

Canine and Feline Parvovirus in Animal Shelters

Overview

Feline panleukopenia and canine parvovirus are highly contagious viral diseases that commonly cause serious illness in cats and dogs in animal shelters. Every shelter is at high risk for exposure to feline and canine parvoviruses and most have been affected by outbreaks of feline panleukopenia or canine parvovirus. These outbreaks are very costly with regard to animal suffering and death, resource allocation to management and eradication, staff morale, and negative public image.

This document provides a basic overview of: 1) the properties of feline panleukopenia virus and canine parvovirus, including the new canine parvovirus 2c strain; 2) incubation times, clinical disease, duration of virus shedding, and modes of transmission; 3) diagnosis; and 4) strategies for management and prevention in shelters.

Virology 101

Feline panleukopenia is caused by infection with feline parvovirus (FPV). This virus has caused massive die-offs of cats around the world since the 1800's. In addition to the commonly used term panleukopenia, FPV has also been referred to as "cat distemper" or "cat plague". Today, there are several strains of FPV circulating in cat populations worldwide, but all are closely related genetically.

Canine parvovirus (CPV-2) emerged in 1978, presumably originating from FPV through a small number of mutations that allowed the cat virus to replicate in dogs. By the mid-1980's, the original CPV-2 strain was replaced by 2 new genetic variants, CPV-2a and CPV-2b, both of which continue to circulate in dogs today. At this time, CPV-2b is the predominant strain that infects dogs in the U.S. today. The CPV-2a and CPV-2b variants differ by one amino acid at position 426 in the major antigenic capsid protein VP2. Both variants can infect cats, causing "panleukopenia-like" disease.

In 2000, another genetic variant, designated as CPV-2c, was identified in Italy. This variant differs from CPV-2a and CPV-2b by another single amino acid change in position 426 of the VP2 protein. Therefore, each of the 3 variants contains a different amino acid at this position in the VP2 protein. However, they are still 99% related genetically. CPV-2c appears to be widespread in Europe, and has been detected in dogs in Asia, South America, and most recently in the U.S. Two studies independently reported in 2007 the identification of CPV-2c in fecal samples from dogs with parvo-like disease.^{1,2} The coast-to-coast geographic distribution suggests that the new CPV-2c strain is probably widespread in the U.S.

Recent vaccine trials have demonstrated that currently available commercial CPV vaccines do provide protective immunity in dogs challenged with CPV-2c.³⁻⁵ Collectively, these vaccine trials demonstrate that current commercial vaccines containing CPV-2 or CPV-2b provide protective immunity against CPV-2c, even when dogs were vaccinated 3 or more years prior to challenge.

Populations at risk

Kittens and puppies are the most susceptible to parvoviral infection due to lack of protective immunity from maternally derived antibodies or from ineffective responses to vaccination. They typically enter shelters at an age when maternal immunity has waned to a level that does not protect against infection, but still interferes with responses to vaccination. Unvaccinated adult cats and dogs are also at risk for infection, but the clinical disease may be inapparent or mild. Older cats and dogs that have spent time outdoors eventually develop immunity by natural exposure to virus in the environment. Panleukopenia outbreaks commonly occur in the summer and fall (“kitten season”) when large numbers of kittens are admitted to shelters. Since dogs are not seasonal breeders like cats, there is no apparent seasonal pattern to parvovirus outbreaks in dogs.

Clinical features

The primary route of exposure to parvoviruses is nasal or oral contamination with virus-containing feces or contaminated surfaces. The incubation period from time of exposure to onset of clinical disease ranges from 2 to 14 days, but typically is 5 to 7 days. Because the disease may be difficult for the shelter to detect during the incubation period, apparently healthy but infected animals may be adopted out only to become ill a few days later in their new home.

Both FPV and CPV infect rapidly dividing cells in the intestinal tract, lymphoid tissues, and bone marrow. Resulting clinical signs include a sudden onset of fever, vomiting, diarrhea, dehydration, hypovolemic shock, panleukopenia, and death from shock or sepsis. The clinical signs can be worsened by concurrent infections with internal parasites and protozoa (coccidia), other viruses, bacteria, and STRESS induced by the shelter environment. The mortality rate can approach 90% in kittens and puppies that are not treated aggressively with supportive therapies. Parvovirus can have a higher mortality rate in shelter puppies and kittens despite early or aggressive therapy because of concurrent debilitation, parasitism and stress. Adult cats and dogs may have subclinical infection or mild transient diarrhea.

