ESSENTIAL PROTECTION The canine parvovirus vaccine is considered a core vaccine, making it a critical part of a routine wellness plan.

VACCINATION STATION

Canine Parvovirus Vaccination

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Canine and feline parvoviral infections are caused by strains of carnivore protoparvovirus 1, a small, nonenveloped, linear, single-stranded DNA virus.[1] Feline parvovirus, the causative agent of feline panleukopenia, is among the oldest known feline viruses. In the 1970s, it likely developed a 6 amino acid mutation, allowing it to infect domestic dogs.[2] This virus is now referred to as canine parvovirus type 2 (CPV-2) to distinguish it from the first described canine parvovirus (minute virus of canines).[3] CPV-2 has since mutated into 3 strains (CPV-2a, -2b, and -2c) that vary in prevalence geographically.[1] Like many parvoviruses, CPV-2 is a robust virus that can survive in the environment for more than 6 months at room temperature, is easily transported on fomites, and requires the use of broad-spectrum disinfectants such as dilute 0.75% sodium hypochlorite on surfaces for effective elimination.[3,4]

CANINE PARVOVIRUS

Pathophysiology

Canine parvoviral disease is caused by infection with CPV-2a, -2b, or -2c. Although feline parvovirus can replicate in canine lymphoid tissue following experimental inoculation, it has not been associated with clinical disease in dogs.[5] Canine parvoviral infection often occurs when maternal antibody wanes, with the highest risk of infection in puppies between 6 weeks and 6 months of age, although unprotected dogs can be infected at older ages. Rottweilers and Doberman pinschers appear to have higher disease morbidity. Though not proven, the increased frequency of infection in these breeds is thought to be due, in part, to a poor immune response to the CPV-2 vaccine.[6]

Fecal–oral transmission is the primary route of infection. In utero infection is possible, but widespread vaccination has made this rare.[4] Fecal shedding occurs as soon as 3 days postinfection and persists for up to 2 weeks after infection; however, viral DNA can be detected in feces up to 46 days after infection.[7]

The virus replicates in rapidly dividing cells (e.g., oropharyngeal lymphoid tissue, tongue epithelium, mesenteric lymph nodes, thymus, bone marrow) and then spreads in a hematogenous manner to the small intestinal crypts.[3] Enterocyte turnover is disrupted, causing villous blunting and malabsorption.[3] Myocardial infection is also possible and is usually attributed to infection either in utero or during the first 8 weeks of life.[4,8]

Clinical Signs and Laboratory Findings

Acute enteritis is the most common clinical sign of CPV-2 infection, which typically first manifests as nonspecific illness including anorexia, depression, lethargy, and fever. These clinical signs may then progress to vomiting and small intestinal diarrhea, ranging from mucoid to hemorrhagic diarrhea. Abdominal pain secondary to enteritis or intussusception is also common.[4]

Lymphopenia is the most consistent hematologic finding in cases of CPV-2 infection, although panleukopenia, anemia, and thrombocytopenia have also been documented.[9] Biochemical changes are often nonspecific and include prerenal azotemia, elevated hepatic enzyme activity, hypoalbuminemia, hyponatremia, and hypoglycemia.[4,9]

Complications and Outcomes

Dogs that survive parvovirus infection have been found to be more than 5 times more likely to develop chronic gastrointestinal disease later in life.[10] Gut translocation and poor immunity may result in septic shock, systemic inflammatory response syndrome, multiorgan dysfunction syndrome, and death. Rare cases of erythema multiforme, leukoencephalopathy, and porencephaly with periventricular encephalitis have been reported in puppies.[3]

The decision to treat parvovirus infection is largely based on the cost of treatment, which can quickly reach several thousand dollars in a private practice setting.[11] Without treatment, the survival rate is as low as 9%; however, this increases to 60% to 90% with treatment.[3] Treatment cost and success vary based on inpatient versus outpatient therapy, with one study reporting that inpatient therapy led to a survival rate of 90% whereas outpatient therapy yielded a survival rate of 80%.[12] Following natural infection, the duration of immunity is lifelong.[6]

VACCINATION

Types and Mechanism of Action

The canine parvovirus vaccine is considered a core vaccine by the World Small Animal Veterinary Association (WSAVA) Vaccination Guidelines Group as well as the American Animal Hospital Association (AAHA), indicating that all dogs should receive this vaccine as part of a routine wellness program.[6,13] Two types of CPV-2 vaccines are currently available: a modified live virus (MLV) and an inactivated (killed) vaccine. The MLV preparations are the predominant form of CPV-2 vaccine available in North America (see a full list at todaysveterinarypractice.com/clinic-resources). Vaccination with any of the commercially available MLV CPV-2 vaccines will induce immunity against all 3 CPV-2 strains.

