



**Veterinary Emergency
+ Referral Center**
of Hawaii

**Ettinger: Textbook of
Veterinary Internal Medicine, 7th Edition
Heartworm Disease
Clarke E. Atkins**

What is heartworm disease?

Heartworm disease (HWD) is a medical problem caused by the parasite *Dirofilaria immitis*, which can affect a number of mammals, including dogs, cats, and ferrets. It is carried by mosquitoes and, in the United States, is most common in the Southeast, East, and the Mississippi River valley, although it also occurs elsewhere.

These parasites are very large worms, measuring up to 12 inches long. They live predominantly in the pulmonary arteries (the large vessels which exit the right ventricle of the heart, carrying blood to the lungs).

The heartworm infection cycle consists of the following stages:

- When an infection consists of both male and female mature worms, reproduction occurs with resultant microscopic circulating babies (microfilariae [L1]). These are an important part of the life cycle because they allow infection of other animals to occur and, when found upon microscopic examination of the blood, allow the diagnosis of heartworm infection.
- For transmission of heartworms (HW) to occur, a mosquito must bite the infected dog, taking these immature worms along with the blood meal.
- These L1 develop in the mosquito, if environmental conditions are correct, in an average of 2 weeks.
- At this time the mosquito is infectious and transmits the infective larvae to a dog (the same or different dog from which it obtained the infection), cat, or ferret, while taking another blood meal.
- In the dog, the parasite develops further, migrating to the heart and pulmonary arteries 3 to 4 months after infection (slightly longer in cats), reaching mature adulthood and reproducing at 6 to 7 months after infection.

Infected cats rarely have L1 and are therefore unlikely to transmit the infection to dogs or other cats. Adult HW is thought to live for 5 to 7 years in dogs and 2 to 3 years in cats.

What are the symptoms?

Dogs

Parasite numbers may range from 1 to more than 200. Symptoms develop because of the effect of adult HW on the pulmonary vessels and lungs and the secondary effects on the heart. The pulmonary arteries become thickened, inflamed, and non-distensible, increasing the work of the heart to push blood through them. In addition, the lungs themselves become inflamed. The severity of clinical signs are dependent upon the parasite burden, the duration of infection, the immune response of your dog, and the degree of exercise that the dog undergoes. Other organs affected include the liver, kidneys, and red blood cells. Mild infestations may not result in symptoms.

Some symptoms of heartworm infection in **dogs** include the following:

- Exercise intolerance (usually only noticed in working/sporting dogs)
- Mild to severe cough
- Weight loss
- Labored breathing
- Heart failure (usually manifested as abdominal swelling, heart irregularities, and weight loss), or even fainting. Once HWD has reached this stage, fatalities may result.

Cats

Since they are not the typical host for HW, most cats (approximately 90%) do not develop adult HW infections even after exposure and some degree of parasite development. For this reason, cats typically are infected only about 10% as often as dogs in the same geographic area and have lower numbers of worms (typically three or less). Nevertheless, they respond differently and more severely than dogs, exhibiting a more severe vascular and pulmonary response than dogs.

The most common signs identified in **cats** with HWD are the following:

- Labored breathing
- Cough
- Vomiting
- Fainting
- Seizures
- Sudden death

There are no mild infections in cats as even one worm can cause serious disease and even death. Not all cats show clinical signs, however.

Humans

Humans are rarely infected and when they are, symptoms are minimal. Occasional skin infestations have been noticed, but most commonly infections are diagnosed only after a "spot" is found on chest x-rays taken for another reason. These are only problematic because a lung biopsy is often needed to rule out cancer.

What tests are needed?

The diagnosis of HW is much easier in dogs than cats. Several testing methods may be used, depending on the species and circumstances involved.

These tests may include the following:

- Classically the diagnosis has been made by finding L1 in blood or by concentrating the L1 to enhance detection (**Millipore filter** or **modified Knott test**). When present, the finding of L1 provides a diagnosis but may miss more than 25% of canine and over 90% of feline infections.
- The **ELISA** (a blood test for HW) detects proteins (antigens) produced by adult female HW. These tests are very specific and sensitive in dogs (readily detecting infections of 3 or more adult female HW). They are, however, less sensitive in cats because of low worm burdens. A positive antigen test in cats does indicate a mature infection. ELISA for HW antibodies (proteins produced by the patient against the HW) is not used in dogs but are useful in cats.

These tests are positive in more than 90% of infected cats and represent an excellent screening test. Because cats that produce antibodies may ultimately fight off the infection, ELISA antibody tests can only

be used to indicate exposure. Nevertheless, when coupled with other tests (i.e., chest x-rays), may provide a diagnosis. Certainly any cat with HW antibodies should be placed on HW preventative, as risk for heartworm infection is present.

Heartworms may be diagnosed by typical x-ray findings of an enlarged heart and/or enlarged tortuous pulmonary arteries. An echocardiogram (sonogram) may also be useful, particularly in cats, by allowing visualization of worms in the heart or pulmonary arteries. This test is less useful in dogs than in cats, where worms can be found in more than 50% of cases with careful examination.

What treatment is needed?