The most common cause of sudden death in kittens and cats in shelters is FPV! Both age groups can progress in hours to a moribund state without having any gastrointestinal signs.

Parvovirus shedding in feces starts within 4 days of exposure, so that infected dogs and cats in the incubation period are already contagious prior to onset of clinical signs. Virus shedding can continue for 14 days, even after recovery from clinical disease. Animals with subclinical infection or transient symptoms also shed infectious virus in feces.

Transmission of parvoviruses occurs by direct contact with an infected animal or feces, by contact with contaminated fomites, and even by contaminated rodents and insects! The infected animal is covered with virus from head to toes, including the fur. Cats and dogs that recover from parvo should be bathed before allowed contact with other animals.

Diagnosis

Not all cases of vomiting or diarrhea in juveniles and adults are due to CPV or FPV, especially in animals that are debilitated, parasitized, co-infected with other pathogens, and stressed from entering the shelter environment. Therefore, parvovirus infection cannot be diagnosed based on the age of the dog or cat and the clinical signs. Since other diseases mimic parvo and panleuk, diagnostic testing should be performed on all dogs and cats with compatible clinical signs instead of making a decision on a guess, especially if animals suspected of having parvo or panleuk are euthanized.

The point of care test kits (IDEXX, AGEN, Synbiotics) for detection of parvovirus antigens in feces are a rapid and cost-effective diagnostic tool for dogs and cats in shelters. All animals with compatible clinical signs should be immediately tested in order to start proper containment strategies. The canine parvovirus antigen tests are suitable for screening dogs and cats for fecal parvovirus.^{5,6} There has been concern that the new CPV-2c strain may not be detected by currently available fecal antigen tests. A recent study showed that the IDEXX SNAP test was similar in sensitivity for CPV-2c as for other strains.⁷ False negative results can occur in about 25% of infected animals due to intermittent virus shedding very early or late in the course of disease, binding of antibodies to the virus, and virus quantities in feces below the level of detection. Test results are most accurate if the test is performed within 5 days of onset of clinical signs. Negative tests should be repeated another day on any cat or dog suspected to have parvo based on clinical presentation. A PCR test on feces may be helpful for cases suggestive of CPV in the face of negative fecal antigen tests.⁷ A WBC count can also be performed to build evidence for or against a diagnosis of parvoviral infection.

Recent vaccination with modified-live parvovirus vaccines sometimes results in transient fecal shedding of vaccine virus that purportedly causes false-positive reactions on the parvo antigen tests. Documentation of this phenomenon in dogs is scant. In a study with kittens,⁹ weak positive results on commercial parvovirus antigen tests were uncommon for the first 2 weeks following vaccination, especially when the Idexx SNAP CPV antigen test was used. A strong positive test result in combination with compatible clinical signs or known contact with virus is unlikely to be due to vaccination. Testing of feces by PCR is likely to result in a higher rate of vaccine-induced false positive test results due to the high sensitivity of PCR.¹⁰

Although it is a common practice, there is no compelling medical evidence to use the parvovirus test kits for routine screening of all dogs and cats in the shelter that don't have compatible clinical signs or known exposure – resources would be better allocated for control and preventive strategies.

Necropsies should be performed on animals with unexplained deaths, particularly when there are unusual numbers of deaths of puppies and kittens in the shelter, foster homes, or adoptive homes. This is especially important for sudden death of adult cats and kittens during “kitten season”. Feces and intestinal mucosal scrapings obtained during necropsy can be tested with the parvovirus antigen diagnostic tests. Histopathological evidence for parvovirus infection is the gold standard for confirming diagnosis.

Disease Management

Tools for effective and life-saving management of parvovirus include:

1. Isolation of infected sick animals for the duration of the shedding period
2. Quarantine of exposed asymptomatic animals for the duration of the incubation period

3. Infection risk assessment for release of quarantined animals
4. Create a clean break to prevent exposure of new animals
5. Strict biosecurity policies
6. Environmental decontamination using a disinfectant that kills parvovirus
7. Communication within the shelter and with community stakeholders

Isolation

The most effective strategy for limiting transmission of CPV or FPV in the shelter is the prompt isolation of sick dogs and cats with positive test results. This reduces the infectious dose in the general population. The sick animals should be housed in a physically contained isolation room if treatment is being considered. The decision to treat CPV or FPV should be carefully considered based on shelter resources, including whether there is an appropriate isolation room to contain infection, enough staff to dedicate to treatment, costs for aggressive supportive treatment 1 to 2 weeks, and costs of personal protection equipment (PPE) which must be worn by staff in contact with the sick animals to maintain strict isolation conditions. The most important consideration is whether the shelter can manage treatment without contaminating the entire facility and putting healthy animals at risk, resulting in spread of shelter-acquired disease forcing temporary closure and potential depopulation. If this is not possible, then sick animals should be removed from the facility for treatment or euthanized to relieve suffering and curtail disease transmission. Although recovery may occur quickly, virus can be shed for up to 14 days postinfection. Recovered animals with a negative parvovirus antigen test may be moved to adoption or rescue with relatively low risk for spreading virus as long as they are housed separately from puppies/kittens and adults vaccinated for <7 days. They should be bathed first to remove virus from the fur.

