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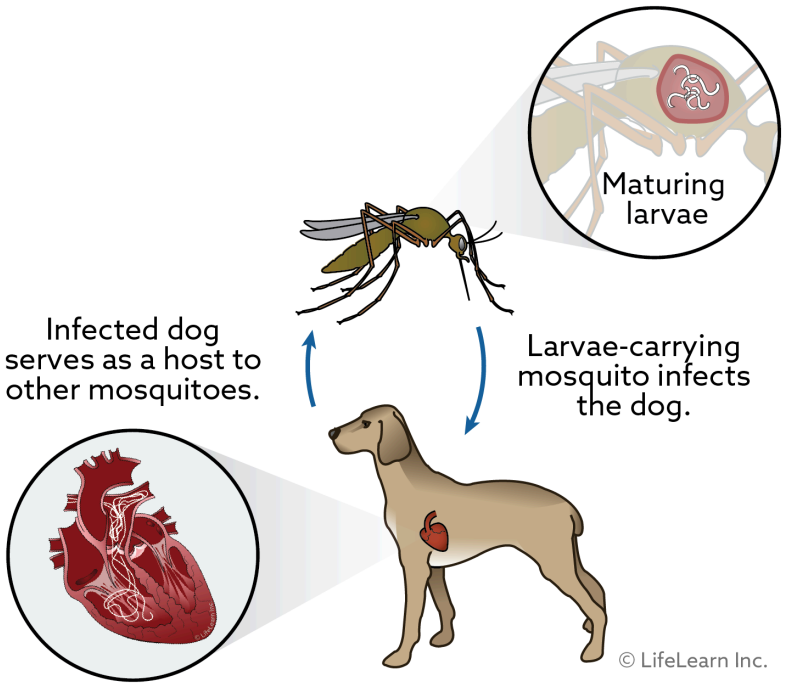
Heartworm Disease in Dogs

What causes 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*.

Adult heartworms are found in the heart, pulmonary artery (one of the big blood vessels from the heart), and adjacent large blood vessels of infected dogs. Rarely, worms may be found in other parts of the circulatory system. 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.



What is the life cycle of the heartworm?

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.

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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.

Where is heartworm disease found?

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. In Canada, the disease is problematic in areas where mosquitoes are prevalent, such as along waterways and coastlines in many provinces. Affected regions include southern British Columbia, Manitoba, Ontario, Quebec, and New Brunswick.

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 (10°C).

How is heartworm disease spread?

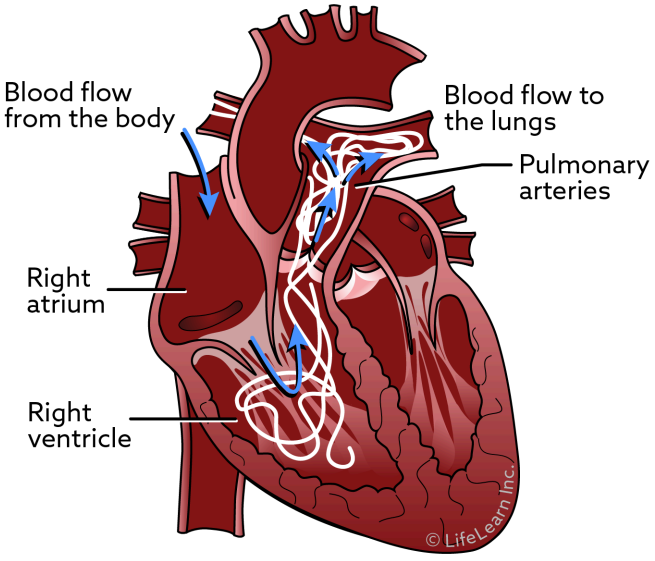
Since transmission requires the mosquito as an intermediate host, the disease is not spread directly from dog to dog. Spread of the disease therefore coincides with mosquito season, which can last year-round in many parts of the United States. The number of dogs infected and the length of the mosquito season are directly correlated with the incidence of heartworm disease in any given area.

What do heartworms do to the dog?

It usually takes 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.



The pulmonary arteries carry blood to the lungs. If clogged with worms, the blood supply to other organs in the body is reduced.

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.

Dogs with heartworm disease don't show signs in the early stages of infection. Later, 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. Severely infected dogs may die suddenly during exercise or excitement.

Microfilariae (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.

How is heartworm disease diagnosed?

