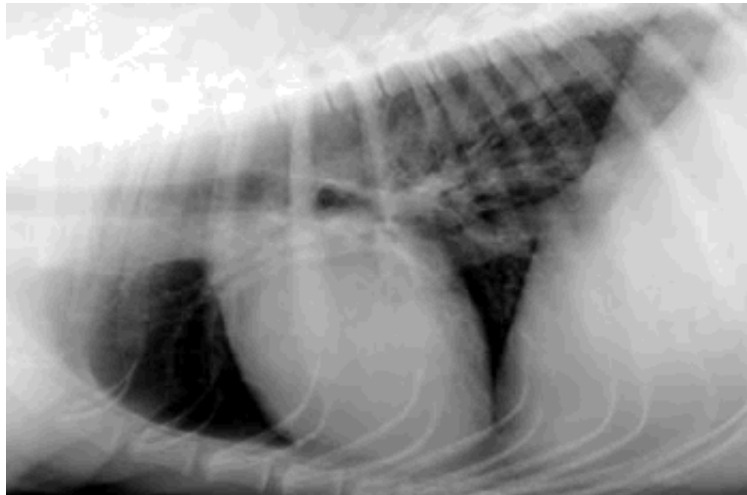


TREATMENT OF INFECTION

It has been said that the treatment of heartworm infection is something of an art. There are several strategies that can be used depending on the dog's medical condition including the option of not treating at all. The important concept to realize is that very harsh arsenic based drugs are necessary to kill adult heartworms and that treating for heartworm infection is neither simple nor safe in itself. Let us review some of the dangers and options in clearing the body of this parasite.

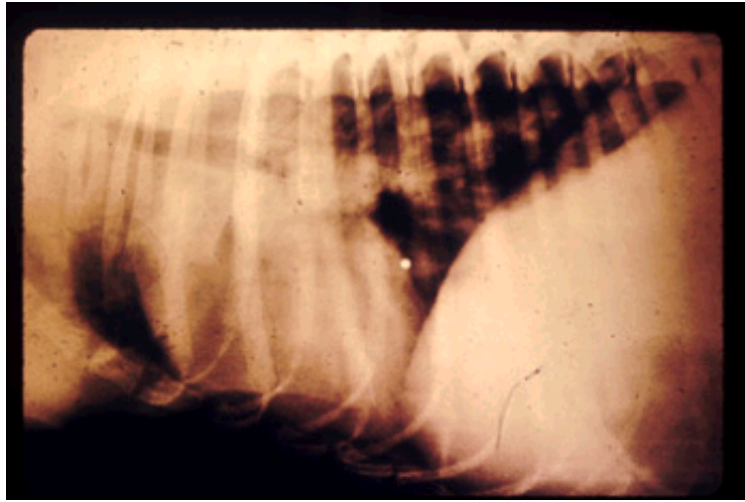
PATIENT EVALUATION

Prior to therapy, the heartworm patient is assessed and rated for risk into one of four categories. Important factors include: how many worms are thought to be present based upon the tests performed, the size of the dog, the age of the dog, concurrent health factors, severity of the heart disease, and the degree to which exercise can be restricted in the recovery period. Some hospitals use computerized formulas to categorize heartworm infected patients. The categories into which patients are grouped are as follows:



Chest radiograph from a mildly affected dog

- Class I: Lowest Risk. Young healthy dogs with minimal disease evident on radiographs, normal blood work, and no symptoms of illness. They may cough only occasionally if ever, they only fatigue with exercise, and their chest radiographs are normal.
- Class II: Moderately Affected. Healthy dogs with minimal signs as above, occasional coughing, fatigue only with exercise but with radiographs that show definite evidence of heart disease. Lab testing shows mild anemia, urine dipsticks show some protein present but not severe urinary protein loss.



