Outbreak of Canine Respiratory Disease in a Large Municipal Shelter

Key words: canine respiratory disease, canine pneumovirus, outbreak management, capacity for care

Summary

An open admission municipal animal shelter housing approximately 100 dogs experienced an outbreak of coughing, pneumonia, and death in their canine population. Over two months, nearly every dog in the shelter showed clinical signs of respiratory disease and eight dogs died as a result. Diagnostic testing performed via consultation with Maddie's Shelter Medicine Program at Cornell University detected canine pneumovirus, in addition to several other common canine respiratory pathogens. Inspection of shelter facilities and protocols revealed lack of canine isolation space, severe overcrowding, and veterinary staff shortage. Recommendations included a clean break, canine population reduction (via rescue/transport/adoption), deep clean of facilities, creation of isolation space, and ultimately operating within capacity for care. After a clean break and reducing canine population, new cases of respiratory disease dropped. Although the resource shortage endured by this shelter initially paralyzed their ability to appropriately implement recommendations, an ongoing series of municipal decisions will increase funding and space for the shelter in the near future.

Introduction

Discovered in 2010 at Cornell University, canine pneumovirus (CnPnV)[1] is a recent addition to the Canine Infectious Respiratory Disease (CIRD) complex, a group of viruses and bacteria that comprise the multifactorial etiology of canine respiratory disease.[2] Despite its recent discovery, CnPnV is neither rare nor emergent. A study measuring antibodies to CnPnV in 215 dogs entering animal shelters throughout the United Kingdom and Ireland found a seroprevalence of 26%.[3] After 3 weeks in the shelter, 93.5% of those dogs had CnPnV antibodies, demonstrating rapid transmission in a shelter environment.[3] Although this and other studies find a strong association between CnPnV and CIRD, the virus's precise role in pathogenesis of clinical disease remains undefined.[3,4]

This enveloped, negative-sense virus with a nonsegmented RNA genome belongs to the *Paramyxoviridae* family and is most closely related to murine pneumovirus as well as the human, bovine, ovine, and caprine respiratory syncytial viruses (RSV).[5] In fact, its initial detection hinged on the use of monoclonal antibody against human RSV.[1] Once exposed via respiratory aerosols,[2] CnPnV replicates in canine respiratory epithelium lining bronchioles and incites primary disease, predisposes the tissue to secondary or synergistic infection, or remains subclinical.[2,3] Detection of CnPnV is now accomplished by real-time polymerase chain reaction, and treatment consists of the typical CIRD complex management: supportive care, isolation from healthy animals, and judicious use of antimicrobials to address concurrent bacterial infection.

Case history

This open admission municipal animal shelter provides both sheltering and animal control functionality for a large city. In 2018, the shelter admitted 5,908 dogs, 10,925 cats, and 1,322 animals of other species, for a total of 18,155 animals. The shelter operates full-time seven days per week including admissions, veterinary health checks, spay/neuter services, and technician appointments.

At the time of the outbreak, the shelter employed one full-time veterinarian and five part-time veterinarians, as well as veterinary technicians and animal care staff. This amount of staff was inadequate to cover daily shelter duties in a timely manner and a consequence of historic underfunding, which also precluded appropriate facility maintenance. The shelter is housed in an old, deteriorating, repurposed building that does not contain a space for canine isolation. It shares the property with a pest control company.

After an intake exam, admitted dogs join the general canine population in one large warehouse-style room containing 58 double-sided kennels, several large dog runs, and a few steel-sided cages for smaller dogs. The double-sided kennels possess a guillotine divider door in the center, allowing

for creation of two half-sized spaces within the kennel. Leading up to and during the outbreak, the guillotine doors had been permanently closed and approximately 100 dogs lived in these half-sized kennels. Recent public pressure to eliminate euthanasia practices heavily contributed to this crowding situation.

From February to April of 2019, the number of active canine respiratory infection cases oscillated between 10 and 35. Within the span of 2 weeks in late April, the prevalence sharply increased to 60 cases. Due to the severity of disease and number affected, the staff veterinarian suspected contribution of a novel pathogen and in early May requested Maddie's Shelter Medicine Program at Cornell University conduct a consultation. Though many dogs resolved their clinical signs, new cases of canine respiratory disease were recognized through late May.

