

## *Dirofilaria immitis*, heartworm

cellular organisms - Eukaryota - Fungi/Metazoa group - Metazoa - Eumetazoa - Bilateria - Pseudocoelomata - Nematoda - Chromadorea - Spirurida - Filarioidea - Onchocercidae - *Dirofilaria* - *Dirofilaria immitis*

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### **Brief facts**

- *Dirofilaria immitis* is a filarial parasitic nematode that infects primarily dogs and other canid species. It usually resides in the pulmonary, femoral, and hepatic arteries, as well as other blood vessels including veins and right atrium of live dogs. Heartworms cause serious vascular damages and can be fatal, especially in working dogs with high level of physical activity.
- The common name **heartworm** is originated from the fact that the worms are frequently found in the heart. However, it is considered to be a postmortem artifact. Heartworm is a vascular pathogen rather than an intracardiac one.
- The vectors of *Dirofilaria immitis* larvae are many mosquito species. The following is an incomplete list of mosquito species that were shown to be capable of supporting larval development of *Dirofilaria immitis* to the 3rd (infective) larval stage: *Culex pipiens* (often infects cats), *Anopheles maculipennis*, *Coquillettidia richiardii*, *Aedes triseriatus*, *Ochlerotatus notoscriptus* (prevalent

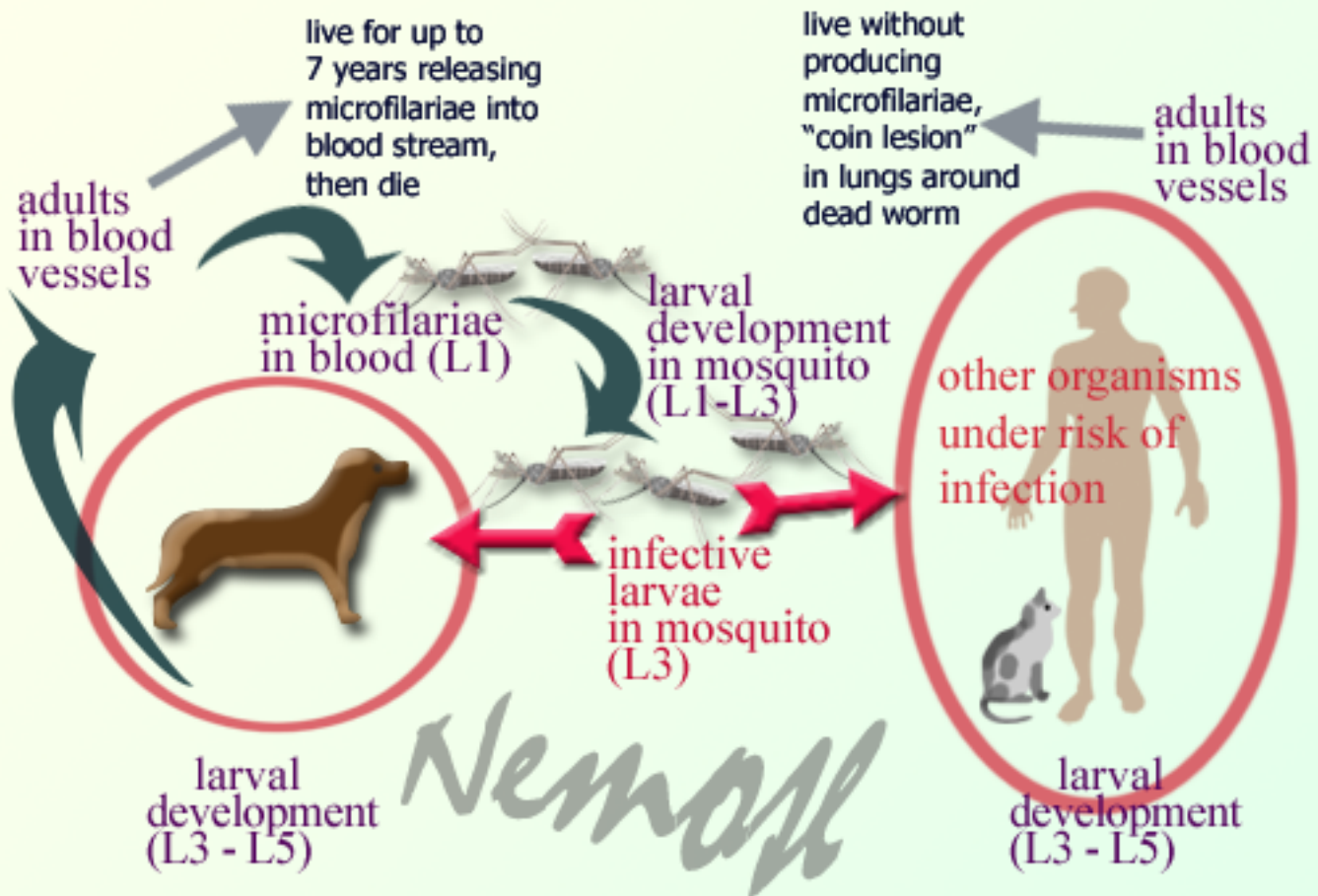
in Australia), *Aedes albopictus*, *Aedes aegypti*, *Culex quinquefasciatus*, *Aedes taeniorhynchus*, *Aedes scapularis*, *Aedes trivittatus*.

- *Dirofilaria immitis* is capable of infecting wide variety of mammals (cats, dogs, rodents, horses, humans), as well as birds (there is a documented case of the parasite infecting the Humboldt penguin). Human pulmonary dirofilariasis, while being a benign and relatively rare zoonosis, represents itself as a medical problem, because it being manifested as a "coin lesion" similar to pulmonary neoplasia (tumor) that warrants unnecessary invasive diagnostics and even surgery.
- Frequency of infection in organisms other than dogs often depends on regionally prevalent competent mosquito species and their preferences to different hosts. Also, normal development of heartworms in hosts other than dogs is usually inhibited; they mature longer and live shorter.
- *Dirofilaria immitis*, like some other filarial parasites, carry endosymbiotic *Wolbachia* bacteria whose metabolites contact with the host's organism and can play a significant role in the survival, adaptation, and reproduction of the pathogen, as well as in the host's immune response and overall pathogenesis. Specifically, two main mechanisms of *Wolbachia* interfacing with the host were identified: (1) a release of *Wolbachia* upon death of the parasites regardless of their developmental stage of the parasite, and (2) continuous release of *Wolbachia* products (metabolites, excreted proteins, etc.) by heartworm females during their production of microfilariae (L1 larvae of the worm, see below). Discovery of *Wolbachia* changed traditional view on duality of filaria-host interactions. It presented an additional challenge for researchers to understand and conquer filarial parasites.
- According to 2001 year survey the following states had greatest numbers of dignosed human dirofilariasis: Texas (23), Florida (16), Louisiana (10), and South Carolina (8).

**Protect yourself from mosquitos - vectors of numerous diseases and parasites including the heartworms.**

**Detailed information on three species of mosquito at [MetaPathogen](#).**

# Heartworm life cycle



## Developmental stages

- microfilariae

L1, first stage larvae that circulate in the bloodstream; the microfilariae can live for years in the bloodstream of canid species

- microfilariae in blood stream

mature heartworms release live larvae into the host's bloodstream; larvae are accumulating and can reach thousands organisms per milliliter of

blood

- **microfilariae in mosquito**

during bloodmeal, the mosquito ingests some microfilariae that start their development into infective heartworm larvae during which they molt twice (L1 to L2 to L3); the process is temperature dependent; when temperature is low, the larvae are not able to reach the infective stage by the time mosquito's finishes its blood feeding

- **infective larvae in mosquito**

the microfilariae develop into the infective larval stage (L3) inside mosquito's gut; in 10-14 days after that they move into mosquito's mouthparts; they break out of the mosquito mouthparts during the bloodmeal, and have to find their way through the hole in the skin after the mosquito finished feeding; as many as 45% of the infective larvae are being lost on the surface of the skin and fail to enter the organism

- **larvae in the host**

description of the migration of the parasite in the host slightly varies in reviewed sources

- **L3 larvae**

the larvae settle at the place of the infection; in 1-12 days they molt and transform into L4

- **L4 larvae**

the larvae migrate with blood and many of them settle in submuscular membranes all over the

body as intermediate sites of development; between 85 and 120 days of infection L4 larvae move from the intermediate sites by entering the blood vessels and migrating to places where they ultimately lodge; if L4 larva enters an artery, it will likely to develop in the branch of the arterial tree, including pulmonary arteries; if L4 larva enters in a vein, it will likely arrive in the lungs

- **L5 larvae**

L5 is a juvenile worm - the last larval stage before mature adult

- **mature adult**

mature female heartworm can measure 31 cm in length; overall, in the dog, it takes a little over six months for the infective larvae to mature into adult worms that can live for five to seven years in the dog; in cats, it takes about eight months to mature into adult worms that live from two to three years

## Types of infection

### Symptoms

- **Initial infection**, asymptomatic and usually undetected, takes place between L3 and adult stages of the parasite, before microfilariae are released into the bloodstream of the canine host and the parasites at different stages of development start dying because of the host's defense reaction or other reasons.
- **Chronic asymptomatic infection** is the most wide-spread type of the infection. The animal hosts (dogs and cats) do not exhibit clear signs of vascular and cardiac distress especially when the parasite burden as well as physical activity are low.

- **Chronic symptomatic infection** usually occurs when the parasite's burden is high and vascular deterioration and local inflammation events take place because of the parasite's activities: feeding, reproducing, leaking toxins and antigens, etc. This period can last as long as 5-7 years. Coughing, anemia, weakness, and lethargy are common.
- **Acute infection** can occur as a result of (1) ectopic (not typical) migration of the worms in an atypical host (e.g. cats) or after strenuous physical activity, (2) massive death and disintegration of the parasites, or (3) extremely high parasite burden. Heart and kidney failure, seizures, blindness, and ultimately death can occur.

## Presence of microfilariae

- **Chronic microfilaraemic infection** is characterized by presence and gradual accumulation of microfilariae (L1 stage larvae) in the host's bloodstream. This type of infection occurs in canine species infected by both genders of the parasites (males and females).
- **Transient microfilaraemic infection** is characterized by brief occurrence and subsequent clearance of the microfilariae in the bloodstream of an atypical host such as cats.
- **Amicrofilaraemic infection** is characterized by absence of the microfilariae in the bloodstream of an atypical host such as human. Amicrofilaraemic infection also occurs when the host was infected by one gender (male or female) of the parasite.

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## Websites

- [American Heartworm Society Information](#)
- [Plymouth County Mosquito Control Project: Dog hearworm](#)



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