Quarantine

Since sick animals shed infectious virus for 3 days before onset of clinical disease, all others exposed to the sick animals either by direct contact or fomite contact should be quarantined for 14 days (incubation period). The infection status of exposed animals is unknown – they may be infected and in the pre-clinical incubation period, have subclinical infection with shedding, or not infected due to immunity. Juvenile and adult animals co-housed with infected animals should be bathed as soon as possible to remove parvovirus from their fur. Quarantined animals should be monitored twice daily for clinical signs. If clinical signs occur, the animal should be removed to isolation to help reduce the infectious dose of virus in the environment. The 14-day quarantine clock must be re-started for the remaining animals.

Assessment of infection risk

No animals should be released from quarantine until after the 14-day incubation period or risk for infection is determined. In some situations, the numbers of exposed dogs or cats in quarantine may comprise almost the entire population. An alternative to holding all the animals in quarantine for 2 weeks is to triage them based on risk for infection. Risk for infection is determined using presence or absence of protective antibody titers to parvovirus combined with a parvovirus antigen test. There is always a small risk for infection, but a combination of extent of exposure, antibody titer status, and parvo antigen test status provide reasonable confidence in assigning risk for infection. The goal is to identify animals at relatively low risk for infection and can be released from quarantine. Animals at greatest risk for infection are those with heaviest exposure (co-housing with an infected animal) and lack of immunity.

For dogs, two point-of-care tests for in-shelter use are available for rapid testing for protective antibody titers in small serum samples: Synbiotics CDV/CPV TiterChek kit (<http://www.synbiotics.com>) and Canine VacciCheck Immunocomb (<http://vaccicheck.com/>). Both of these tests have high sensitivity and

specificity, provide capability for batch testing, and yield results in 25 min.

Currently, no point-of-care tests are available for cats to determine FPV antibody titers. Serum samples from FPV-exposed cats can be submitted to the Maddie's Laboratory for Diagnosis and Prevention of Shelter Diseases at the University of Wisconsin (contact Dr. Laurie Larson at larsonl@svm.vetmed.wisc.edu for sample submission instructions). This lab provides a 2-day turnaround time for FPV antibody titers, and testing is usually at no charge for shelters.

Asymptomatic animals with protective antibody titers and negative parvo antigen test are at low risk for infection and can be moved out of quarantine. Asymptomatic animals without protective antibody titers are at high risk for infection upon exposure – those with negative antigen tests should be kept in quarantine or moved to foster or rescue homes and re-vaccinated, while those with a positive antigen test should be moved into isolation and monitored for treatment needs.

Clean break

Unexposed resident animals and newly admitted animals must be protected from exposure to infected and quarantined animals. This group should be housed in a separate ward or ideally, a separate building. Staff should care for these “clean” animals first to avoid contamination of the environment and should not backtrack into this housing area after working with animals in isolation and quarantine unless they wear full PPE.

Biosecurity

Staff caring for the infected animals in isolation and exposed animals in quarantine must wear full PPE (hair cover for long hair, gown, gloves, boots). Handling of dogs and cats should be minimized. Ideally, separate staff would be assigned to isolation, quarantine, and unexposed housing areas. If there is not enough staff for dedicated assignments, staff should always care for healthy unexposed animals first, followed by quarantined animals and sick animals in isolation last. In addition to PPE, the isolation and quarantine areas should have dedicated cleaning and feeding supplies that are not transferred between populations.

Environmental decontamination

Parvoviruses are very durable, can persist in the environment for years, and are resistant to inactivation by quaternary ammonium disinfectants, including Roccal, Parvosol, Triple Two, Broadcide, and A33. Only 4 disinfectants kill parvoviruses – sodium hypochlorite (bleach), calcium hypochlorite (WysiWash), potassium peroxymonosulfate (Trifectant), and accelerated hydrogen peroxide (Accel). For optimum killing activity, environmental surfaces contaminated with feces, urine, vomit, blood, and other organic material must first be cleaned with a detergent before applying the disinfectant solution. Air drying of the disinfectant on the surface is preferred, but if the animal needs to be returned to the same run or cage, the area should be rinsed after the required contact time, then dried using a squeegee or towel.