In most cases, one or more simple blood tests will diagnose heartworm disease. Further diagnostic tests are often required in heartworm-positive dogs to determine if the dog can safely undergo heartworm disease treatment. Some or all of the following diagnostic procedures are recommended before treatment is started:

- **Serological test for antigens** to adult heartworms (antigen test, ELISA). This test is performed on a blood sample. See the handout "Testing for Heartworm Disease in Dogs" for further details.
- **Chest X-rays (radiographs)** are often recommended in dogs with heartworm disease, to assess the extent of heart and lung damage present prior to beginning treatment.
- **Heart ultrasound (echocardiography)** may help to assess the degree of heart enlargement, function, and even see if worms are present in the heart and associated blood vessels.
- **Bloodwork** (complete blood cell count, serum biochemistry) may also be recommended prior to the treatment of heartworm disease, in order to assess for the presence of heartworm-associated organ damage.

How is heartworm disease treated?

There is some risk involved in treating dogs with heartworms, although fatalities are rare. Many dogs have advanced heartworm disease at the time they are diagnosed. This means that the heartworms have been present long enough to cause substantial damage to the heart, lungs, blood vessels, kidneys, and liver. Rarely, cases may be so advanced that it is safer to treat organ damage and keep the dog comfortable than it is to risk negative effects associated with killing the heartworms. Dogs in this condition are not likely to live more than a few weeks or months. Your veterinarian will advise you on the best treatment approach for dogs diagnosed with advanced heartworm disease.

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.

An antibiotic (doxycycline), is also recommended to better eradicate heartworm that may contain a symbiotic bacteria (*Wolbachia*) that inhabits heartworm and helps it survive.

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.

Prompt treatment is essential if the dog has a significant reaction in the weeks following the initial treatment, although such reactions are rare. Notify your veterinarian if your dog shows loss of appetite, shortness of breath, severe coughing, coughing up blood, fever, or depression. Treatment with anti-inflammatories, antibiotics, cage rest, supportive care, and intravenous fluids is usually effective in these cases.

In addition to the drug that is used to kill adult heartworms, your dog will receive a drug to kill microfilariae (heartworm larvae). Your dog may need to stay in the hospital for observation on the day this medication is administered, and this is often performed either before starting injections for adult heartworms. Following treatment, your dog will be started on a heartworm preventative.

Newer heartworm treatment protocols use a variety of drugs to kill the microfilariae. The “Slow-Kill” method of heartworm treatment involves continuous monthly administration of a heartworm preventive, along with oral doxycycline antibiotic. This method is not generally recommended as it takes a year or more to kill all the heartworms and during that time, they continue to cause damage. This also requires strict exercise restriction for a much longer period of time. It may be used if the risk of rapid-kill methods outweigh the benefits, when the dog is likely to die from an unrelated disease such as cancer, or melarsomine isn’t available. Your veterinarian will select the correct drug and administration time based on your dog's condition.

Are any other treatments necessary?

Dogs with severe heartworm disease may require antibiotics, anti-inflammatories, pain relief medications, special diets, diuretics to remove fluid accumulation in the lungs, and/or drugs to improve heart function prior to treatment for the heartworms. Even after the heartworms have been killed, some dogs may require lifetime treatment for heart failure. This includes the use of diuretics, heart medications such as ACE-inhibitors, beta-blockers or cardiac glycosides, and special low-salt diets.

What is the response to treatment and the prognosis post-treatment?

Dog owners are usually surprised at the improvement in their dog following treatment for heartworms, especially if the dog had been demonstrating clinical signs of heartworm disease. **Many dogs display increased energy and vitality, improved appetite, and weight gain.**

How can I prevent my dog from getting heartworm disease?

You can prevent your dog from getting heartworms by using a heartworm preventive approved by the FDA or Health Canada. In the United States, using a preventive is recommended year-round. Reducing mosquito exposure is also important in prevention. The American Heartworm Society recommends using an FDA- or EPA-approved insecticide designed for use on dogs to minimize mosquitos. Prevention or reduction of standing water and limiting outdoor activities during the peak mosquito times of dawn and dusk will also help prevent heartworm infection.

Dogs who have been successfully treated for heartworms are still vulnerable to reinfection. With the safe and affordable heartworm preventives available today, no pet should ever have to endure this dreaded disease. Consult your veterinarian to determine which heartworm preventive program is best for your dog.