Clinical findings

Multiple dogs of all ages, sexes, and reproductive statuses experienced a constellation of clinical signs including coughing, sneezing, serous ocular discharge, serous-to-mucopurulent nasal discharge, lethargy, inappetance, and pneumonia. All dogs had been clinically healthy upon intake and almost every dog in the shelter was affected during the course of the outbreak. Two dogs who developed signs after being adopted were hospitalized, and eight shelter dogs died or were euthanized as a result of severe, intractable respiratory disease. Thoracic radiographs of one young, otherwise healthy female dog who had developed a severe respiratory infection in the shelter showed marked pulmonary consolidation. This particular dog had been hospitalized, but remained oxygen-dependent and was ultimately euthanized due to poor prognosis. These clinical findings are consistent with an outbreak of canine pneumovirus.

Diagnostic testing

Three weeks into the outbreak, nasopharyngeal swabs from 14 dogs were submitted to IDEXX for canine respiratory pathogen detection via polymerase chain reaction (PCR). Test results revealed a high prevalence of *Mycoplasma cynos* and canine herpesvirus type I, as well as other common pathogens in the canine respiratory disease complex. A transtracheal wash of a clinically ill dog was submitted to IDEXX for culture and sensitivity, though no bacterial growth was found. During the consultation with Cornell, PCR testing of nasopharyngeal swabs from four dogs by the Animal Health Diagnostic Center showed the presence of canine pneumovirus in addition to the previously detected canine respiratory pathogens.

Problem list

While the respiratory disease outbreak with a canine pneumovirus component is of serious clinical concern, this case report regards it as a manifestation of the following chronic systemic problems.

Lack of canine isolation space: Clinically sick dogs remained in the general population, persistently transmitting pathogens via aerosols, fomites, and occasional direct contact. Given the shelter infrastructure, isolating sick dogs to any effect was impossible.

Severe overcrowding: Dogs were housed inappropriately with two dogs to each two-sided kennel, separated by a guillotine door. This practice halved their space and allowed for stockpiling of dogs, creating a highly stressful environment and contributing to ease of aerosol transmission of respiratory pathogens. About 100 medium-to-large dogs lived in the shelter during the outbreak, while humane housing in the current facilities is feasible for a maximum of 63 medium-to-large dogs.[7-9] Overcrowding was perpetuated by increased lengths-of-stay due to slow decision-making for each dog, allowing dogs with marked medical or behavioral concerns to languish in the shelter.

Staff shortage: The one full-time veterinarian, five part-time veterinarians, and number of veterinary technicians employed at the time of the outbreak was inadequate to appropriately care for the animals in the shelter, including recognition and management of medically and behaviorally declining animals. According to calculations from another shelter medicine group, 4-6 full-time veterinarians would be required to manage a yearly intake of 18,000 animals.[7]

Severe lack of communication: No method of communication, such as daily rounds, existed to ensure that medical, behavioral, and adoption teams knew the status of each dog. There was also a near complete communication breakdown between upper management and animal care staff, breeding distrust and ill will.

Inappropriate cleaning protocols: Overconcentration of the accelerated hydrogen peroxide disinfectant Rescue and overcleaning of kennels, combined with minimal ventilation, resulted in fumes damaging to respiratory epithelium.[8,10] Defects in this epithelial barrier further predisposes the respiratory tract to pathogenic invasion.

Outbreak management recommendations

Clean break: The canine population within the shelter, all of whom were exposed to the ongoing respiratory disease, must be completely physically isolated from incoming, unexposed dogs.[10] Since there is only one canine housing area in the shelter, incoming dogs would require a separate facility outside of the building such as emergency tents and trailers. In this outbreak situation, the shelter building acts as the isolation facility for exposed dogs, while the emergency tents and trailers house unexposed, incoming dogs. This clean break protocol extends to all shelter personnel as well. Staff and volunteer movement

between the two populations should be limited and requires the use of personal protective equipment (PPE) if moving from exposed to unexposed populations. Termination of the clean break protocol depends on when the last dog in isolation first exhibits clinical signs. Dogs harboring a pneumovirus infection have been documented to shed the virus for up to 10 days from the onset of clinical signs,[14] so 10 days after the last new case of respiratory disease is noted would be an appropriate time to consider merging the two populations. Retrospective action such as this requires careful documentation and constant monitoring of new cases.

Reduce dog population: The high number of isolated dogs in the shelter building and the growing number housed in the off-site tents and trailers predisposes both populations to illness by increasing stress as well as the potential for aerosol transmission of pathogens. Dogs that have already cleared the respiratory infection and the unexposed dogs in temporary housing should leave the shelter via rescue or adoption as soon as possible. To abide by shelter policy, these animals should be spayed or neutered either at the shelter (exposed dogs) or an off-site facility (unexposed dogs) before rescue/adoption. Additionally, the number of incoming dogs should be markedly limited, and set on a path for rescue/adoption or immediately euthanized in order to move them through the shelter as quickly as possible.

