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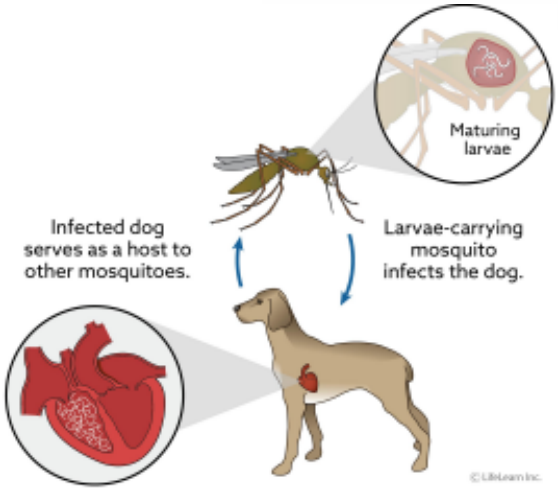
Heartworm Disease

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, 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.

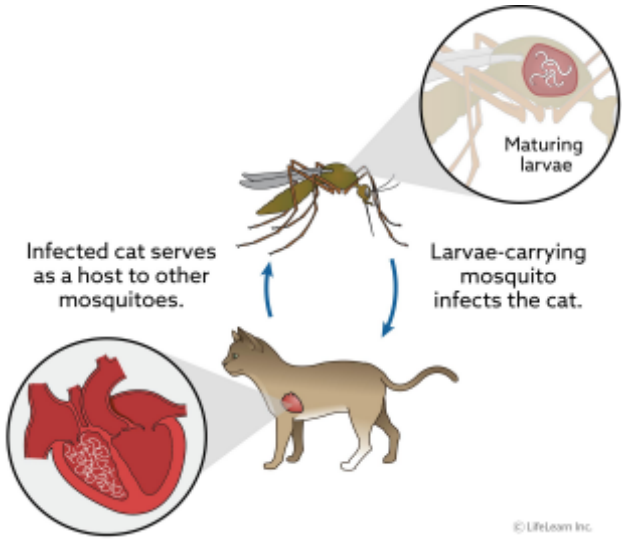


Adult heartworms may live up to five years. During this time, females produce millions of offspring called microfilaria. These microfilariae live mainly in the small vessels of the bloodstream.

Heartworm disease is much more common in dogs than in cats. However, recent studies of cats with heart and respiratory diseases have found an incidence of heartworms that is far greater than previously thought. Cats are relatively resistant to heartworm infection when compared to dogs, with the infection rate in cats reported to be 5-20% of the rate in dogs in the same geographic location; however, infection can still occur. Typically, cats have fewer adult worms than dogs, usually less than six. Many pet owners are surprised to learn that approximately 1/3 of infected cats live indoors only.

What is the life cycle of the heartworm?

The life cycle of the heartworm is complex and requires two host animals in order to complete it. Heartworms require the mosquito as an intermediate host and as many as 30 species of mosquitoes can act as this host and transmit heartworms. Mosquitoes ingest immature heartworm larvae, called microfilariae, by feeding on an infected cat or, more commonly, an infected dog. The microfilariae develop further for 10 to 30 days in the mosquito's gut and then enter its mouthparts. When an infected mosquito bites a cat, it injects infective larvae into the cat. The larvae migrate into the bloodstream, ending up in the right side of the heart and the pulmonary arteries. There they mature into adult heartworms capable of reproduction within about 6 to 7 months. Shortly thereafter, at around eight months after infection, they begin to produce a new crop of microfilaria that will live in the cat's blood for about one month. Cats are resistant hosts, and few circulating microfilariae are generally found.



Because of this life cycle, it is necessary for a cat to be bitten by an infected mosquito in order to become infected with heartworms. Heartworms are not transmitted directly from one cat to another or from a dog directly to a cat.

Where is heartworm disease found?

Canine heartworm disease occurs all over the world. In the United States, it was once limited to the south and southeast regions. The highest numbers of reported cases are still within 150 miles of the Gulf of Mexico and the Atlantic Ocean coastlines and along the Mississippi River and its tributaries. However, the disease is spreading and is now found in most regions of the United States, including California, Oregon, and Washington.

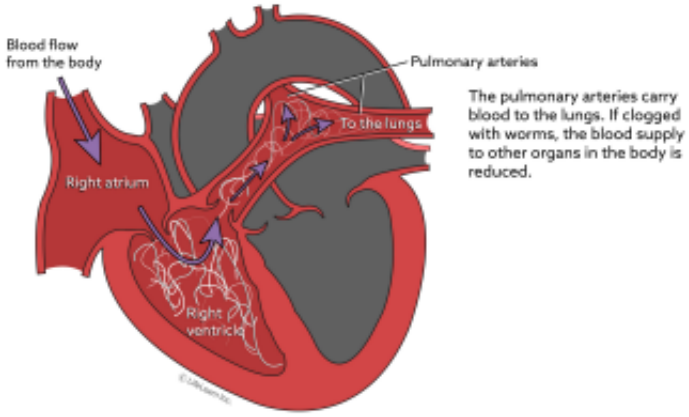
In Canada, the disease is problematic in areas where mosquitoes are prevalent, such as along waterways and coastlines in many provinces. The greatest number of Canadian cases occurs around the southern Great Lakes.

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. Consequently, the disease is diagnosed mainly in two- to eight year-old dogs. The disease is rare in dogs less than one year of age, 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 disease by clogging the heart and major blood vessels leading from the heart, including the pulmonary artery. They also interfere with the function of valves within the heart. By clogging the main blood vessels, the blood supply to other organs of the body is reduced, particularly blood flow to the lungs, liver, and kidneys. Decreased blood flow and decreased oxygen delivery can cause these organs to malfunction.

