All Creatures Animal Hospital
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# Heartworm Disease in Dogs

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## BASIC INFORMATION

### Description

Heartworms (HWs) are parasites that live in the arteries of the lungs (pulmonary arteries) of dogs and wild canines. HWs cause elevated pressure in the pulmonary arteries (pulmonary hypertension), which increases the workload of the right side of the heart. If HWs persist (they can live 5-7 years), the right heart eventually fails. HWs also cause inflammation in the lungs.

### Causes

HWs (*Dirofilaria immitis*) are found in most parts of the world and in every state of the United States. Domestic dogs, as well as wolves, foxes, and coyotes, serve as the primary hosts. HWs also occur in cats (domestic and wild), ferrets, and California sea lions.

HWs are spread from an infected animal to other animals by mosquitoes. HWs molt in the mosquitoes to their infective form and are then passed on to the dog. HW disease is only spread when mosquitoes are present. Adult female HWs produce larvae (microfilariae) that migrate throughout the body. The microfilariae are picked up by the mosquitoes when they feed on the dog, molt in the mosquitoes, and then are spread to other animals.

### Physiologic Effects

Once a dog is bitten by an infected mosquito, the HW organisms molt and travel to the lungs, where they develop into adults. It takes about 6 months from the time the dog is bitten until the HWs are mature in the pulmonary arteries. Adult female HWs produce a substance that irritates the arteries of the lungs. The physical presence of HWs also injures the lining of the arteries, which causes the arteries to become thickened and stiff. As adult HWs die, they become lodged in the smaller pulmonary arteries, which contributes to the overall problem.

Some dogs are bitten by many infected mosquitoes at one time, especially in areas where there are large numbers of infected mosquitoes. As a result, many HWs become adults at the same time. If there is no room for all of them in the pulmonary arteries, the HWs will live in the heart and the large vein (posterior vena cava) that carries blood back to the heart from the abdomen. The presence of HWs in the vena cava is called *caval syndrome*. A large mass of adult HWs in the vena cava alters blood flow and damages red blood cells. If HWs are not removed from the vena cava within a short time, the dog usually dies.

Migration of the microfilariae throughout the dog's body sometimes causes inflammation in other organs, such as the kidneys and skin. The microfilariae may also contribute to changes in the lungs that result in pulmonary hypertension.

### Clinical Signs

Most dogs with HW disease have no signs, and the disease is detected by routine HW blood tests. The more athletic and active the dog, the earlier signs are seen. The first signs are often lethargy, decreased activity, and coughing. As the disease worsens, breathing rate (more than 50 breaths per minute) and effort increase. Some dogs have fainting episodes when stressed. With advanced disease and right heart failure, fluid may build up in the abdomen, and weight loss may occur.

If large numbers of adult HWs obstruct blood flow in the vena cava, lethargy, weakness, loss of appetite, and fever may occur. The membranes in the mouth may be pale or yellow (jaundiced) from red blood cell destruction and anemia.

### Diagnostic Tests

Two blood tests can be run to diagnose HW disease in your dog. A Knott's test looks for microfilariae in the blood. Because some dogs have no circulating microfilariae or are on HW-preventive drugs that kill microfilariae, an occult (ELISA) HW blood test may be needed to detect antigens (proteins) given off by the adult female HWs. The occult (ELISA) HW test is the most common screening test used, but both tests may be done in a dog that has received no preventive medications in the past (such as stray dogs).

If a dog is positive for HWs, chest x-rays are done to look for lung and heart changes. An echocardiogram (heart ultrasound) is done in dogs with right heart failure to rule out other causes of heart failure and to assess the heart. Echocardiography is also done when caval syndrome is suspected.

Prior to treatment, routine laboratory tests are usually recommended. If other problems, such as liver or kidney disease, are found, they are treated first, because the drug used to kill adult HWs can adversely affect the kidneys and liver.

