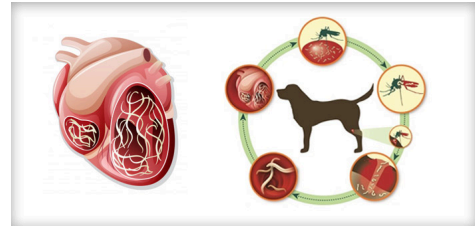




Canine Heartworm Disease



Heartworm disease, or dirofilariasis, is a serious and potentially fatal disease. It is caused by a blood-borne parasite known as *Dirofilaria immitis*.

The life cycle of the heartworm is complicated; the parasite requires the mosquito as an intermediate host before it can complete its life cycle in the dog. The mosquito is needed for the life cycle of heartworm. As many as 30 species of mosquitoes can transmit heartworms. The life cycle begins when a female mosquito bites an infected dog and ingests the microfilariae during a blood meal. The microfilariae develop further for 10 to 14 days in the mosquito's gut and then enter its mouthparts. At this stage, they are infective larvae and can complete their maturation when they enter a dog. The infective larvae enter the dog's body when the mosquito bites the dog.

These infective larvae migrate into the bloodstream and move to the heart and adjacent blood vessels, maturing to adults, mating, and reproducing microfilariae within 6 to 7 months.

Female adult heartworms are 6 - 14" long (15 - 36 cm) and 1/8" wide (3 mm). Males are about half the size of females. One dog may have as many as 300 worms present when diagnosed. Adult heartworms may live for five to seven years. During this time, females produce millions of offspring called microfilaria. These microfilariae live mainly in the small vessels of the bloodstream.

Canine heartworm disease occurs all over the world. In the United States, the highest numbers of reported cases are still within the southeastern US, but it has been detected in all 50 states. Factors that affect the prevalence of heartworm infection include the species of mosquitoes, the climate, and the presence of reservoir animals. The risk of infection is greatest when mosquitoes are actively feeding. This typically requires temperatures over 50°F. Since transmission requires the mosquito as an intermediate host, the disease is not spread directly from dog to dog. Spread of the disease therefore coincides with mosquito season, which can last year-round in many parts of the United States.

It can take several years before dogs show clinical signs of infection. Dogs of any age, breed or sex may be affected. The disease is rare in dogs less than one year of age, however, because the microfilariae take 5 to 7 months to mature into adult

heartworms after infection. Unfortunately, by the time clinical signs are seen, the disease is usually well advanced.

Adult heartworms cause heartworm disease through their effect on the heart and blood vessels that lead from the heart to the lungs (pulmonary arteries). They cause chronic inflammation that leads to scarring and narrowing of the pulmonary arteries and thickening (fibrosis) of the surrounding lung tissue. These irreversible changes cause pulmonary hypertension (increased blood pressure in the vessels of the lungs), which means the heart has to work harder to pump blood to the lungs for oxygen. Worms can also interfere with heart valves, further worsening workload on the heart. This will ultimately lead to heart failure. Heartworms may also affect the kidneys or the liver through damaging effects of the body's reaction to them being in other vessels in the body (caudal vena cava). The signs of heartworm disease can depend on the location of the worms, the length of time the worms have been in the dog, and the degree of damage that has been sustained by the heart, lungs, liver, and kidneys. Even low numbers of worms can cause signs of severe heartworm disease.

Microfilaria (immature heartworms) circulate throughout the body but remain primarily in the small blood vessels. Because microfilariae are about as wide as the small vessels, they may block blood flow in these vessels. The cells being supplied by these vessels are then deprived of the nutrients and oxygen normally supplied by the blood. Microfilariae primarily injure the lungs and liver. Destruction of lung tissue leads to coughing. Liver injury leads to cirrhosis of the liver, causing jaundice, anemia, and generalized weakness. The kidneys may also be affected and allow toxins to accumulate in the body.

The most obvious clinical signs of heartworm disease are a soft, dry cough, shortness of breath, weakness, listlessness, and loss of stamina. All of these signs are most noticeable following exercise, when some dogs may even faint or become disoriented. Your veterinarian may notice abnormal lung and heart sounds when listening to the chest with a stethoscope. In advanced cases, congestive heart failure may cause the abdomen and legs to swell from fluid accumulation. There may also be evidence of weight loss, poor condition, and anemia.

It is highly recommended that all dogs are tested at least once per year for heartworm disease. This is usually referred to as a "4DX" test; this is a diagnostic test that checks for exposure to heartworm disease, as well as 3 tick-borne diseases. If a dog tests positive for heartworm disease, the veterinarian will take a small drop of blood and examine it under the microscope. This will confirm a diagnosis of heartworm disease if there is evidence of microfilaria in the blood sample. Additional diagnostics may include radiographs and/or a cardiac ultrasound to evaluate the extent of the disease, especially in pet's without a known medical history (stray/rescue animals).