To see a list of selected canine parvovirus vaccines that are commercially available in the United States and their coverage, visit **todaysveterinarypractice.com/clinic-resources**.

Immunity is mediated primarily by IgG-neutralizing antibodies, while secretory IgA and cell-mediated immunity may be less important in conferring protection after vaccination.[6] In general, B lymphocytes in peripheral lymphoid tissues recognize parvoviral antigen and undergo growth, division, and differentiation into plasma cells and memory B cells. The plasma cells initially produce antigen-specific IgM in response to vaccine antigens but switch to antigen-specific IgG production as the immune response matures. Between 3 and 5 encounters with antigen typically lead to the differentiation of the maximal number of antigen-specific memory B cells.[14]

Sources of Interference

Maternally derived antibodies (MDA) are absorbed in utero and concentrated in the mammary gland during the final stages of pregnancy. These are a major constituent of colostrum. Nursing puppies absorb colostral antibodies (usually IgG) in the gut during the first few hours after birth until about 18 to 24 hours after birth.[15] While MDA play an important role in protecting puppies from infection, they can also neutralize vaccines, preventing the induction of durable immunity. The amount of vaccine inactivation is relative to the amount of MDA in circulation at the time of vaccination; puppies with high concentrations of MDA generally exhibit a poor response to the vaccine.[4] The amount of MDA a puppy receives is proportional to the mother's titer and inversely proportional to the litter size.[16]

Small-breed dogs appear to be more susceptible to adverse reactions than large dogs, with dogs weighing less than 10 kg being about 4 times more likely to experience an adverse vaccine reaction in one study.[19]

In puppies without MDA, MLV vaccines can induce immunity as soon as 3 days postvaccination.[6] It is likely that MLV vaccines provide more robust immunity and are probably the best choice in puppies with MDA when compared with killed vaccines. MLV CPV-2 vaccines are frequently referred to as "high-titer, low-passage," denoting that they contain a high concentration of virus that has spent a relatively short time in tissue culture; the longer a virus is passaged in tissue culture, the less virulent it becomes.[4] Killed or inactivated vaccines, which are generally unavailable in the United States, typically require a longer amount of time to induce immunity than MLV vaccines. Killed vaccines may also be inadequate at inducing an immune response in the presence of MDA.[17] Killed or inactivated vaccines may be beneficial in pregnant or immunocompromised dogs, in which MLV vaccines are not usually recommended. The duration of immunity following killed vaccine administration is at least 6 months.[6,17]

Route and Schedule

The recommended route for CPV-2 vaccination is via either subcutaneous or intramuscular administration. While the intranasal route is not recommended, this route has been shown to induce immunity; however, oral administration does not induce immunity.[6] The CPV-2 vaccine is administered either alone as a monovalent vaccine or as a multivalent vaccine in combination with other core puppy vaccinations, often including those against canine distemper virus, adenovirus, and parainfluenza virus.[6]

For puppies younger than 16 weeks, vaccination should begin at 8 to 9 weeks and be repeated every 3 to 4 weeks until 14 to 16 weeks of age, as recommended by the AAHA and WSAVA guidelines. Dogs in a high-risk environment may benefit from an additional vaccination at 18 to 20 weeks of age.[13] In a shelter environment, vaccines should be administered at admission and then every 2 to 3 weeks thereafter until 18 to 20 weeks of age. Vaccination as early as 4 weeks may be considered in situations where an outbreak is occurring or where the disease is especially prevalent. Dogs older than 16 weeks that have never received a CPV-2 vaccination should receive 2 doses at 3 to 4 weeks apart, although one dose with an MLV vaccine is likely protective.[6] For both puppies and adult dogs, a booster vaccine should be administered 1 year after the initial series, and then not more often than every 3 years thereafter.[6]

Adverse Reactions

The most severe adverse reactions to core puppy vaccines include those caused by a type I hypersensitivity; these include anaphylaxis, dermatologic signs such as edema and urticaria, laryngeal and pharyngeal edema, gastrointestinal distress, collapse, cyanosis, and sudden death. Type I hypersensitivity reactions to vaccines, although rare in general, are more likely to occur after several doses of a vaccine series than after the first vaccine. Animals with siblings or parents with a history of type I reactions or animals that display any of the clinical signs mentioned should be monitored in the clinic for observation for 15 to 30 minutes after vaccination.

