

CANINE VACCINOLOGY

Susan E. Anderson, DVM

Diplomate, American Board of Veterinary Practitioners
Certified in Canine and Feline Practice
University of Florida, College of Veterinary Medicine

Vaccination

The goal of vaccination is to stimulate the animal's immune system by giving a killed or weakened form of an organism. The animal will then be protected from becoming ill when exposed to the real disease. The two major parts of the immune system are humoral immunity (B-lymphocytes that produce antibodies) and cell-mediated immunity (T-lymphocytes that directly or indirectly destroy infected cells). Vaccination is, therefore, critical in the prevention and control of disease. For the most part, veterinary vaccines are safe and efficacious and have saved many animal lives. An important point to remember is that vaccination is a medical procedure that should include the same considerations and reasoning skills required when deciding to use any medical treatment or surgical procedure. The goal should be to vaccinate more total animals in the populations and to vaccinate individual animals less frequently and only for disease for which there is a risk of exposure.

Risk Assessment

The potential risk of exposure to various diseases should be determined for each individual patient. Vaccination recommendations will vary depending on the environment of the dog. Consider the differences of exposure for a Poodle living on the 20th floor of a high-rise who never goes outside vs. the racing Greyhound vs. the suburban Golden retriever in a fenced yard vs. the rural bird dog who roams many acres.

Duration of Immunity

If humans generally receive only childhood vaccinations then why do dogs have annual revaccinations throughout their entire lives? This is definitely an area of intense research and controversy in veterinary medicine today. Most vaccines produced before 1995 were only evaluated for efficacy for several weeks after the last vaccination was given and the recommendations for annual revaccination was arbitrary. The exception, of course, is rabies vaccine that must provide one or 3 year duration of immunity under strict guidelines from the USDA. Since 1995, new vaccines for diseases that have not previously had an approved product must be shown to produce the duration of immunity advertised on the label. To really determine efficacy of vaccines, vaccinated and unvaccinated animals need to be kept for one to many years and then challenged with exposure to the real disease. Ideally, most of the unvaccinated animals that are challenged should get sick and/or die and most of the vaccinated animals should not get sick. The difficulty and expense (in dollars and animal lives) of such studies is great, so it is understandable why results from such studies are limited. Appropriate vaccination with distemper and parvovirus vaccines probably affords long-term immunity (years) whereas vaccination with leptospirosis and kennel cough vaccines may last less than one year.

Core Versus Non-Core Vaccines

Core vaccines are those which should be given to every dog to provide protection against diseases that are serious, common or a risk to humans. These include parvovirus, distemper, adenovirus (infectious hepatitis) and rabies. Non-core vaccines are those given on the basis of risk assessment. These vaccines include coronavirus, parainfluenza, leptospirosis, bordetella, Lyme disease and giardia.

Maternal Antibodies

Newborns can respond immunologically at birth, but the response is slow and inferior compared to older animals. Protection for newborns is provided by antibodies that are passed in the colostrum from the dam to the puppies during first 24-72 hours after birth. Eighty-two percent to 98% of the maternal antibodies come from the colostrum, while only 2-18% of antibodies are transferred in utero. The amount of antibody the pups receive depend on the antibody titer of the dam and how much colostrum each pup receives. Maternal antibodies can interfere with the ability for puppies to respond to vaccination by inactivating the vaccine just as it was the real disease. Vaccination, therefore, starts at 6-8 weeks of age when the levels of maternal antibodies are waning. There is a critical period of susceptibility to disease for puppies when there are not enough maternal antibodies to protect the puppies from disease, but too many antibodies to allow for active immunization. Exposure to disease during this time may result in sick puppies even though they may have received one or more vaccinations. The most common example is exposure to parvovirus.

Types of Vaccines

The two most common types of vaccines are modified live (attenuated) and non-infectious or killed vaccines. There are newer types of vaccines becoming available that include recombinant vector, recombinant protein and purified subunit vaccines. The infectious agent in modified live (MLV) vaccine has been modified so that it will produce an immune response but not cause disease as it replicates in the body. The advantages of MLV vaccines are that they provide rapid protection of a long duration, they are less allergenic, they produce cell-mediated, humoral and local immunity, they overcome maternal antibody more quickly and can often protect with one dose. Disadvantages of MLV vaccines include the risk of contamination with other infectious agents, the possibility of producing disease in immunocompromised patients, the possibility of reversion to virulence and the need to be handled more carefully to maintain effectiveness. Killed vaccines have the advantages of being safer in immunocompromised patients, not reverting to virulence and they are more stable in storage. The disadvantages, however, are that killed products are more likely to cause allergic reactions because they contain more foreign protein, they require the addition of adjuvants (non-specific immunostimulants), they require that two doses be given initially, they require more frequent revaccination and they don't stimulate much cell-mediated immunity or local immunity. In regard to the newer types of modified live vaccines, the recombinant vector vaccines take the genetic code for key immunogenic proteins and insert them into a non-pathogenic organism like pox virus, herpes virus, bovine papillomavirus or Simian virus 40. The goal is to stimulate immunity without the potential of causing disease. Examples of this vaccine are Merial's Recombitek CDV for distemper and Recombitek-R for rabies protection. The newer types of non-infectious vaccines are a purified subunit vaccine containing just the specific proteins to stimulate a good immune response (Pfizer's Leukocell-2 vaccine for cats) and the recombinant protein vaccine where the desired gene is cloned into an organism that produces a desired protein then the protein is harvested and purified (Merial's Recombitek Lyme vaccine).

Vaccine Failures

Not all vaccines will effectively immunize due to host factors, vaccine factors or human factors. Host factors include whether the animal is incubating a disease, is debilitated or malnourished, has a high or low temperature, has existing maternal antibodies or some form of immunodeficiency. Vaccine factors that may cause failure to immunize include improper storage or handling, strain differences between the vaccine and the actual infectious agent, excessive attenuation and reversion to virulence. Human factors that cause vaccine failure are improper vaccination protocol, vaccine interference, improper mixing, improper route of administration, improper disinfectants and the concurrent use of some antimicrobials.

Adverse Reactions

Complications can develop after routine vaccination that can be immunologic or non-immunologic. Immunologic reactions include Type I immediate hypersensitivity or anaphylaxis usually caused by killed vaccines especially *Leptospira* bacterin and rabies vaccine. Miniature Dachshunds seem to have a higher incidence of this type reaction than other breeds. Immune-mediated hemolytic anemia and thrombocytopenia are examples of Type II hypersensitivity. Modified live adenovirus-1 vaccine can cause Type III hypersensitivity (uveitis). Non-immunologic reactions include local injection site reactions, cutaneous granulomas, especially in Poodles and Bichon Frises, systemic fever and malaise. If modified live vaccines are given during pregnancy, vaccine infections can result in fetal malformations, death or abortion. Neonatal infections can occur if puppies less than 4-5 weeks of age are vaccinated with MLV vaccines. Some related Akitas have developed polyarthritis after receiving vaccines especially MLV. The dogs often must be euthanized by 2 years of age due to progressive disease and renal failure. Young Weimaraners with a primary immunodeficiency defect can develop hypertrophic osteodystrophy (HOD) and juvenile cellulitis usually associated with attenuated distemper vaccine. Vaccines can also cause illness if given to an immunocompromised animal, if the vaccine given is incompletely attenuated or if the vaccine is contaminated with another virus. Adverse reactions should always be reported to the manufacturer of the vaccine and to the U.S. Pharmacopia on-line at <http://www.usp.org/prn/vprp.htm> or by calling 1-800-487-7776.

Recommended Sites for Vaccination

The location where vaccines are given along with the manufacturer, type of vaccine and serial number should be recorded in the medical record. Site recommendations include giving the DA₂PP(L) subcutaneously in the right shoulder and rabies subcutaneously or intramuscularly in the right rear leg. Other vaccines and sites should be recorded in the medical record also.

Vaccination Protocol for Dogs at UF VMTH

Distemper, adenovirus type 2, parainfluenza and parvovirus (high titer) are given starting at 6-8 weeks of age and repeated every 2-4 weeks until the puppy is 16 weeks of age, Leptospirosis is included in the combinations when the puppy is ≥ 9 weeks of age. DA₂LPP is repeated in 1 year and then given on a biannual basis opposite rabies vaccine. Rabies is given at 12-16 weeks of age, repeated in 1 year and then given biannually (Alachua County requirements). Bordetella/parainfluenza is given intranasally to dogs at risk for infection at > 3 weeks of age or 7-14 days preboarding and repeated every 6-12 months of age. Corona virus vaccine, Lyme vaccine and giardia vaccine are not currently used at the UF VMTH.

CURRENT CANINE VACCINES

Distemper. Vaccinations against distemper usually produce solid and long lasting immunity. Reports of outbreaks of distemper in the 90's in the Midwest were found to be secondary to poor vaccination protocols or no vaccination at all rather than the appearance of a "new strain" of virus or ineffective vaccines. If distemper in puppies is a particular problem a heterotypic measles vaccine can be used for the first vaccination between 9-12 weeks of age. It will protect pups from distemper in the face of maternal antibodies. The vaccine must be given IM and not given later than 12 weeks of age so the pups don't develop permanent immunity to measles. Pups receiving measles vaccines require two more distemper vaccinations to provide immunity.

Infectious Canine Hepatitis. Canine adenovirus Type 1 causes hepatitis and the CAV-1 vaccine can cause acute anterior uveitis and corneal opacity (blue eye). To prevent this Type III hypersensitivity reaction CAV Type 2 vaccine is used to provide cross protection to hepatitis and reduce the risk of the adverse reactions.

Leptospirosis. Leptospira bacterin is the most allergenic component of most vaccines and can result in anaphylaxis. Combinations with other killed products such as coronavirus can increase the risk of anaphylaxis. Vaccination reduces the severity and incidence of the disease but not the carrier state. Immunity that is developed is of short duration (6-8 mos.). Also the serovars in the vaccine (canicola and icterohemorrhagica) are not cross protective to the serovars of the disease more commonly diagnosed (bratislava, grippotyphosa and pomona). Puppies should not be given Lepto until they are ≥ 9 weeks of age because the bacterin can be immunosuppressive in young pups.

Infectious Tracheobronchitis. Infectious tracheobronchitis (kennel cough complex) can be caused by multiple agents that include parainfluenza, bordetella, adenovirus-1, adenovirus-2, herpes virus, distemper, reovirus and mycoplasma. The most common pathogens are parainfluenza and bordetella. The best protection seems to come from a modified live combination product of parainfluenza and bordetella that is given intranasally. The intranasal product begins protecting within 4 days by stimulating local immunity in the nasal cavity (IgA). The intranasal product protects against clinical disease and shedding of the virus. It can also produce mild clinical signs post vaccination. The vaccine can cause serious disease if given parenterally by accident. The injectable form of parainfluenza/bordetella is not as effective as the intranasal vaccine due to the mucosal nature of the disease. Two doses are required for protection and it protects against clinical disease but not virus shedding.

Canine Parvovirus. Breeds that seem more susceptible to parvovirus include Dobermans, Rottweilers, Labrador Retrievers, American Staffordshire Terriers and German Shepherds. The disease is most common in puppies < 6 months of age and is rare in dogs > 1 year of age. Maternal antibodies can interfere with active immunization so there is a critical period of susceptibility that was previously discussed. When giving conventional parvo vaccines it was previously recommended to give the last vaccine at 18-22 weeks of age especially for susceptible breeds. There is a new high titer/low passage vaccine that contains more virus and is more immunogenic, therefore, overcoming maternal antibodies and stimulating active immunity more quickly. Most manufacturers claim most puppies are protected by 12 weeks. It is recommended to vaccinate at 16 weeks to protect as many puppies as possible.

Canine Corona Virus. Coronavirus is primarily a disease of puppies usually < 6 weeks of age and is self-limiting. Studies show that if parvovirus infection is prevented, canine coronavirus is almost nonpathogenic. Vaccination should be considered in a kennel situation with confirmed coronavirus illness in young puppies.

Lyme Disease (Borrelia burgdorferi). Ninety-nine percent of Lyme disease cases occur in the northeast and mid Atlantic coast, the upper Midwest near the Great Lakes and in the Pacific northwest. Tick control is most important as it takes 24-48 hours to transmit the organism during the feeding of ticks on the dog. Vaccines should be given to “at risk: dogs in endemic areas beginning at 9-12 weeks of age and repeated in 3 weeks then repeated annually or if at risk.

Rabies. Rabies is an important vaccine to be given especially since once humans and animals develop the clinical signs of the disease it is 100% fatal. Rabies is a killed product and highly allergenic. It is very high in antigen and adjuvant so that animals can be protected with one dose instead of two doses 3-4 weeks apart.

Giardia. There is a vaccine available for Giardia called Gardiavax by Ft. Dodge. It apparently will prevent clinical disease and reduce the severity and duration of cyst shedding. The vaccine is recommended to be given at 8 weeks of age and repeated in 2-4 weeks. It has a demonstrated duration of immunity of 1 year after challenge. The vaccine should only be considered on the basis of risk assessment.