Disinfection with bleach, WysiWash, Trifectant, or Accel should be performed not just during CPV or FPV outbreaks, but on a daily basis for all animal housing areas, food and water bowls, litterpans, animal transport vehicles, transport cages, and hallways to reduce the risk for environmental transmission of any infectious disease. Food/water bowls and litterpans should not be cleaned in the same sinks. In addition, they should be made of stainless steel instead of plastic because scratched plastic is difficult to fully disinfect. Consider using disposable litterpans in cages housing cats quarantined due to exposure to FPV.

Mop buckets should not be used for cleaning and disinfection of kennel runs. High pressure hoses and power washers should also not be used in kennels unless all dogs are removed, because the force sprays feces on all surfaces and can even aerosolize fecal matter. Cleaning and disinfection supplies should be dedicated to each room and not removed for use in other areas in order to minimize cross contamination.

While foster homes are generally a safer and less stressful environment for puppies and kittens, they have porous surfaces that are difficult to disinfect after contamination with parvovirus. It is very risky to send susceptible puppies and kittens to foster homes with a previous history of parvovirus.

It is also very risky to let puppies or kittens co-mingle in exercise areas and playpens containing wood, plastic, or dirt that can't be effectively disinfected.

Communication

Proactive communication about disease spread within the shelter and the control strategy provides an opportunity to disseminate accurate information to shelter staff as well as community stakeholders such as adopters, rescue groups, and veterinarians. Proactive communication averts spread of rumors and false information, improves the shelter's image, and enlists public support and trust.

A written statement describing the disease, what animals are at risk, and the transmission modes should be provided to all shelter staff, including managers, directors, and public information officers. A written protocol detailing the management strategy should also be provided to each staff member, regardless of whether they are directly tasked with implementing the protocol or not.

A press release containing pertinent facts about the disease, the number of affected and exposed animals in the shelter, number of deaths, diagnostic testing, strategy for control and elimination, and what expertise has been enlisted should be released to media sources, community veterinarians, and pet placement partners.

A trace-back of all animals exposed to parvovirus-infected animals based on the full incubation period of 14 days should be conducted to identify what exposed animals were released to adopters and pet placement partner agencies during this time. The adopters and transfer agencies should be notified and provided a written statement explaining what to do if infection is suspected or diagnosed, including who to contact at the shelter and whether the shelter is accepting animals back or assuming financial responsibility for veterinary treatment.

Prevention

Vaccination of all dogs and cats on intake is the cornerstone for prevention of parvoviral transmission in shelters. All dogs and cats 4 weeks of age and older should receive a vaccine containing modified-live parvovirus on intake, regardless of intake status (stray, owner surrender, rabies quarantine, cruelty case, pregnant, lactating, injured, ill). A delay of even a day can significantly increase the risk for infection. All puppies and kittens should be re-vaccinated every 2 weeks while in the shelter until they are 5 months old.^{11, 12} The potential for maternally derived antibodies to interfere with vaccination in puppies and kittens <4 months old is the reason they should be re-vaccinated every 2 weeks to successfully induce protective antibody titers. Restricting vaccinations to adoptable animals only

creates a large pool of susceptible animals that can make parvovirus infections an endemic problem which eventually affects all animals. Feline parvovirus vaccines protect against both FPV and CPV infection in cats.

Another strategy to reduce risk for parvoviral outbreaks is to segregate juvenile animals from adults. Puppies and kittens should not be housed with adults - adults may have subclinical infections with virus shedding. Puppies or kittens can be housed together using a planned all in-all out co-housing approach. In this approach, littermates can be housed together in small groups (3 per group), and unrelated puppies or kittens that were already living together before admission can also be housed together.

In addition to vaccination, another strategy to prevent parvovirus infection is to move puppies and kittens from the shelter into foster as soon as possible after intake, as long as the foster homes do not have a history of housing parvovirus-infected animals in the past. Vaccination should be repeated every 2 weeks for puppies and kittens in foster care.

Finally, all efforts to reduce stress should be pursued. The most effective way to reduce stress on animals and staff in the shelter is to prevent crowding by practicing population management principles. Limiting run and cage occupancy to 1-2 compatible animals each results in less stress and substantially reduces risk for infectious disease.

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Valuable Resources

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