Chest radiograph from a severely affected dog

- Class III: Severely Affected. Dog is suffering from weight loss, cough, difficulty breathing, blatant damage to the vasculature is apparent on radiographs, lab work reveals a more severe anemia and marked urinary protein loss.
- Class IV: Caval Syndrome. Dog is collapsing in shock with dark brown urine evident. Heartworms visible by ultrasound in the AV valve of the right side of the heart, very abnormal bloodwork. These dogs are dying and can only be saved by the physical removal of adult heartworms via an incision through the jugular vein. If such a dog can be saved from this crisis, further heartworm infection treatment cannot be contemplated until the dog is stable enough to fit into one of the other categories above.

To view the physical removal of adult heartworms from the jugular vein of a dog with caval syndrome, click here:

www.youtube.com/watch?v=VOLzFsNOJ-4

After knowing what Class the patient fits in, treatment can be determined. The dog has three groups of heartworms in his or her body:

- The microfilariae which are the newborn children of the adult worms living in the heart and pulmonary arteries. The microfilariae are swimming freely in the bloodstream possibly in large numbers and it is the microfilariae which can (through a mosquito) spread to other dogs. The microfilariae are killed so as to keep the dog from spreading his or her infection.
- The new arrival heartworm larvae, delivered from mosquito bites in the last 6-7 months. These are L3 & L4 larvae living in the skin (having arrived within the last 3 months). These will continue their maturation and repopulate the heart and pulmonary arteries if they are not killed before the adult worms.
- The L5 larvae and adult worms living inside the heart and pulmonary arteries. This group requires the arsenic compounds for destruction while the other two groups can be killed with less toxic products.

KILLING THE MICROFILARIA AND MIGRATING WORMS

The first step in treatment is clearing the migrating immature worms. If we were to jump directly to

killing the adult worms first, the adult worms we remove could be readily replaced shortly afterwards by those that were in the process of migration at the time of treatment. By addressing the migrating immature worms first, we minimize the number of adult worms we must kill in the second step. Fewer adult worms dying at once means less risk.

Happily the microfilariae, L3, and L4 larvae can all be killed by monthly ivermectin based heartworm preventive products (i.e. Heartgard[®], Triheart[®] etc.). The milbemycin based products (Sentinel[®] and Interceptor[®]) will also do the same job but will kill the microfilariae much faster which can create circulatory shock if there are large numbers of microfilariae dying all at one time. The newer products such as the selamectin and moxidectin products do not clear microfilaria well enough to be used in the treatment of an active infection so right now the ivermectin based products seem to be the best for this use. The American Heartworm Society recommends 1-3 months of a preventive prior to treating the adult worms. How long one chooses to wait depends on how urgent the dog's need is to remove the adult worms. After all, it is the adult worms that cause heartworm disease, not the immature worms addressed by the preventives.

KILLING THE ADULT WORMS

The only product currently available for the treatment of adult heartworms is melarsomine dihydrochloride (immiticide[®] made by Merial). If one goes by the manufacturer's recommendations, treatment can be done in 2 doses or 3 doses depending on the Class of heartworm infection. Most universities, however, opt to treat all patient with the 3 dose protocol as it creates a more gradual kill of the adult worms (which is safer in terms of embolism and shock).

The patient receives an intramuscular injection deeply in the epaxial (lower back) muscles as shown above. This is a painful injection with a painful substance and it is common for the patient to be very sore at home afterwards. Pain medication may be needed. Be very careful of the injection site as the pet may bite. The site may actually form an abscess which requires warm compresses. Approximately 30% of dogs experience some sort of injection site reaction which resolves in 1-4 weeks. Some dogs develop a permanent firm lump at the site of the injection.



In the 2 dose protocol, the dog comes back for a second injection the next day on the opposite side of the lower back. In the 3 dose protocol, the dog comes back one month later for 2 doses 24 hours apart (the first dose representing an introductory treatment to kill some of the more sensitive worms.) Keep in mind, too many worms dying at once creates circulatory shock.