Destruction of adult HW (*adulthood therapy*)

An arsenical drug (melarsomine) is administered into the muscle to rid **dogs** of HW. Although this intramuscular injection can cause irritation, by far the greatest problem is the death of HW, producing a severe reaction in the lungs 1 to 3 weeks after treatment in some dogs. This can be prevented or minimized by dividing the treatment into 3 dosages (1 dose, followed in a month or longer by 2 doses, 24 hours apart). Melarsomine can also be used as 2 injections, given 24 hours apart, but the worms may die abruptly, increasing the risk of adverse reactions. The most important measure to reduce lung damage is severely curtailing exercise for at least 1 month after adulthood therapy. **Exercise restriction is mandatory.**

Prior to adulthood therapy, evaluation of the general health of the dog or cat should be established by the use of the following diagnostic tests:

- Blood chemistry analysis, to evaluate liver and kidney health, among other things
- Complete blood count, to ascertain red blood cell status and for the presence of unrelated infections, etc.
- Urinalysis, to evaluate kidney function and to establish if there is HW-induced renal damage
- Chest x-rays, to establish the amount of lung, pulmonary artery, and heart disease produced by HW

Adulthood therapy may not be necessary in all dogs. This decision, which may be difficult, should be made in concert with the veterinarian. Dogs that may not be best served by adulthood therapy include the very aged, those with other terminal disease, and those with very mild infections (difficult to ascertain exactly). Whether infected dogs are treated or not, they should **all** be placed on MAC (macrolide agents, given orally, topically, or by injection, either monthly or every 6 months) HW-preventative.

In **cats**, adulthood therapy is of greater risk than in dogs and is avoided.

Symptomatic therapy

In **dogs**, symptomatic therapy with steroid hormones is often used to treat lung inflammation and the cough it produces. Aspirin may be used to reduce the vascular damage caused by HW.

Microfilaricidal (L1) therapy

It is important to rid the **dog** of L1, thereby lessening the risk to other pets. This can be done in one of two ways. A microfilaricidal dosage of MAC can be given approximately 6 weeks after adulthood. This often renders the pet free of L1 but may produce adverse, sometimes severe, reactions in about 8% of cases. Repeated treatment may also be necessary. An alternative is to utilize certain of the MAC HW-preventatives (ivermectin, selamectin, moxidectin) at preventative doses, thereby gradually eliminating

L1 over about 6 months. This may be done before or after adulticidal therapy and adverse reactions are rare. Ideally, the dog is hospitalized for observation the day of the first dose.

How is heartworm infection prevented?

Heartworm infection is clearly better prevented than treated. Preventative is instituted in new puppies or kittens at 6 to 8 weeks of age or as soon thereafter as climatic conditions in dogs dictate.

Dogs

Prevention of HWD in **dogs** can be accomplished by a number of means:

- Daily administration of diethylcarbamazine (DEC)
- Monthly administration of macrolide (MAC) HW-preventatives (i.e., oral ivermectin, oral milbemycin oxime, oral or injectable moxidectin, or topical selamectin)
- 6-month administration of injectable selamectin

Each of these drugs is effective if given as directed. However, even brief lapses in DEC therapy may result in infection. On the other hand, the MAC provides a safety net of prevention because a lapse of up to a month, followed by continuous administration, does not allow infection. Additional protection can be attained by reduced exposure to mosquitoes by avoiding walks at night or keeping cats indoors, for example.

These drugs are also extraordinarily safe if administered prior to infection. Both groups of drugs can, however, produce severe, even fatal reactions if administered to microfilaremic dogs (those with L1). The risk is much greater with DEC than MAC. Nevertheless, HW testing should be performed in **all** dogs over 6 months of age (if there has been seasonal potential for exposure) prior to institution of preventative.

Cats

The issue of prevention in cats is more difficult, as HWD is less frequently recognized in this species. Indoor housing has been proven to be beneficial, but in more than 25% of cats with HWD owners claim total indoor housing. This may reflect indoor exposure; some mosquitoes readily go indoors to feed. Alternatively, some owners may not consider the risk of exposure on the deck, balcony, etc., as being outdoors. Infection can occur any place that there are mosquitoes.

More and more frequently, cats living in areas where HW is known to occur are being placed on preventative therapy with ivermectin, milbemycin, or selamectin. Because cats infrequently have L1, the risk of an adverse reaction to MAC in cats already infected is negligible. For this reason, and because testing methods are less reliable in cats, screening for HW, prior to initiation of preventative, is not mandatory. Antibody testing will, however, allow the owner and veterinarian to know if the cat has been exposed recently. Exposed (i.e., antibody-positive) cats are clearly at risk and should receive preventative therapy.

Seasonal/Geographic Considerations

The need and timing for preventative administration varies with geographic region. In some areas in the United States no HW preventative is necessary. In the deep South, preventative is typically administered all year around and in the more northern states, DEC is administered from the first mosquito sighting until 2 months after the first hard frost, whereas MAC are administered from the onset of mosquito season until the first hard frost. Each veterinarian must decide on the appropriate preventative schedule for his/her region.

How often should my pet be tested for heartworms?

Yearly testing is required for dogs on DEC because of the potential for lapses in therapy and the potential for adverse reactions in infected dogs restarted on preventative. The need for yearly testing with MAC is less clear because of the excellent efficacy and safety net provided by these compounds. Many veterinarians still advocate yearly testing because of proven failure of a high percentage of pet owners to provide medications as directed. If an owner is absolutely certain that the medication is taken and swallowed for the whole period recommended, then if he/she so chooses, biannual testing is reasonable. For cats on MAC HW-preventative, yearly antibody testing is probably unnecessary, although will provide information about exposure to HW.