The signs of heartworm disease depend on the number of adult worms present, 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.

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). Microfilariae 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?

There are several methods used in diagnosing heartworms; unfortunately, none

are 100% reliable, so a combination of tests is often needed. Further diagnostic tests are often required in heartworm-positive dogs to determine if the dog can safely undergo heartworm disease treatment. The diagnostic sequence usually progresses as follows:

A) Clinical Signs

One of the most challenging aspects of diagnosing feline heartworm disease is that there are no specific clinical signs. The most common signs are a sudden onset of coughing and rapid breathing, signs that can also be caused by several other diseases.

Other common non-specific clinical signs include weight loss and vomiting. On occasion, an apparently normal cat may be found dead, or may develop sudden overwhelming respiratory failure, and heartworm disease is diagnosed on a post mortem examination. Sudden death is thought to be due to a reaction within the lungs to the young heartworms, or to a reaction to dead or live heartworms entering the pulmonary arteries and obstructing the flow of blood to the lungs.

Acute Clinical Signs	Chronic Clinical Signs
collapse	coughing
shortness of breath	vomiting
convulsions	shortness of breath
diarrhea/vomiting	lethargy
blindness	lack of appetite
rapid heart rate	weight loss
fainting	chylothorax (accumulation of fluid around the lungs)
sudden death	

B) Blood Tests
Several blood tests are used for heartworm diagnosis, but the heartworm antibody test and the heartworm antigen test are proving to be most helpful in diagnosing heartworm disease in dogs and cats. For dogs, a serological test is used to detect antigens to adult heartworms (antigen test, ELISA). This test is performed on a blood sample. Cats have a slightly more involved process.
1. The heartworm antibody test determines if the immune system has been exposed to heartworms. A positive test may indicate that an active infection is present. However, cats who have had heartworms but whose heartworms have died will also have antibodies for an unknown time. Cats with late stage larvae that are not yet adults, and cats with adult heartworms in places other than the heart, may also test positive with the antibody test. This test is relatively sensitive, so it is used first. If it is positive, the next test is performed.

2. The heartworm antigen test detects the presence of adult female heartworms. It is very specific, but not as sensitive as the antibody test. A positive test indicates that heartworms are present, but a negative test does not mean that they are absent. Because the cat must have at least two adult female worms present to have a positive test result, a negative test may mean that the cat has only a small number of worms or that all the worms present are male. The low worm burdens often seen in infected cats results in a high number of cats testing false-negative on antigen tests.

In summary, a diagnosis of feline heartworm infection is confirmed when both the antibody and antigen tests are positive, but not all infected cats will test positive on both tests.

3. A blood sample can be tested for the presence of microfilariae. However, less than 20% of cats with heartworms have microfilariae in their blood, and microfilariae are only present for one to four weeks. Although a positive test is diagnostic, a negative test means little.

4. An eosinophil count can be measured in cats suspected of harboring heartworms. Eosinophils are a type of white blood cell that occur in increased numbers when certain parasites are present. They are elevated in the presence of heartworms, but this elevation only occurs for a few months. This test is not specific, since cats with allergies or other parasites (e.g., intestinal worms, fleas) also commonly have increased eosinophil counts. An eosinophil count is often performed with a complete blood cell count (CBC) and serum chemistries during the initial diagnostic workup.

C) Radiographs (X-rays) permit your veterinarian to view the size and shape of the heart. They also allow measurements on the diameter of the pulmonary arteries. Many dogs and cats with heartworms have an increased size of the pulmonary arteries, or the arteries may appear blunted (suddenly come to an

apparent stop) on their way to the lungs, due to worms obstructing them. However, many other cats with heartworms have no abnormal findings on their radiographs, especially early in the infection.

D) Cardiac ultrasound or echocardiography allows the internal structures of the heart and surrounding vessels to be directly viewed and the condition and function of the heart to be assessed. In some animals, adult heartworms can actually be seen; this finding confirms the presence of heartworms. However, because most infected cats have a low number of worms this does not occur often.

How is heartworm disease treated?

There is some risk involved in treating dogs with heartworms, although fatalities are rare.

In the past, the drug used to treat heartworms contained high levels of arsenic and toxic side effects frequently occurred. A new drug is available that does not have as many side effects, allowing successful treatment of more than 95% of dogs with heartworms.

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 is an injectable drug, and it 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, 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.

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.

Treatment to kill microfilaria. 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 may be performed either before or after the 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. Your veterinarian will select the correct drug and administration time based on your dog's condition.

Cats are a little more complicated as there is no drug approved for treating heartworms in cats. One of the drugs used for treating dogs has been used in cats, but it causes significant side effects.

To complicate things further, when the adult heartworms die during this treatment, they pass through the pulmonary arteries to the lungs where the reaction to the dead and dying worms can cause sudden death. Thus, causing a dilemma when a cat is diagnosed with heartworms. If your cat is diagnosed with Heartworm your veterinarian will discuss the options with you.

Are any other treatments necessary?

Dogs with severe heartworm disease may require antibiotics, 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.

Is there a way to prevent heartworms?

Veterinarians now strongly recommend that all dogs and cats receive year-round monthly heartworm prevention. There are excellent heartworm preventives now available for dogs and cats, making prevention of heartworm disease safe and easy. Consult your veterinarian to determine which prevention program is best for your pet!