Once a dog has been diagnosed with heartworm disease, the veterinarian will begin a treatment plan. Treatment to kill adult heartworms requires an injectable drug, melarsomine (brand name Immiticide® or Diroban®). Melarsomine kills the adult

heartworms in the heart and adjacent vessels. This drug is administered in a series of injections. Your veterinarian will determine the specific injection schedule according to your dog's condition. Most dogs receive an initial injection, followed by a 30-day period of rest, and then two more injections that are given 24 hours apart. Many dogs will also be treated with an antibiotic (doxycycline), to combat potential infection with bacteria (Wolbachia) that inhabit the heartworm.

Complete rest is essential after treatment. The adult worms die in a few days and start to decompose. As they break up, they are carried to the lungs, where they lodge in the small blood vessels and are eventually reabsorbed by the body. This resorption can take several weeks to months, and most post-treatment complications are caused by these fragments of dead heartworms. This can be a dangerous period, so it is absolutely essential that the dog be kept as quiet as possible and is not allowed to exercise for one month following the final injection of heartworm treatment. The first week after the injections is critical because this is when the worms are dying. A cough is noticeable for seven to eight weeks after treatment in many heavily infected dogs. If the cough is severe, notify your veterinarian for treatment options.



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Heartworm Treatment Guidelines for the Pet Owner

The American Heartworm Society recommends the following heartworm treatment protocol for dogs. This method

effectively eliminates most heartworm infections when closely followed by both you and your veterinarian. The overall goals of treatment are to safely and successfully eliminate current adult and immature heartworms, prevent new infections and minimize treatment related complications in your dog. The recommended treatment consists of the 5 steps outlined below.

Initial Treatment (Day 0) From the moment your dog is diagnosed with heartworm disease your dog must be kept strictly confined! That means your dog should be restricted to a very small area at all times throughout the entire treatment period (the use of a small cage or crate may be necessary), and continuing for 6 to 8 weeks after the last injection of melarsomine (the drug that kills adult heartworms). To ensure exercise restriction, your dog must be kept on a leash when going outside. Your veterinarian will tell you when it is permissible to gradually allow your dog to exercise again. Your dog will be started on a once-monthly medication called a “preventive,” to kill immature heartworms and prevent new infections from developing. You should continue to give it to your pet throughout treatment as well as for the rest of his/her life. Your dog will also be given the antibiotic doxycycline or minocycline for 30 days. This medication kills bacteria which live in the heartworms. These bacteria help the worms survive and reproduce. They also may cause worsening inflammation when adult heartworms die. By giving this antibiotic prior to the medication that will kill your dog’s heartworms, we decrease the likelihood of complications from the treatment and optimize the chance for complete elimination of the infection.

First Adulticide Treatment (Day 60) Two months after starting heartworm preventive, you will need to bring your dog to the clinic for the first injection of melarsomine, the drug that kills adult heartworms. Because complications can occur, your veterinarian might require your pet to stay in the clinic for observation. Upon discharge, your veterinarian may also prescribe prednisone or another anti-inflammatory medication for your dog to reduce side effects.

Second Adulticide Treatment (Day 90) One month after the first injection, two additional injections of melarsomine must be given 24 hours apart. Once again, your dog may need to stay at the clinic during this treatment period.

Interim Assessment of Health and Microfilaria Status (Day 120) Your veterinarian will examine your dog to determine his/her status following treatment. This examination will include a careful physical examination with an emphasis on the heart and lungs as well as testing for circulating immature stages of heartworm (microfilaria). This interim assessment will help your veterinarian determine when your pet can gradually resume more vigorous physical activity. If microfilaria are still present, your veterinarian may prescribe an additional medication to help eliminate them and then retest at Day 150 to assess effectiveness.

Final Assessment of Efficacy (Day 365) Your veterinarian will test your dog's blood to assess the success of adulticide treatment. The goal is to eliminate all stages of heartworms from your dog.

Home Care – Your Responsibility Throughout the recovery period, please watch your pet for coughing, gagging, vomiting, diarrhea, or loss of appetite. Excessive sluggishness, respiratory distress, and coughing up blood are signs of a serious problem that require immediate veterinary attention. The most important thing you can do to minimize complications during treatment is to restrict your pet's exercise before, during and after the melarsomine injections. When adult worms die, they collapse and are pushed deeper into the smaller branches of the vessels that supply blood to the lungs. Because exercise increases blood flow to the lungs, it increases the likelihood that dead worms will block blood flow. This can result in severe complications and possibly death. The importance of restricting your dog's activity cannot be overemphasized.