*Continued*

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# Heartworm Disease in Dogs—*cont'd*

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## TREATMENT AND FOLLOW-UP

### Treatment Options

If right heart failure, kidney disease, or liver disease is present, it is treated before treatment for adult heartworms (HWs) is started. No single drug treats all stages of HW disease. Adult HWs are killed by adulticide drugs, such as melarsomine (*Immiticide*). Two dosing schedules are available:

- In one schedule, two intramuscular (IM) doses of melarsomine are given 24 hours apart. This regimen kills 90-95% of adult HWs, usually within 2-3 weeks.
- Dogs with right heart failure or x-ray changes in their lungs are treated with split doses. This method kills fewer HWs with each injection, which decreases the risk of worsening lung problems or causing acute death. With this schedule one dose of melarsomine is given IM. The dog is rested for 4-6 weeks, and then two doses of melarsomine are given 24 hours apart.

Ivermectin is an HW-preventive drug that can slowly kill some of the adult HWs if given for at least 18 months. Dogs that are not confined have an increased risk of pulmonary embolism and sudden breathing problems with this method, so it is used only for dogs with other medical problems that make use of melarsomine risky.

Circulating microfilariae may be treated before or after adulticide therapy, depending on the time of year and the presence of other diseases. Either ivermectin (at high doses) or milbemycin is used. If large numbers of microfilariae die, a shock-like syndrome can occur 2-8 hours after the drugs are given. The dog may be hospitalized for 12-24 hours of observation.

Once the adult HWs and microfilariae are treated, HW-preventive drugs are started. Several drugs are available that prevent adult HWs from developing after a dog is bitten by an infected mosquito. Ivermectin (*Heartgard*) is safe in all breeds of dogs, including collies and Shetland sheepdogs at the preventive dose. If ivermectin is given at high doses, it can cause death in collies and other susceptible dogs.

Ivermectin, milbemycin, and selamectin are given monthly. Moxidectin is an injectable HW-preventive that lasts for 6 months. Moxidectin should not be given to animals that are debilitated or have other medical problems. Daily preventive drugs, such as diethylcarbamazine, are no longer recommended.

Shock from caval syndrome is treated aggressively with intravenous fluids and supportive care. Once the dog is stable, the adult HWs are removed surgically. A bacterium (*Wolbachia*) that lives in the reproductive tract of female HWs has been discovered, but its role in HW disease is unknown. Further research is needed to determine whether treating the bacteria with tetracycline before giving adulticides will result in less reaction to the death of HWs.

### Follow-up Care

When adult HWs die, they break up and lodge in the smaller pulmonary arteries (embolism). If the dog has no or few lung changes on x-rays and no symptoms, the dead HWs may cause no significant problems. All dogs receiving melarsomine *must* be kept quiet for 6 weeks to lessen the risk of acute death from pulmonary embolism. Recheck visits are often scheduled during this 6-week period. Notify your veterinarian if any coughing (especially with blood) or breathing problems develop after adulticide therapy. Occasionally, even with the best care and rest, a dog will die when the adult HWs die.

Four to six months after adult HWs are treated, a blood test is done to determine whether all the adults were killed. A few dogs may remain positive and require repeated adulticide treatment. After successful HW treatment, preventive therapy is often given year round or at least during the mosquito season. An annual or biannual occult (ELISA) HW test is done to ensure that the preventive is working.

### Prognosis

Dogs that are asymptomatic have a very good prognosis. Occasionally a healthy dog will die when the adult HWs die, but this is uncommon if the animal's exercise is restricted for 4-6 weeks after adulticide therapy. Dogs with liver or kidney problems have a guarded (uncertain) prognosis if the problems persist, because melarsomine may cause an adverse reaction in these patients.

Dogs with lung changes on their x-rays have a more guarded prognosis. Some of these dogs return to normal activity after being treated, but athletic dogs may not be able to perform as well. Dogs with right heart failure have a poor prognosis, because their significant lung changes may not reverse after HW disease is treated. They may improve with therapy but will require medication for the rest of their lives.

***IF SPECIAL INSTRUCTIONS HAVE BEEN ADDED, THEY WILL APPEAR ON THE LAST PAGE OF THE PRINTOUT.***