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The canine heartworm, *Dirofilaria immitis*, has become a serious problem in dogs in areas of Minnesota and the upper Midwest in the past two decades. Veterinarians and dog owners now recognize the dangers of this parasite and want to combat it effectively. To do so requires a thorough understanding of the parasite and sound treatment and control measures.

Heartworms are found primarily in the natural host, the dog. Heartworms are long, thin, threadlike worms whose adult stages are 25 to 30 centimeters long and 1 to 1.5 mm in diameter. The parasites usually are found in the right heart chambers and pulmonary arteries. The parasites are found occasionally in domestic cats and wild red foxes in Minnesota and in wolves, coyotes, lions, tigers, and various apes and rarely in man in other parts of the United States and the world.

Distribution of Heartworms

The canine heartworm is found in most temperate and tropical regions of the world. In the United States, they have been seen for many years in Florida, Georgia, and Alabama as well as along the Gulf coast states to the southern tip of Texas and along the Atlantic as far north as Maine. The natural range of the parasites includes most states east of the Mississippi River and parts of southern Canada. The parasite is present in scattered areas west of the Mississippi River. Oklahoma, Kansas, and California have significant problems. Heartworms in dogs have been spreading to new areas during the past several decades.

Heartworms of dogs

In Minnesota, heartworms have been observed in native dogs since the mid-1950's. The principal range is thought to be the five-county greater metropolitan area including Minneapolis and St. Paul. Hennepin County has been particularly heavily involved although other localities in the state report scattered cases.

The Life History of Heartworms

Adult heartworms normally are found in the right heart chambers and pulmonary arteries. These parasites mate when sexually mature; the females give birth to live larvae, known as microfilariae, which are found in the bloodstream. The microfilariae are only 0.3 mm long and occur throughout the blood in large numbers.

Heartworms are transmitted exclusively by mosquitoes. At least 12 separate species of Aedes, Culex, and Anopheles spp. are known transmitters of heartworms in Minnesota. The female mosquito ingests microfilariae when she takes a blood meal from an infected dog. Once inside the mosquito, microfilariae migrate from the stomach to the excretory structures in its abdomen known as malpighian tubules. Here the microfilariae moult, develop, and become infective larvae in 10 to 18 days depending on temperature and humidity. The infective larvae then migrate to the mouth parts of the mosquito and are inoculated into a dog when the mosquito takes another blood meal. Back inside the dog, the larvae migrate under the skin through various tissues including muscle and connective tissues. After continuing to grow for 80 to 120 days, the immature worms enter the bloodstream and are carried to the heart where they continue to grow to adult worms. When the immature worms enter the heart, they are only 10 to 30 mm long. Approximately 185 days after infection the worms are sexually mature and full grown and begin producing microfilariae. The entire life cycle is completed in 6 to 7 months. (See diagram on next page.)

Harm Done by Heartworms

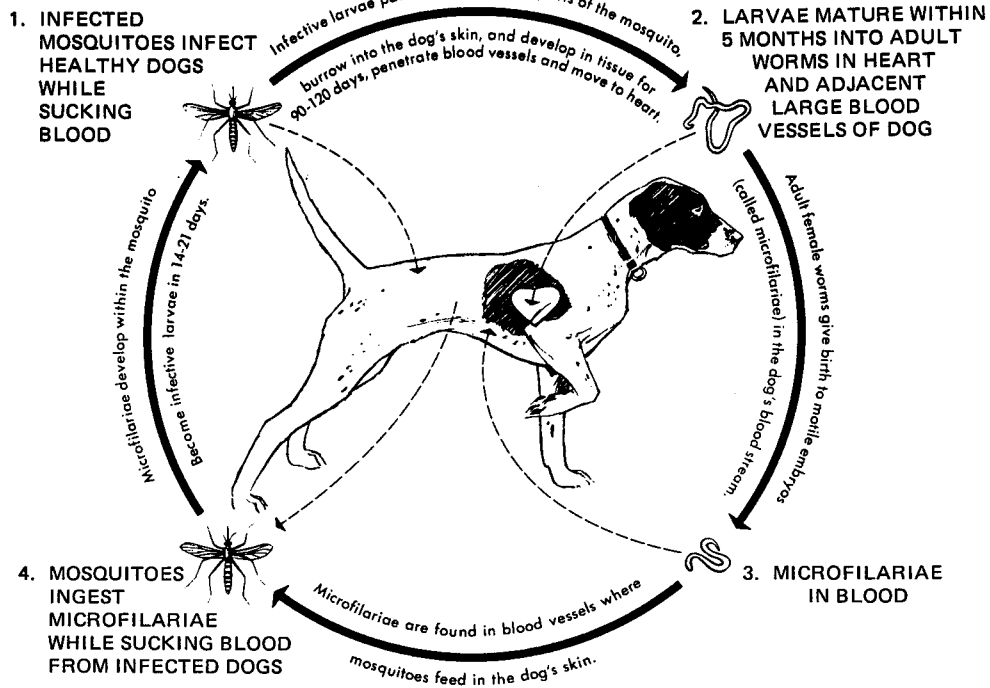
The most frequently observed early signs of heartworm are rapid tiring, exhaustion, and soft coughing. Later dogs develop dry, rough hair coats, lose weight, become anemic, and develop ascites or "water-belly" in severe cases. The primary damage is associated with thickening and obstruction of the pulmonary arteries that carry blood to the lungs for oxygenation. This produces classic pulmonary hypertension. The liver and kidneys also may become involved as the disease progresses.

Diagnosis of Heartworms

Heartworms usually are diagnosed by examining blood samples for the typical microfilariae. Because 5 to 20 percent of

LIFE CYCLE OF THE HEARTWORM OF DOGS

Dirofilaria immitis



infected dogs may not have circulating microfilariae, other aids such as x-ray and various blood tests also must be employed.

Treatment and Control of Heartworms

The treatment of heartworms falls into supportive therapy, medicinal therapy, or surgical removal of the worms. Some dogs tolerate the infection with rest, good nursing, and adequate nutrition. The most common treatment used by veterinarians is the intravenous injection of one of the trivalent arsenical drugs to kill the adult parasites. Other medications must be used subsequently to kill the circulating microfilariae. Killing the adult worms presents some hazard because there is no way for the dead worms to be expelled from the dog's body. In time they will be dissolved by the dog's natural defensive mechanisms. Surgery provides for their physical removal but has not been used widely.

Heartworms can be prevented by three different means: 1.) mosquito control, frequently difficult or impossible; 2.) annual treatment of dogs in December, January, or February to kill the developing worms before they are fully mature; and 3.) preventive oral medication, i.e., diethylcarbamazine, before, during, and after the mosquito season.

Heartworm treatment and prevention require close supervision by one's local veterinarian.

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