Inflammatory immune responses may result in delayed adverse reactions; these include pain, pruritus, lethargy, anorexia, minor behavioral changes, and tenderness at the injection site. These signs typically manifest 2 to 3 days after vaccination and should resolve within 12 to 24 hours. Vaccine site abscesses are also possible, and therefore the site of vaccination should always be documented in the medical record. Some MLV parvovirus vaccines can suppress T-cell proliferation for 2 to 5 weeks, resulting in postvaccination lymphopenia.[18]

Small-breed dogs appear to be more susceptible to adverse reactions than large dogs, with dogs weighing less than 10 kg being about 4 times more likely to experience an adverse vaccine reaction in one study.[19] This study found that dachshunds, pugs, Boston terriers, miniature pinschers, and Chihuahuas were at highest risk for development of an adverse reaction.[19]

The number of vaccines during the visit was also found to be a significant risk factor for the development of an adverse reaction, with dogs receiving more than 4 vaccines during a visit being nearly 2 times more likely to experience a reaction.[19] In the United States, suspected adverse vaccine reactions should be reported to the U.S. Department of Agriculture; other countries, including Canada, the United Kingdom, Australia, and New Zealand, have similar reporting guidelines.[18]

ANTIBODY TESTS

Antibody tests are useful for monitoring immunity to CPV-2. Tests for determining antibody titers are performed on serum and include enzyme-linked immunosorbent assays (ELISAs), indirect immunofluorescence antibody (IFA) tests, and hemagglutination inhibition (HI) tests, with the HI test being considered the gold standard.[4] Several in-clinic ELISAs are commercially available, and at least one is reported to correlate well with current gold standard tests.[20] Antibody tests are also available from many commercial veterinary diagnostic laboratories.

Antibody titers from the mother can be measured before whelping to determine MDA levels; similarly, puppies may have titers measured after whelping to determine their level of protection and the potential for MDA-associated vaccine interference. Perhaps the most useful time to measure antibodies is after completion of the puppy core vaccinations at 14 to 16 weeks of age. This may be especially useful in Rottweilers and Doberman pinschers.

A positive titer should be present 2 weeks after the final vaccination; puppies with an HI titer ≤1:80 are considered susceptible to infection.[17] If the antibody test is negative or the titer is ≤1:80, the dog should be revaccinated, and the antibody test should be repeated 2 weeks later. If the dog remains negative, it may be a nonresponder; these dogs may have adequate innate or cell-mediated immunity to provide some protection, but it is possible that the dog will remain unprotected.[6] One option for nonresponding dogs is to attempt vaccination with a vaccine from a different manufacturer.

Antibody tests may also be useful for dogs that are immunocompromised or are receiving medications that interfere with their ability to mount an adequate immune response. Monitoring titers in these dogs can help reduce the risk of adverse reaction development as well as overvaccination in general; it may also serve as an additional tool for clients who are concerned about vaccine reactions or are hesitant to vaccinate their pets in general.

CLIENT COMMUNICATION

The vaccine hesitancy movement has provided veterinarians with an additional, complex challenge regarding vaccination of pets. Veterinarians should exercise good communication and listening skills by allowing clients with vaccination concerns to voice those concerns openly and completely. This open dialogue allows veterinarians to remind those clients that some vaccines (such as that for rabies virus) are legally required. Additionally, a discussion about the risks versus benefits—such as the consequences of infection with diseases protected by these vaccines, as well as the cost of treatment—can help to persuade vaccine-hesitant clients. Resources such as the AAHA and WSAVA vaccination guidelines can be used to show that large-scale, peer-reviewed documents exist to support vaccine recommendations.

Antibody tests may also be offered as a tool following initial vaccination to provide proof that a pet may or may not need revaccination. Clients should be advised that dogs that have not completed their vaccine series are at a higher risk of infection and, therefore, contact with other dogs or environments where canine feces or fomites may be present (e.g., dog parks, nature trails, kennels, groomers) should be restricted. Following any vaccination, the client should be made aware of potential adverse reactions and advised to seek veterinary attention if they suspect a serious reaction is occurring. TVP

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