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Heartworm: The Parasite

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What is a Heartworm?

Heartworm (*Dirofilaria immitis*) is a fairly large worm - up to 14 inches long - that, in adulthood, lives in the heart and pulmonary arteries of an infected dog.

Dogs become infected through mosquito bites as mosquitoes readily pick up heartworm larvae from the blood of an infected dog and carry the larvae to new dogs. Some geographic areas have severe heartworm problems while other areas have virtually none. In order for the parasite to establish its presence in an area, the following conditions must be met:

Additional Resources

- Heartworm Diagnosis in Dogs and Cats
- Heartworm Infection in Cats
- Heartworm Preventive Comparison for Dogs and Cats
- Heartworm Treatment for Dogs
- Preventing Heartworm Infection in Dogs
- What Happens in Heartworm Disease

- Types of mosquitoes capable of carrying larval heartworms must be present. (Not all mosquito species are capable of transmitting heartworm.)
- The weather must be consistently warm throughout the period of time it takes for the larva to develop to its infective state within the mosquito's body.
- There must be infected dogs or coyotes in the area.
- There must be vulnerable host dogs in the area.

When these conditions come together, an area becomes endemic for heartworm disease.

Let's look at the heartworm life story in more detail.

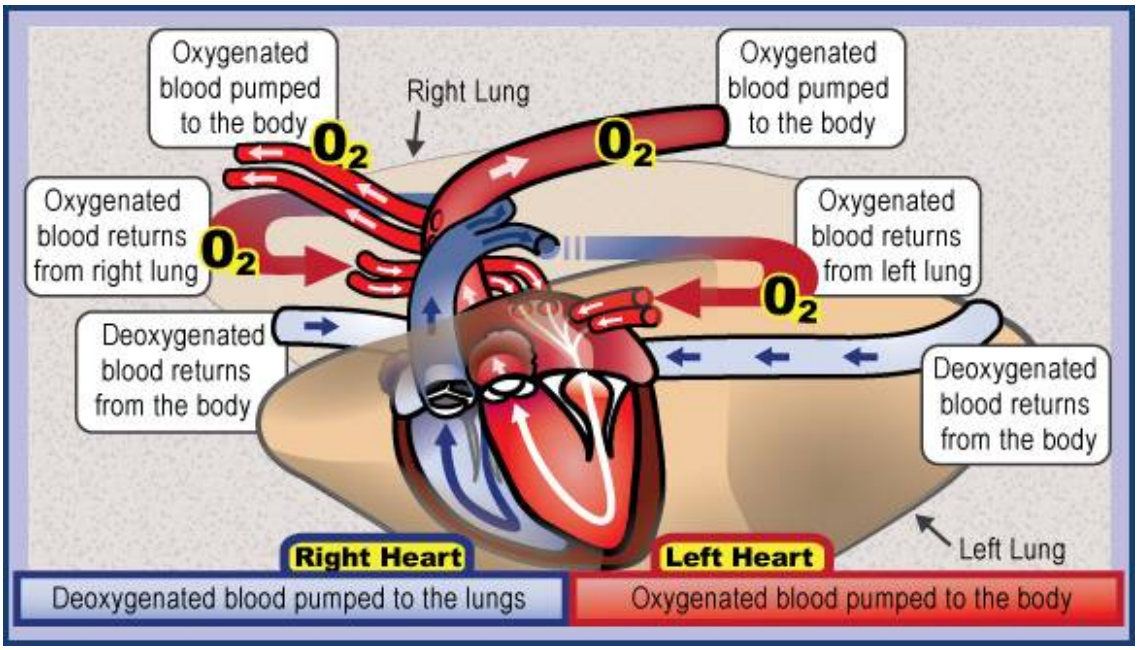
Heartworms live on the right side of the heart, the side that pumps blood through the pulmonary arteries and on to the lungs to pick up fresh oxygen. (In the graphic below, this pathway is outlined in blue.)

The adult heartworm is fairly large, as mentioned up to 14 inches in length, and it prefers to live not in the heart, but in the pulmonary arteries. It swims into a cozy tubular artery where it is massaged and nourished by the blood coursing past it. In the pulmonary arteries of an infected dog, the worm generates a strong inflammatory response and a tendency for blood to inappropriately clot. If there are a lot of worms, the heart must work extra hard to pump blood around all the worm bodies.

If the worm infection is a heavy one (over 25 worms for a 40-lb dog), the worms begin to back up into the heart's right ventricle, the chamber that pumps blood through the lung. The worms actually take up a significant amount of space within the heart, space that could have been taken up by blood. With less blood going through the heart, there is less blood being pumped out to the lung.

When there are over 50 worms, the ventricle is completely full and the atrium, the chamber receiving blood from the rest of the body, begins to fill with worms.

When there are over 100 worms, the entire right side of the heart is filled with worms and there is little room for any blood to be pumped. This drastic phenomenon is called caval syndrome and most dogs do not survive it.



Microfilariae (First Stage Larvae)

When adult male and female worms are there, mating begins to occur. Heartworms do not lay eggs like other worm parasites; instead they give live birth and the baby worms are called microfilariae. Microfilariae are released into the circulatory system in hope that they will be slurped up by a mosquito taking a blood meal and carried to a new host.

Microfilariae may live up to two years within the host dog in whom they were born. After this period, if a mosquito has not picked them up, they die of old age. Microfilariae may also be transmitted across the placental barrier to unborn puppies if the mother dog is infected with heartworm. It is important to realize that such puppies will not develop adult heartworms or heartworm disease from these microfilariae; in order for a heartworm to reach adulthood, it must be passed through a mosquito.

Parasitic worms have five larval stages and are termed L1, L2, L3, etc. Heartworm microfilariae are first stage larvae, L1s.

Note: Ivermectin, moxidectin, selamectin, and milbemycin-based heartworm preventives will kill microfilariae after prolonged use. Dogs on these heartworm preventives, even if infected with adult heartworms, usually will not test positive for microfilariae.

Inside the Mosquito

Let us continue to follow the young heartworm's development inside the mosquito who has taken it in with a blood meal. Within the mosquito's body, the microfilariae will develop to L2s and finally to L3s, the stage capable of infecting a new dog. How long this takes depends on the environmental conditions. In general, it takes a few weeks. A minimum environmental temperature of 57 degrees Fahrenheit is required throughout this period. The process goes faster in warmer weather but if the temperature drops below 57 degrees, the mosquitoes will die and no heartworms can be transmitted.

The nose is especially vulnerable to mosquito bites as there is no fur for protection there. Graphic by MarVistaVet

Infecting a New Dog

When a dog is bitten by an infected mosquito, the L3 is not deposited directly into the dog's bloodstream. Instead, it is deposited in a tiny drop of mosquito spit adjacent to the mosquito bite. For transmission to occur, there must be adequate humidity to prevent evaporation of this fluid droplet before the L3s can swim through the mosquito bite and into the new host.

Once safely inside the new host, the L3 will spend the next week or two developing into an L4 within the host's skin. The L4 will live in the skin for three months or so until it develops to the L5 stage and is ready to enter the host's circulatory system. The L5, which is actually a young adult, migrates to the heart and out into the pulmonary arteries, if there is room, where it will mate approximately five to seven months after first entering the new host.

Note: All commercially available heartworm preventives act by wiping out the freshly delivered L3s and the L4s living in the skin. The ivermectin products are also able to kill the younger L5s.

Because the heartworm tests on the market either look for microfilariae or for adult worm proteins, they will not detect infection with immature worms. This is why it takes five to seven months from the time of exposure to get a valid heartworm test and also why there is no point in testing puppies less than five to seven months of age.

See an animated depiction of how heartworm infection causes disease in dogs, courtesy of The American Heartworm Society.

Summary

- Adult heartworms live in the heart and pulmonary arteries, clogging up the circulation and causing inflammation. They give birth to microfilariae that will circulate freely in the bloodstream.
- Microfilariae are slurped up by mosquitoes but won't survive the trip to a new host unless it is warm enough to support a one to three week maturation period inside the mosquito.
- L3 larval heartworms are deposited in a small spitball next to the mosquito's bite mark. In order to enter the new host, it must be humid enough for the spitball not to evaporate before they can find their way into the bite mark.
- Young heartworms spend several months maturing under the skin of the new dog and it is this period where they are vulnerable to heartworm preventive medications. If the young heartworm gets too old, the preventive medications will not reliably kill it.
- It takes 5 to 7 months for the young heartworm to become detectable by blood test.

Related resources

- Heartworm Preventive Comparison Chart for Dogs and Cats - *December 8, 2022*
- Heartworm Treatment for Dogs - *November 17, 2021*
- Heartworm Disease in Dogs - *August 22, 2021*
- Heartworm Diagnosis in Dogs and Cats - *June 10, 2021*
- Heartworm Infection in Cats - *April 29, 2021*
- Preventing Heartworm Infection in Dogs - *August 7, 2019*

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