Deep clean: Once the canine population is reduced, the dogs in isolation should be temporarily moved out of the shelter to allow for an intensive cleaning of all facilities. After this, the unexposed dogs in emergency housing can be rehoused within the shelter building, and the isolation dogs can be moved to the tents and trailers. This will facilitate open adoptions and streamlined operations.

Outbreak prevention recommendations

Create canine isolation facilities: Aerosols easily transmit canine respiratory disease pathogens.[8-10] Therefore, clinically ill animals must be physically isolated from the general population to prevent the spread of infection. Ideally, isolation spaces have separate ventilation as well. Although subclinical dogs shed pathogens during the incubation period, clinically sick animals who cough, sneeze, and spread nasal discharge by sniffing common areas pose a greater threat to the biosecurity of a shelter. In order to prevent outbreaks as rampant as this one, the shelter must create and appropriately use an isolation facility for dogs.

Operate within capacity for care: Capacity for care describes the number of animals a shelter can humanely care for, and depends on an array of factors including number of veterinarians and staff, adequate staff training, number of appropriately sized housing units, and average length of stay.[9] Budget directly dictates these factors. With current municipal funding and an intake of 18,000 animals per year, the shelter spends $237 per animal in medical, husbandry, staffing, maintenance, and overhead costs.[7] Shelters of comparable size and urban environment that operate within capacity for care invest $350-475 per animal.[7] To function within its current capacity for care, the shelter in question must either decrease their yearly intake to about 12,000 animals or the city must drastically increase funding.[7]

Shelter response

Led by the full-time shelter veterinarian, the shelter implemented several steps to mitigate the outbreak. A clean break protocol was instituted by housing newly admitted dogs in temperature-controlled tents and trailers about 100 meters from the shelter building. These temporary facilities were loaned at no cost from the city emergency management department, and all dogs housed within them were unexposed to the outbreak and available for removal by rescue organizations. To ease resource strain, canine intake was

severely limited by diverting owner surrender and stray dogs to other shelters in the area. Dogs in the isolation population within the shelter building were not available for adoption to minimize risk of outbreak transmission to other animal organizations; rescue organizations could still transport ill dogs with informed consent.

Shelter veterinarians closely monitored exposed dogs for clinical signs of respiratory disease and tracked the progression of each clinically affected dog on a shared spreadsheet. Dogs showing clinical signs received supportive care or antibiotics depending on severity of disease.

Throughout the course of the outbreak, the shelter transparently communicated updates to local shelters, rescue organizations, other community partners, volunteers, and the public. Spearheaded by its full-time veterinarian, the shelter actively sought guidance from shelter medicine experts.

Although lack of funding and inflexible leadership initially paralyzed the shelter's ability to implement further recommendations suggested by the Cornell consultation, ongoing developments may soon change this. The outbreak garnered substantial public attention, and ensuing protests outside city hall[12] at the tailend of the outbreak in June further pressured local government to make changes. In August, shelter leadership changed, and in October another shelter medicine team visited for several days of pro bono intensive training and instituting new protocols.[13] Around this time, the neighboring pest control company announced relocation, relinquishing its space to the shelter.[13] Most recently in early November, the city council voted to approve an additional nearly $500,000 in funding for the shelter.[14] "Passionate public testimony" played an important role at the council meetings.[14]

Discussion

This case highlights the difficulty of determining the pathogens responsible for a canine infectious respiratory disease outbreak in a shelter setting. Diagnostic testing implicated a number of common CIRD pathogens as well as canine pneumovirus, although the samples may not have been representative and the

results do not necessarily indicate causation. Several other shelters in the United States have experienced an apparent outbreak of canine pneumovirus in the recent past,[16] which increases the index of suspicion for a potential causative role.

This case also demonstrates the serious consequences of poor leadership and municipal animal shelter underfunding. Shortage of funding forces shelters to maintain operations with fewer human and material resources. Exceeding capacity for care in this manner, combined with the lack of canine isolation space, increased immunosuppressive stress as well as probability of pathogen load in the dog population, allowing resident pathogens to flourish. This resulted in an outbreak of canine infectious respiratory disease that persisted for almost five months. The cost of managing this and future outbreaks, in addition to the previous outbreaks of *Streptococcus zooepidemicus* and canine influenza, exceeds the investment necessary to address the etiology of such infectious crises. Fortunately, the public spectacle created by protestors and those who gave testimony at council meetings have garnered widespread support for increased allocation of funds to the shelter.

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