After treatment, the patient must be strictly confined for one month following the final treatment. No walks, no running around. The dog must live the indoor life. The reason for this is that embolism to some degree is inevitable and it is important to minimize embolism-related problems. Exercise increases heart rate and oxygen demand and we need the heart to rest during this recovery period.

Watch for:

- **Coughing**

- **Fever**
- **Nose bleeds**

If any of these occur, report them to the vet as soon as possible. The most critical time is 7-10 days following a melarsomine treatment but they can occur anytime in the following month.

IVERMECTIN ONLY

Melarsomine treatment is expensive and often out of reach for rescue groups, shelters, and many individuals. If the dog is stable (Class I) one option is to simply leave the dog on an ivermectin based preventive. This option has led to a great deal of misconception about the ability of ivermectin to kill adult heartworms. Let us lay the rumors to rest now:

- Ivermectin does not kill adult heartworms.
- Ivermectin does shorten the lifespan of adult heartworms.
- Ivermectin does sterilize adult heartworms.
- Ivermectin does kill microfilaria (keeping the dog from being a source of contagion)
- Ivermectin does kill L3 and L4 larvae (preventing new infections).

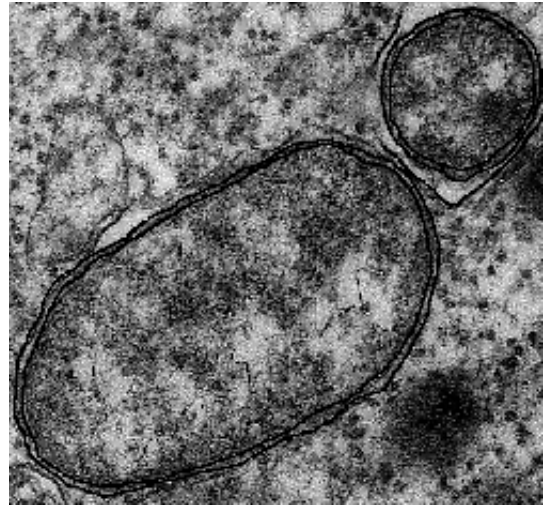
This means that if one opts to treat a heartworm positive dog with an ivermectin heartworm preventive only, one can expect the dog to remain heartworm positive for as long as 2 years and the heartworm disease will be progressing during that 2 years. This is not good for the dog but certainly beats getting no treatment of any kind.

There is another aspect to this treatment which is important to mention and that is the development of resistant heartworm strains. Using heartworm preventives long term in dogs with adult heartworms, leads to the production of heartworm preventive resistant microfilaria. In other words, this "slow kill" method of treating heartworm infection leads to strains of heartworm that cannot be stopped by any of the heartworm preventives presently available on the market. Heartworm preventive resistance has now been documented in some of the heartworm strains of the Mississippi river delta area and inappropriate use of heartworm preventives is felt to be the cause. Previously, the "slow kill" method of heartworm treatment was deemed acceptable for dogs in the Class I (early) stage of heart disease but this has changed given confirmation of resistant strains. The Companion Animal Parasite Council now recommends that the "slow kill" protocol using heartworm preventives NEVER be used regardless of whether the patient is in Class I stage of infection or not. Heartworm infection should be dealt with definitively and promptly so as to preserve the effectiveness of the medications we have.

WHAT IS WOLBACHIA

Wolbachia is a genus of rickettsial organisms (sort of like bacteria but not exactly). They live inside the adult heartworm. These organisms seem to be protective or beneficial to the heartworms and treating the dog with the antibiotic [doxycycline](#), which kills the *Wolbachia*, seems to sterilize female heartworms (meaning they cannot reproduce). *Wolbachia* is also thought to be involved in the

embolism and shock that results when heartworms die. The role of this organism is still being investigated. If your veterinarian wants to pre-treat your heartworm positive dog with doxycycline, it may be because of concerns regarding this organism. As new information emerges, we will post here.



Micrograph of a Wolbachia organism.