

Heartworm

Background

Canine heartworm infection is due to *Dirofilaria immitis*, for which dogs are definitive hosts. Microfilariae (L1) are ingested by mosquitoes when they feed on infected dog. The microfilariae develop into L3 larvae within the mosquito. These, now-infective, L3 larvae are transmitted to naïve dogs when the mosquito next feeds. The L3 larvae spread through the dog's body and mature (L3>L4>L5) with adult heartworms eventually living in the pulmonary artery, where microfilariae are produced. Dogs develop patent infections (i.e. have circulating microfilariae produced by female adult heartworms) around 7-9 months after initial infection. Adult heartworms can live for up to 7 years in the dog.



FAQs

What are the clinical signs of heartworm disease?

No clinical signs are seen in the early stages of heartworm infection. The longer the infection persists, the more likely clinical signs will develop. Active dogs, dogs with heavy infections, or dogs with concurrent health problems may show more pronounced clinical signs. Signs may include a mild persistent cough, reluctance to exercise, fatigue after moderate activity, decreased appetite, and weight loss. As the disease progresses, dogs may develop heart failure (including ascites) and caval syndrome (when heartworms reside in the right atrium and venae cavae; this is life threatening). Shear damage injury to red blood cells can occur in the peripheral blood leading to haemoglobinaemia and haemoglobinuria.

How do I diagnose heartworm infection in dogs?

The heartworm antigen test and the modified Knott's test are most commonly used screening tests:

- The heartworm antigen test detects **adult female** heartworm (ovarian) **antigens** in a serological assay (0.5 ml serum required)
- The Modified Knott's test detects and allows identification of **microfilariae** in the blood (1ml blood EDTA required)

The most sensitive test is the antigen detection test. However, the modified Knott's test should also be done when dogs are being screened for infection as false negatives for the antigen test can occur e.g. animals with a low burden of female heartworms, if only male heartworms are present, or if macrocyclic lactone heartworm preventatives (including moxidectin, selamectin, and milbemycin) have been given (due to the formation of immune complexes that block detection of *D. immitis* antigen).

Reception Hours

Mon-Fri 9am - 5pm

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Occasionally dogs can be infected with *D. immitis* and be negative on both tests. In these cases, diagnosis may be achievable by demonstration of the heartworms on echocardiography. Thoracic radiography may show right ventricular enlargement, a pulmonary arterial bulge, and blunted or enlarged tortuous pulmonary arteries.

When can I use the tests to detect heartworm infection?

There is no justification for testing dogs for heartworm antigen and microfilariae before 7 months of age or less than 7 months post-exposure, as both tests need adult female heartworms to be present in the dog to be positive, and maturation to adults following infection takes at least 7 months (usually 7-9 months).

How do I interpret the heartworm infection test results?

Heartworm antigen positive, D. immitis microfilariae detected:

- Animal is infected with heartworm

Heartworm antigen positive, microfilariae not detected:

- Single sex infection (females only so no microfilariae produced)
- Immature (non-adult) worms (up to 7 months after exposure)
- Animal recently given macrocyclic lactone heartworm preventatives (moxidectin, selamectin, or milbemycin) which are microfilaricidal
- Immune-mediated clearance of microfilariae

When a heartworm antigen positive result is unexpected, or is in an asymptomatic dog, alongside a negative modified Knott's test, confirmation with an alternative heartworm antigen detection test and possible repeat of the modified Knott's test is recommended before starting any adulticide treatment.

Heartworm antigen not detected, D. immitis microfilariae detected:

- False negative heartworm antigen test (low female worm burden, or following treatment with macrocyclic lactone preventatives, as described above)
- Adult worms are dead and antigen has been cleared, but microfilariae still present
- Animal has been transfused with microfilaraemic blood
- Animal has had prenatal transfer of microfilariae
- Heartworm antigen has been destroyed due to improper storage or treatment of sample

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Heartworm antigen not detected, microfilariae not detected

If clinical suspicion is still high, other diagnostic tests may be conducted, such as thoracic radiographs and echocardiography. If the animal is clinically normal, follow up testing in 6 months with a heartworm antigen test and a modified Knott's test is recommended.



What other microfilariae can we find and what is their significance?

Dirofilaria repens infections are usually asymptomatic, though cold, painless nodules containing the adult parasites can be found in the skin of infected animals. Occasionally, in cases of heavy infection or in sensitised animals, a mild to severe (often eosinophilic) dermatitis can be observed. These can result in microfilariae being detected with a negative heartworm antigen test result. Animals can be co-infected with both *D. repens* and *D. immitis*.

Athocheilonema reconditum and *Athocheilonema dracunculoides* (formerly *Dipetalonema reconditum* and *Dipetalonema dracunculoides*, respectively) infections are usually also subclinical, discovered incidentally. The adults of these species live in the peritoneal cavity and adipose tissue.

What treatment options are there?

The American Heartworm Society has produced excellent guidelines on the treatment of dogs with heartworm.

In summary, macrocyclic lactone heartworm preventatives are given once monthly; these kill microfilariae, L3 and early L4 stages of heartworm. Doxycycline is given for the first month post-diagnosis, to reduce risk of side effects of adulticide therapy (by killing the rickettsial agent that lives symbiotically in *D. immitis*). At 60, 90 and 91 days, melarsamine, is given, which kills the adult heartworms. Strict rest throughout the treatment period is advised. Prednisolone may be required in dogs with marked clinical signs.

How do I monitor the response to treatment?

Microfilariae can persist in a heartworm infected dog for up to 6 months after treatment. The antigen test may also remain positive up to 6 months after adulticide therapy. Repeat testing (heartworm antigen and modified Knott's test) should be done 6 months after treatment to confirm that it has been effective.

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How can we prevent heartworm disease?

Animals travelling from endemic to non-endemic areas, with more than seven months of exposure to potential infection, should be examined for heartworm using antigen testing and the modified Knott's test before starting any preventative therapy to determine the dog's heartworm status. Treatment is undertaken as described above, if infection is confirmed. Regular (i.e. monthly) preventative treatment using macrocyclic lactones should then be given if the animal will be living in, or travelling to, an endemic area. Animals travelling from non-endemic to endemic areas must be given preventative treatment. As these agents kill microfilariae, L3 and early L4 stages of heartworm and typically last a month, they will prevent infection if given within one month of the beginning of any exposure to heartworm, and if the treatment is continued for the duration of exposure, with the last treatment given within one month after leaving the endemic area.



Ideally preventative treatment should be started a month before exposure, as this engages the client and helps ensure preventative treatment is given and remembered; however, if this has not occurred, treatment within a month of arrival in the endemic area is adequate (e.g. if a dog has spent less than a month abroad in an endemic area and has not been given preventative treatment ahead of travelling, one treatment administered soon after returning home is usually sufficient). The use of mosquito repellents in endemic areas can also be considered e.g. permethrin, deltamethrin (Note: take care with the use of these agents if cats are in the household due their toxicity in cats).

Pets with an unknown history either coming from, or having travelled for a long time in, endemic areas and that show no evidence of antigen or microfilariae, should be treated twice, one month apart, and tested by the antigen test and modified Knott's test 6 and 12 months later.

Where can I get further information on heartworm?

More information can be found at:

- American Heartworm Society <https://www.heartwormsociety.org/>
- ESCCAP <https://www.esccap.org/>

Last reviewed July 2021 by Dr Emi Barker

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