked Questions by Dog Owners (University of Florida College of Veterinary Medicine)

Canine Influenza Fact Sheet (Iowa State University)

Canine Influenza (University of California-Davis Shelter Medicine Program)

Canine Influenza Virus: Detection, Sampling and Statistics (Cornell University Veterinary Diagnostic Laboratory)

References:

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2. Crawford C. Canine influenza: Frequently asked questions from dog owners. *University of Florida*; 2009. Available at:

http://www.vetmed.ufl.edu/college/pr/documents/CanineinfluenzaFAQDogowners_001.pdf . Accessed on August 19, 2009.
3. Cornell University: College of Veterinary Medicine. Emerging issues - Canine influenza: Test summary for canine influenza virus in dogs not affiliated with greyhound racetracks *Animal Health Diagnostic Center*. Available at: http://www.diaglab.vet.cornell.edu/issues/civ-stat.asp. Accessed on August 19, 2009.
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5. Iowa State University. Canine Influenza 2009. Available at: www.cfsph.iastate.edu/Factsheets/pdfs/canine_influenza.pdf. Accessed on August 19, 2009.
6. Control of canine influenza: Questions, answers, and interim guidelines. *American Veterinary Medical Association*; 2005. Available at: http://www.avma.org/public_health/influenza/canine_guidelines.asp. Accessed on August 19, 2009.
7. Cornell University: College of Veterinary Medicine. Emerging issues - Canine influenza virus. *Animal Health Diagnostic Center*; 2006.Available at: http://www.diaglab.vet.cornell.edu/issues/civ.asp . Accessed on August 19, 2009.
8. United States Department of Agriculture. Animal and Plant Inspection Service. *Veterinary Services: Center for Veterinary Biologics*. Center for Veterinary Biologics Notice No. 09-13. Issuance of Licenses. 2009. Available at: http://www.aphis.usda.gov/animal_health/vet_biologics/publications/notice_09_13.pdf. Accessed on August 19, 2009.
9. Cole, L. McNally, A. APHIS issues conditional license for canine influenza virus vaccine. *United States Department of Agriculture. Animal and Plant Inspection Service*; 2009. Available at: http://www.aphis.usda.gov/newsroom/content/2009/06/caninevacc.shtml. Accessed on August 19, 2009.

Connecticut Reportable Diseases

Multiple species diseases

- Anthrax
- Aujeszky's disease (Pseudorabies)
- Bluetongue
- Botulism
- Brucellosis (*B. abortus, B. canis, B. melitensis, B. ovis, B. suis*)
- Crimean Congo haemorrhagic fever
- Echinococcosis/Hydatidosis
- Foot and mouth disease
- Heartwater (*Cowdria ruminantium)*
- Japanese encephalitis
- Leptospirosis
- New world screwworm (*Cochliomyia hominivorax*)
- Old world screwworm (*Chrysomya bezziana*)
- Paratuberculosis (Johne's disease)
- Plague
- Q fever (Coxiella burnetti)
- Rabies
- Rift Valley fever
- Rinderpest
- Salmonellosis
- Scabies
- Trichinellosis (Trichinela spiralis)
- Tuberculosis
- Tularemia (Francisella tularensis)
- Vesicular stomatitis
- West Nile fever/encephalitis

Sheep and goat diseases

- Caprine arthritis/encephalitis
- Contagious agalactia
- Contagious caprine pleuropneumonia
- Enzootic abortion of ewes (ovine chlamydiosis)
- Maedi-visna
- Nairobi sheep disease
- Ovine epididymitis (*Brucella ovis*)
- Peste des petits ruminants
- Salmonellosis (S. abortusovis)
- Scrapie
- Sheep pox and goat pox

Swine diseases

- African swine fever
- Classical swine fever (Hog cholera)
- Nipah virus encephalitis
- Porcine cysticercosis
- Porcine reproductive and respiratory syndrome (PRRS)
- Swine vesicular disease
- Transmissible gastroenteritis

Cattle diseases

- Bovine anaplasmosis
- Bovine babesiosis
- Bovine genital campylobacteriosis
- Bovine spongiform encephalopathy
- Bovine tuberculosis
- Bovine viral diarrhoea
- Contagious bovine pleuropneumonia
- Enzootic bovine leukosis
- Haemorrhagic septicaemia (*P. multocida)* serotypes B/Asian or E/African
- Infectious bovine rhinotracheitis/infectious pustular vulvovaginitis
- Lumpy skin disease
- Malignant catarrhal fever
- Theileriosis (East Coast Fever)
- Trichomonosis
- Trypanosomosis (tsetse-transmitted)

