

## THE PET HEALTH LIBRARY

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### Distemper

#### ***(Q&A below)***

Most of us have heard of distemper infection for dogs and gather it is bad. The basic vaccine for dogs is "the distemper shot," which vaccinates against distemper, parvovirus and some minor kennel cough agents. Luckily, this is all most people ever hear of distemper. If you are reading this, however, you probably have a dog that is suspected of having this dreaded infection.

The typical distemper suspect is a rescue or pet store dog or puppy, usually with questionable vaccination history or an as yet incomplete vaccination series. The dog or puppy has been housed with other rescue dogs.



Symptoms begin with:

- Goopy eye and nose discharge
- Fever, which often comes and goes unnoticed
- Poor appetite
- Coughing and development of pneumonia

The virus is attacking interfaces of the body with the environment (the mucous membranes) and starts with the respiratory tract, hence the pneumonia, but it does not stop there. The virus moves on to produce:

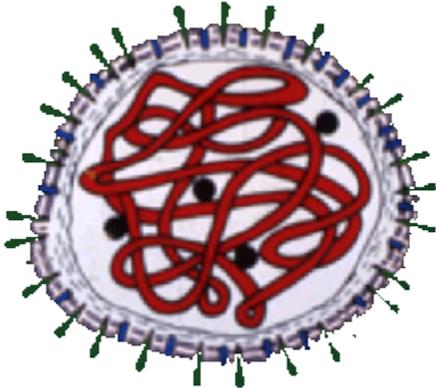
- Vomiting and diarrhea
- Callusing of the nose and foot pads (hence one of the old names for distemper – hard pad disease).

After completing what is called the mucosal phase of infection where environmental interfaces are attacked (as described by the above GI and respiratory disease), the virus proceeds to the central nervous system for its neurologic phase leading to:

- Seizures, classically starting with snapping or tremors of the jaws that progress to convulsions of the whole body. This distemper classic sign is called a chewing gum fit.
- Seizures are not the only distemper sign by any means. Tremors, imbalance, and limb weakness all may occur. Signs may progress to death or may become non-progressive and permanent. Recovery is also possible.

This means that the dog appears to recover only to break with neurologic disease 1 to 3 weeks later. Younger puppies or individuals with weak immunity often die during the mucosal phase while stronger individuals may have relatively mild mucosal signs and not appear ill until the neurologic phase strikes.

## The Virus Itself



The canine distemper virus is closely related to the human measles virus and in years past puppies were immunized for distemper with the vaccine against measles. It has been said that a child in the home of a dog vaccinated with live distemper virus vaccine will become exposed to the virus and immunized against the measles (we do not recommend such experiments at home).

The distemper virus consists of a single strand of RNA, encased in a protein coat which is again encased in a fatty envelope. This sounds esoteric but the fatty envelope makes all the difference in the world. The fatty envelope is easily disrupted in the environment which makes it impossible for infectious virus to persist in the environment. Because an intact fatty envelope is required for infection, virus

transmission must involve dog to dog contact or at least contact with extremely fresh (less than 30 minutes old at 60 degrees and up to 3 hours old at room temperature) infected body secretions. As with other viruses, living virus happily freezes and can survive for years if kept frozen and protected from light. Routine disinfection and cleaning readily kills the distemper virus in the kennel setting.

## Transmission and Infection

The infected dog typically infects other dogs via coughing infected respiratory secretions though the virus is shed in most other body secretions, including urine. The virus enters the new host via the nose or mouth and promptly begins to replicate. The virus is engulfed by cells of the immune system called macrophages. The idea is that the virus will be engulfed, walled off within the cell, and then destroyed by enzymes. Unfortunately for the new host, this process does not damage the virus as intended; instead, the virus is able to use the macrophage as a means of transportation through the host's body. Within 24 hours, the virus has traveled to the lymph nodes of the lung. By the 6th day, the virus has migrated to the spleen, stomach, small intestine, and liver. Fever is developing at this point.

By day 8 or 9 an important crux is reached in the timetable of infection. The host is mounting an immune response during this time and the outcome depends on how fast and how well this is accomplished. A strong immune response begins to clear the virus at this point and has eliminated all traces of virus with no symptoms of illness by Day 14. A weak immune response allows the virus to reach the epithelial cells, the cells that line every interface the body has with the outside world. The tender epithelial cells lining the chambers of the brain are infected as well. The host begins to get sick as the virus spreads, but as the host's immune response grows symptoms wane. This phenomenon accounts for the wide variability in symptoms; some dogs get only a few mild symptoms while others get a full lethal combination.

After clearing from most internal organs, the virus is able to hide out for long periods of time in the nervous system and skin. Because of this phenomenon, callusing of skin or - much worse - seizures may occur long after the infection was thought to be cleared.

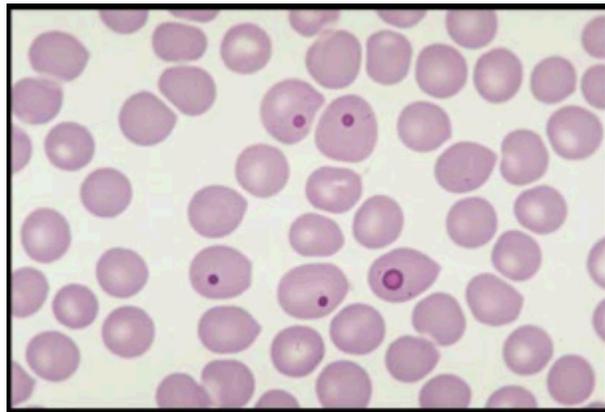
Most cases in the U.S. involve puppies. The colostrum suckled in the first day or so of life will provide them with a solid reflection of their mother's immunity. This immunity will have waned by age 16 weeks, leaving the puppy vulnerable if vaccines have not been administered for further protection. In our society most mother dogs will have received some form of vaccination and thus be able to pass on at least some immunity and will have some ability to protect herself. In societies where vaccination is not common, distemper attacks dogs of all ages.

## Confirming the Distemper Infection

As if it is not bad enough that this infection has a poorly defined endpoint so you never know for sure if the dog is out of the woods, it is almost impossible to confirm a distemper diagnosis. Because of this, distemper is a clinical diagnosis, which means that rather than confirming infection with a test that is negative or positive, the veterinarian must look at the whole picture: what symptoms are there, is the history typical, etc. The virus itself remains elusive so that positive test results are meaningful in confirming the infection, but negative results do not rule it out. The following are tests that can be used.

#### *Distemper Inclusion Bodies*

Distemper inclusion bodies are clumps of virus that are visible under the microscope within infected cells. Post-mortem inclusion bodies are readily visible in the urinary bladder tissue, thus making confirmation of distemper after death relatively easy. In the living patient, we typically have ready access to blood cells and cells of the eye's conjunctival membranes (the pink park of the eye socket). To enhance the visibility of inclusion bodies, immunocytology is used. In this technique, antibodies against distemper virus are tagged with fluorescent markers. The antibodies bind to virus, if it is present, effectively dyeing the inclusion body with glow-in-the-dark fluorescent color. The presence of inclusion bodies confirms distemper infection. The lack of detectable inclusion bodies does not rule out distemper infection as inclusion bodies ultimately become coated with the host's own antibodies, which in turn block the fluorescent-tagged antibodies used in the test.



If callusing of the footpads or nose is evident, a biopsy of this tissue can be tested for inclusion bodies fairly late in infection.

#### *Distemper Antibody Levels*

Distemper titers (another word for antibody level) of either the IgM type (produced in early stages of infection) and the IgG type (produced in later phases of infection) can be checked. The problem is that distemper vaccination induces these same antibodies, and often distemper suspects have recently been vaccinated. A high IgM titer indicates recent infection or recent vaccination, but there is no way to tell which.

#### *PCR Testing*

Polymerase chain reaction (PCR) testing involves amplification of the presence of DNA so as to allow detection of very small amounts of virus. Since the distemper virus is an RNA virus, not a DNA virus, a test called reverse transcriptase PCR must be used but the amplification concept is the same. Vaccination will interfere with PCR testing for approximately 2 weeks (i.e., the modified virus from the vaccine will be detected creating a false positive). Newer testing technology has made it possible for the amount of viral RNA to be measured and expressed as an amount. This process has made it much easier to distinguish true infection from recent vaccination.

#### *Cerebrospinal Fluid Antibody Levels*

In neurologic distemper cases, cerebrospinal fluid is often tapped and distemper antibody levels

checked. Distemper antibodies in cerebrospinal fluid are highly indicative of distemper infection as vaccine-induced antibodies do not cross the blood-brain barrier into the CSF fluid.

### **Treatment for Distemper**

Many bizarre protocols have emerged over time as we grope for meaningful anti-viral therapy. The fact remains that recovery from distemper is all about immunity and the only real treatment is supportive care while the patient mounts an immune response. If the patient has pneumonia, antibiotics are used on the secondary bacterial infections. Airway dilators are used as needed. Physical therapy is used to promote coughing. If the patient has diarrhea, intravenous fluids are used to prevent dehydration.

Distemper is extremely variable in its ability to produce symptoms and recovery occurs at any stage. This has led to assorted therapies being credited with effect when what was more likely witnessed was the natural removal of the infection by the host's immune system.

Neurologic distemper is particularly difficult to treat. Still, it is possible for dogs to recover with livable deficits even from neurodistemper; euthanasia is best left for progressive, incapacitating neurologic symptoms.

### **Preventing Infection**

If confirming diagnosis and therapy are the pitfalls of distemper, prevention is the easy part. Effective distemper vaccination has been available since the 1950s. Prior to widespread vaccination, distemper was the scourge of the canine community, wiping out entire towns of pet dogs. Today, distemper is a rare disease except in the shelter, rescue, and pet store world.

The "distemper shot" is the basic immunization for dogs. It is generally combined with vaccine for canine parvovirus as well for parainfluenza, adenovirus 2, leptospirosis, and sometimes coronavirus. Puppies are vaccinated beginning at age 6-8 weeks and then every 2 to 4 weeks thereafter until age 16 weeks. The next vaccine is one year later. After that subsequent vaccination boosters are given every 1 to 3 years or based on antibody levels depending on the policy of the supervising animal hospital.

Vaccine is available in the traditional modified live virus format, where distemper virus is modified to induce immune-response but not illness. Vaccine is also available in the recombinant format where a live harmless virus (not the distemper virus, modified or otherwise) is used to carry the portion of the distemper virus which generates the immune-response. The benefit of the recombinant format is that it is completely impossible for distemper or distemper encephalitis to occur as the result of vaccination. These complications are exceedingly rare but still possible with modified live virus vaccine.

The use of the human measles virus to vaccinate against canine distemper is largely passé nowadays. Immunity obtained this way does not last as long and is not as successful as that obtained with a modified live or recombinant distemper vaccine.

### **The Neurologic Phase**

Classically, the neurologic phase of distemper occurs 1 to 3 weeks after the mucosal phase resolves but can potentially occur months afterwards. Sometimes the mucosal phase is so minor that it is not noticed, as might occur in a dog that is older or has received some vaccines but not enough for full protection. For these dogs, the neurologic phase seems to come out of nowhere. Often a dog can survive even a severe mucosal phase, but the development of a neurologic phase is a more serious blow to the dog's ability to recover.

A wide variety of neurologic signs are possible: twitching, seizures, vestibular signs, neck pain and muscle rigidity have all been described. A classic type of seizure is called the chewing gum fit, as described above, and often the appearance of this type of seizure clinches the distemper diagnosis if there was any question. Neurologic signs tend to be progressive, becoming more severe and frequent, but in some patients they seem to arrest and become permanent at a certain level. For some dogs this might mean a muscle tic. For others, it involves seizures or other symptoms that can be controlled or palliated with medications. If symptom progression stops, hopefully the symptoms the dog is left with will leave enough room for good life quality and euthanasia will not be necessary.

Whether or not the virus is able to penetrate the central nervous system seems to depend on the dog's ability to make antibodies against the outer envelope of the virus. Dogs that mostly make antibodies against the core proteins of the virus are not able to keep the virus out of their nervous systems. However, what happens once the virus reaches the nervous system depends on the strain of the virus as well as the host's immunological ability at the time of the infection. Not all dogs with nervous system infection experience nervous system symptoms. There is currently no way to predict which dogs will develop symptoms and which ones will not.

## **Q&A**

It seems that here we have a disease for which a lethal outcome is possible yet there is no test to confirm the infection and no way to determine if the infection is truly over with. The owner of a distemper suspect will have numerous questions and here we attempt to answer questions that may not have been overtly covered in the above text.



***I own a young dog with very badly stained and pitted teeth. I was told this might indicate she had distemper as a puppy. How would distemper have caused this?***

The distemper virus attacks epithelial cells. These are cells that line the interfaces with the environment, including the mouth. In puppyhood the buds of the permanent teeth are still developing from epithelial cells. The distemper infection and associated fevers can leave these tooth buds permanently damaged so that the adult teeth come in with stained and pitted enamel. This is called enamel hypoplasia.

***Is there any way to predict whether a dog with distemper will progress to the neurologic phase?***

Not really. The phase of infection that precedes the virus entering the central nervous system is the phase where the skin is attacked. Callusing of the nose and foot pads tends to be associated with development of neurologic distemper. As a general rule, about 50% of dogs that recover from the mucosal phase will progress to neurodistemper. Of the dogs that develop neurodistemper, it has been said that about 50% will do so within a month or two of the mucosal phase. Our impression is that 50% is probably a bit of an over-estimation. The risk of progressing to neurodistemper is less in adult dogs as they tend to mount more effective immune responses than puppies do.

***We owned a dog that died and was suspected of having distemper. How should we disinfect our home before a new dog is introduced?***

One of the few positive aspects of distemper is that the virus cannot live without fresh secretions; it is inactivated in minutes outside the living host's body. Minimal disinfection is necessary.

***How long is a recovered dog contagious?***

A recovered dog may shed virus up to 2 to 3 months. It is important to keep this in mind when taking a recovered pet anywhere where there are other dogs. The most intense viral shedding occurs in the first 2 weeks of infection.

### ***What is "Old Dog Encephalitis?"***

The condition called "Old Dog Encephalitis" refers to a chronic brain inflammation that can occur in a dog that had distemper many years prior. These brain lesions are identical to those in dogs who progress to a chronic neurologic distemper as part of the brunt of their infection. For some reason, in some individuals, the dog lives nearly all its life as a distemper survivor only to break with neurodistemper in old age.

### ***What is vaccinal distemper? Can a dog actually get distemper from its vaccine?***

Vaccinal distemper refers to the development of neurodistemper 10 to 21 days after administration of a modified live distemper vaccine (it is not possible to have this reaction when a recombinant vaccine is used).

### ***Can humans get infected with the canine distemper virus?***

Humans can get infected with the virus, meaning the virus seems able to replicate in the human body, but no illness results. At one time, multiple sclerosis was thought to be associated with exposure to the canine distemper virus but further research suggests that it is actually the human measles virus (a close relative of canine distemper) that may be the culprit. It does not appear that there is any human hazard in the canine distemper virus.

### ***Should a recovered dog continue to receive distemper vaccinations?***

Technically, if a dog has recovered from the distemper virus the resulting immunity should be lifelong and vaccination is unnecessary. That said, the "distemper vaccine" is actually a combination vaccine covering up to 7 infections, including canine parvovirus. You may not want to skip these other important vaccinations. Further, as discussed, confirmation of distemper infection can be problematic. This begs the question as to whether there is any harm to vaccinating with a product that includes a possibly unnecessary distemper vaccine. In fact, if a dog has recovered from distemper, there will be a rapid antibody response against the distemper vaccine live virus and it will be inactivated just as a natural infection would be. So the answer to this question is that while a recovered dog does not need distemper vaccination, there is no harm in continuing to give the vaccine and reaping the benefit of the additional infections typically covered in the product.

If you have a distemper question, we would love to add it here as others may benefit. Feel free to use the Ask a Vet feature on the [Veterinary Partner home page](#).

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