

MOSQUITO-BORNE DOG HEARTWORM DISEASE

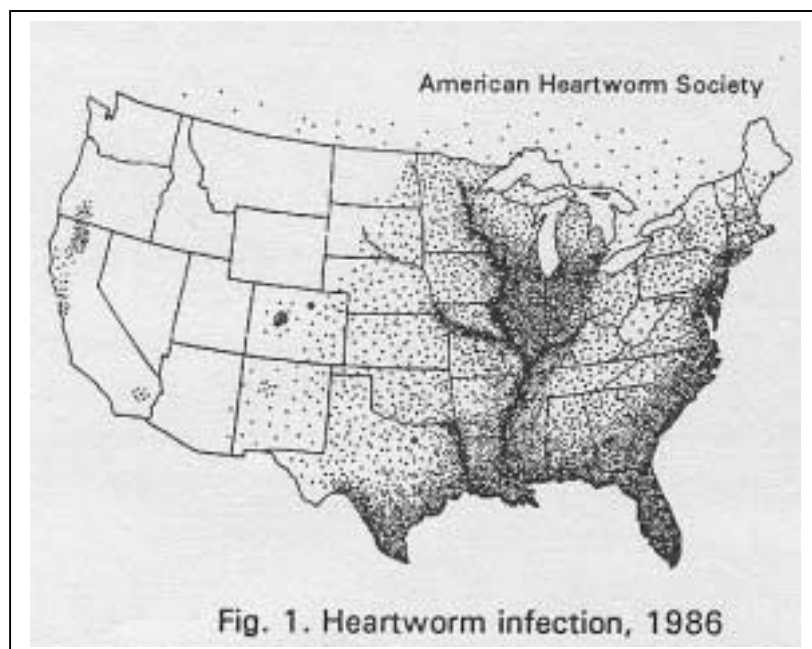
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Each year thousands of dogs become disabled or die from lung, heart or circulatory problems caused by the heartworm disease. Heartworm disease in dogs and related canines is caused by a filarial nematode (thread-like round worm), *Dirofilaria immitis*. It is a major problem that promises to become more serious with time. The adult inhabits the right ventricle and pulmonary arteries, and because of its location in the heart, it is commonly called “the dog heartworm.” The parasite can only be transmitted from one dog to the other by some vector mosquito species.

DISTRIBUTION OF HEARTWORM DISEASE

Heartworm is distributed worldwide in most tropical and subtropical regions, with increasing frequency in temperate climates. Until the late sixties, the disease was restricted to southern and eastern coastal regions of the United States. Now, however, cases have been reported in almost every state and in several provinces of Canada. For most of North America, the danger of infection is greatest during the summer when temperatures then are favorable for mosquitoes.

In the southern U.S., especially the Gulf Coast and Florida, where mosquitoes are present year round, the threat of heartworm disease is constant.



THE HEARTWORM PARASITE

The complete development of the nematode parasite requires two hosts; the dog and the mosquito. The problem starts when a mosquito draws blood from an infected dog. In the dog, sexually mature adult nematodes are 8-14" long and live in the heart. Once a dog is infected it is infected for life. The sexually mature nematodes deposit tiny immature worms called **microfilariae**, which circulate in the blood stream. Microfilariae are less than 1/800" long. They do not develop further in the dog, but they can survive in circulation for up to seven years. They must be ingested by a mosquito before they can progress in their development. Numbers of microfilariae in blood are generally higher during the day than at night. Optimum numbers of microfilariae in the peripheral circulation coincide with times of peak feeding activity by the mosquito vector. Numbers of microfilariae may be higher in the summer when mosquitoes are abundant.

LIFE CYCLE IN THE MOSQUITO

Development of heartworm in the vector starts when microfilariae are ingested by the female mosquito during blood feeding on an infected dog. Microfilariae leave the midgut of the mosquito soon after ingestion and migrate into the Malpighian tubule cells (the mosquito kidney). During the next four days the parasite becomes immobile, shortens and thickens, and gives rise to a so-called "sausage form" larva. This larval form is followed by the first stage larva and the first molt occurs in the Malpighian tubule cells at 8 days. During the second larval stage formation of internal organs takes place. The second molt occurs at 12 days.

Third-stage larvae resemble miniature adults. During the next 2-3 days, they increase in length, break out of the Malpighian tubules, migrate through the body to the head, and accumulate in the mouthparts. These third stage larvae are now called infective larvae. This infective larva cannot develop further in the mosquito. Further development can only take place in the dog.

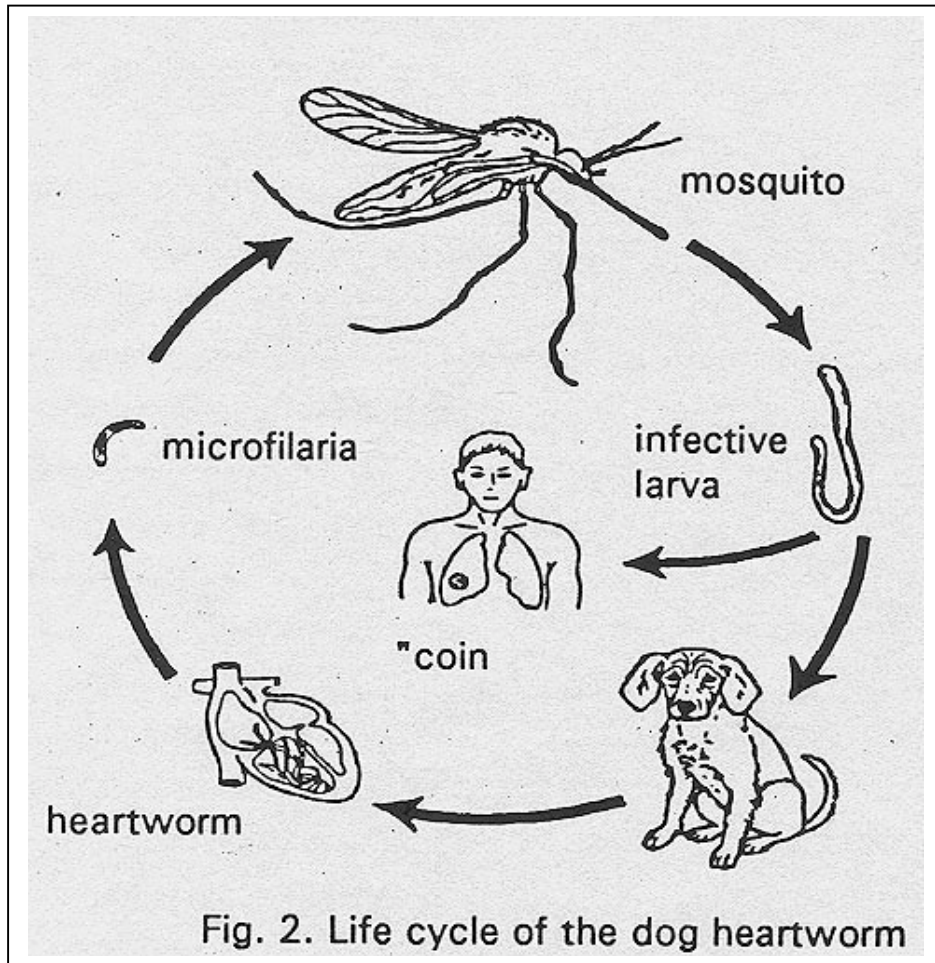
Infective larvae are found primarily in the proboscis, or mouth parts. As the infective mosquito feeds on a dog, the infective larvae emerge from the tip of the proboscis and on to the skin of the animal. A drop of mosquito blood protects the larvae from drying prior to their entry into the host. The infective larvae penetrate the skin through the puncture wound that remains after the mosquito withdraws her mouthparts.

LIFE CYCLE IN THE DOG

After penetrating the skin, the larvae stay close to the site and grow very little during the next few days. The molt from the third to fourth-stage larvae occurs 6-10 days after infection. Fourth-stage larvae migrate through subcutaneous tissue and muscle toward the upper abdomen and thoracic cavity. Fourth-stage larvae grow to about 1/10" in length during the next 40-60 days and then molt to the fifth and final larval stage, or young adults. The young adults penetrate veins to get into the blood stream and eventually, after 70 to 90 days in the dog, reach the heart. For unknown reasons, the

percentage of infective third-stage larvae that reach maturity vary in different breeds of dogs.

Upon reaching the heart, the young adults continue to grow. Up to now there has been no evidence of disease in the dog. It is only after adult worms mate and start to deposit tiny motile microfilariae that circulate in the blood that disease becomes apparent. Microfilariae appear in the blood about 200 days after infection.



THE SYMPTOMS

Visible signs of heartworm disease may not appear until a full year after infection. In fact, the disease may be well advanced before the dog shows any symptoms. Dogs with typical heartworm disease fatigue easily, cough, and appear rough and unthriving. Blood and worms from ruptured vessels may be coughed up. Blockage of major blood vessels can cause the animal to collapse suddenly and die within a few days.

Dogs with 50-100 mature worms exhibit moderate to severe heartworm disease. Dogs with 10-25 worms that receive little exercise may never show signs of heartworm disease,

and one may not be able to find microfilaria in the blood. Heartworm infection without detectable microfilaremia is called **occult dirofilariasis**.

DIAGNOSIS

Diagnosis of dog heartworm disease is done by drawing a blood sample and looking for microfilaria using a microscope. These tests are reliable only 80% of the time. A more reliable method is to take x-rays. When heartworm disease is confirmed, a treatment program is set up to remove both adult worms and microfilariae.

HEARTWORM DISEASE IN CATS

Heartworm disease in cats is less frequent than in dogs. Cats are susceptible but appear to be poorer hosts than the dog. The most prominent clinical signals include coughing, **dyspnea**, vomiting, lethargy, and anorexia. Acute collapse and death can occur. Because less than 20% of infected cats have microfilaria in the blood, diagnosis is best confirmed by x-rays.

HEARTWORM DISEASE IN HUMANS

Heartworm is also an occasional parasite of humans. The parasite is usually found in the lung (**pulmonary dirofilariasis**), less often in the heart. Although the worm forms a “coin lesion” in the lung which may be confused with other diseases on x-rays, such as carcinoma, its clinical significance in man has not been fully determined. During the last 20 years about 80 cases of human pulmonary dirofilariasis have been reported from Florida.

MOSQUITO VECTORS

More than 70 of the nearly 3,000 known species of mosquito worldwide have been identified as capable of sustaining the development of dog heartworm microfilariae to the infective stage. In Florida, about 20 species are potential vectors. The main vectors near the coasts are two mosquitoes that breed in salt marshes; *Aedes taeniorhynchus* and *Ae. sollicitans*, and 1 freshwater species, *Culex nigripalpus*. The inland vectors that breed in fresh water are *Culex quinquefasciatus*, *Culex salinarius*, *Aedes aegypti*, *Anopheles quadramaculatus* and *Mansonia titillans*. These mosquitoes breed in a wide variety of habitats, including marshes, swamps, ponds, ditches, old tires and trash piles.

TREATMENT, PREVENTION, AND CONTROL

Heartworm disease in dogs and cats cannot be eliminated, but it can be controlled or prevented. The first step in ridding a dog of the parasites is to administer an agent to kill the adult worms.

- a) **Kill the adult worms:** **Capasolate**[®] (Arsenamides, Thiacetarsamide), is an arsenical compound used to kill adult heartworms in both dogs and cats. It is given as an intravenous injection and two doses are given each day for two days followed by

restriction of physical activity for one or two months. As the worms die they are carried by the bloodstream to the lungs. One dog in twenty may be expected to die as a result of complications from this therapy. There are fewer complications with cats. Adult female worms and immature forms are somewhat resistant to Capasolate and, consequently, this drug may be less than 100% effective.

- b) Kill the microfilariae: After the adult worms have been eliminated, the next step is to kill the microfilariae. **Dithiazanine iodide** is the recommended microfilaricide. The compound is given orally; the dosage varies with the weight of the dog. After 7 days on this program, the dog's blood should be re-examined. If microfilariae are still present, and there has been no drug reaction, the dosage may be continued until the blood is microfilariae free.
- c) Prevent larval development: Only after the adult heartworms and the microfilaria have been eliminated may an infected dog be put on a program to prevent reinfection.

Filaribits[®] (Diethylcarbamazine—DEC, **Caricide**[®], **Hetrazan**[®]) kills the infective larval stage, but is less effective against the adult heartworm. It should be administered daily throughout the mosquito season when dogs are exposed to infective larvae. It is a safe and efficacious drug in noninfected dogs, but may cause a fatal shock reaction if given to dogs with microfilariae. Sudden destruction of large numbers of microfilariae occasionally causes severe shock-like symptoms that may kill the dog. **Cypip**[®] can be mixed with dog meal for continuous administration of DEC in feed.

Heartgard-30[®] (ivermectin), a recently developed drug when given once a month can prevent heartworm disease. It eliminates infective larvae before they reach the heart. It also kills microfilariae. In certain dogs, particularly of the Collie breed, Heartgard[®] has been reported to cause serious adverse reaction. The major advantage is that it need be given only once every 30 days. The disadvantages are that the dog owner may forget to give the medication and that there are risks of a mild reaction and transient diarrhea if given to a heartworm infected dog.

- d) Control mosquitoes: In addition to drug therapy for dogs and cats, mosquito control in residential areas where dogs and cats live can break the transmission cycle of heartworm. Dog owners should keep their animals out of mosquito-infested areas. Dog's living quarters should be mosquito-free. Indoor dogs usually show much lower incidence of infection. Insect repellents are safe and effective when applied properly.

For more information...

...about dog heartworm, contact your local veterinarian or **Dr. Roxanne Rutledge at the Florida Medical Entomology Laboratory, IFAS-University of Florida, 200 9th Street Southeast, Vero Beach, FL 32962, (561) 778-7200**

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