Equine diseases

- African horse sickness
- Contagious equine metritis
- Dourine (*Trypanosoma equiperdum*)
- Equine encephalomyelitis (Eastern)
- Equine encephalomyelitis (Western)
- Equine infectious anaemia
- Equine influenza (Virus Type A)
- Equine piroplasmosis
- Equine rhinopneumonitis (EVH-1 & EVH-4)
- Equine viral arteritis
- Glanders (*Pseudomonas mallei*)
- Surra (*Trypanosoma evansi*)
- Venezuelan equine encephalomyelitis

Lagomorph diseases

- Myxomatosis
- Rabbit haemorrhagic disease

Bee diseases

- Acarapisosis of honey bees
- American foulbrood of honey bees
- European foulbrood of honey bees
- Small hive beetle infestation (*Aethina tumida*)
- *Tropilaelaps* infestation of honey bees
- Varroosis of honey bees

Fish diseases

- Epizootic haematopoietic necrosis
- Epizootic ulcerative syndrome
- Gyrodactylosis (*Gyrodactylus salaris*)
- Infectious haematopoietic necrosis
- Infectious salmon anaemia
- Koi herpesvirus disease
- Red sea bream iridoviral disease
- Spring viraemia of carp
- Viral haemorrhagic septicaemia

Crustacean diseases

- Crayfish plague (*Aphanomyces astaci*)
- Infectious hypodermal and haematopoietic necrosis
- Infectious myonecrosis
- Spherical baculovirosis (*Penaeus monodon*-type baculovirus
- Taura syndrome
- Tetrahedral baculovirosis (*Baculovirus penaei*))
- White spot disease
- Yellowhead disease

Mollusc diseases

- Abalone viral mortality
- Infection with *Bonamia exitiosa*
- Infection with *Bonamia ostreae*
- Infection with *Marteilia refringens*
- Infection with *Mikrocytos roughleyi*
- Infection with *Perkinsus marinus*
- Infection with *Perkinsus olseni*
- Infection with *Xenohaliotis californiensis*

Avian diseases

- Avian chlamydiosis (Psittacosis)
- Avian infectious bronchitis
- Avian infectious laryngotracheitis
- Avian mycoplasmosis (*M. gallisepticum*) (*M. synoviae*)
- Duck virus hepatitis
- Fowl cholera (*Pasteurella multocida*)
- Fowl typhoid (*Salmonella gallinarum*)
- Highly pathogenic avian influenza (Fowl plague)
- Low pathogenic avian influenza in poultry as per Chapter 2.7.12. of the *Terrestrial Animal Health Code*
- Infectious bursal disease (Gumboro disease)
- Marek's disease
- Newcastle disease (Exotic)
- Pullorum disease (*Salmonella pullorum*)
- Turkey rhinotracheitis

Other diseases

- Camelpox
- Canine influenza
- Chronic wasting disease
- Leishmaniosis
- Viral hemorrhagic fevers

STATE OF CONNECTICUT
DEPARTMENT OF AGRICULTURE
165 Capitol Avenue • Hartford, CT 06106

Disease: _____

Date:_____

REPORTABLE DISEASE RECORD

Reported by: Veterinarian Owner Other: _____

Veterinarian:

Name: _____

Address: _____

_____

Phone: _____

FAX: _____

Hours: _____

Owner:

Name: _____

Address: _____

_____

Phone: _____

FAX: _____

Hours: _____

Animal or **Bird**

Species: _____

Breed: _____

Description: _____

Name and/or ID: _____

Age or Birth Date: _____

Sex: __ Male __Female __Unknown

Vaccinations: _____

No. in Group: _____

Type of Housing: _____

Address Where Housed: _____

_____

Travel History: __Yes __No

When? _____

Where? _____

Veterinarian:

Date of 1st visit: _____

Clinical Signs on Presentation:

_____

_____

_____

_____

Owner:

Date of Onset: _____

Clinical Signs or Major Complaint:

_____

_____

_____

_____

Treatment:

_____

Outcome: Survived_____ Died (date): _____Euthanized (date): _____Necropsy (date): _____

Date Samples Collected: _____Type of Samples: Blood Serum CSF Brain Other: _____

Tests Requested: _____ Lab Used: _____

Results: _____

Attach Copies of Lab Results, Necropsy Report and other documents to record.

Contacts: Veterinarian Owner State DPH Local Health Other: _____

Date: