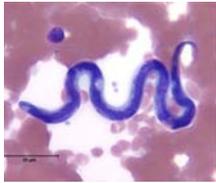


Current heartworm issues



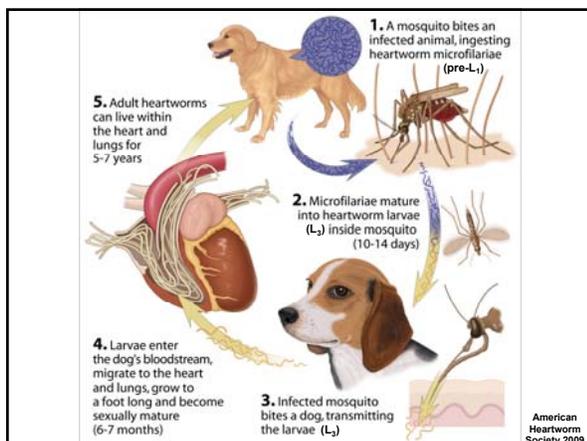
(T. Hornak)

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Topics



- Heartworm:
 - risk of infection ?
 - testing for heartworm ?
 - development of drug resistance ?
 - current recommendations for treating heartworm infections
 - surgery on heartworm-positive dogs ?



Heartworm in dogs in 2010



Heartworm in Canada in 2010

Province	# cases	% cases
Ontario	431	76%
Manitoba	77	14%
Québec	41	7%
British Columbia	8	1.6%
Alberta/Saskatchewan	4	0.8%
Nova Scotia/New Brunswick	3	0.6%
Total	564	
	(354 in 2002)	

Heartworm in Ontario dogs (2010)



How likely is a dog to get infected ?

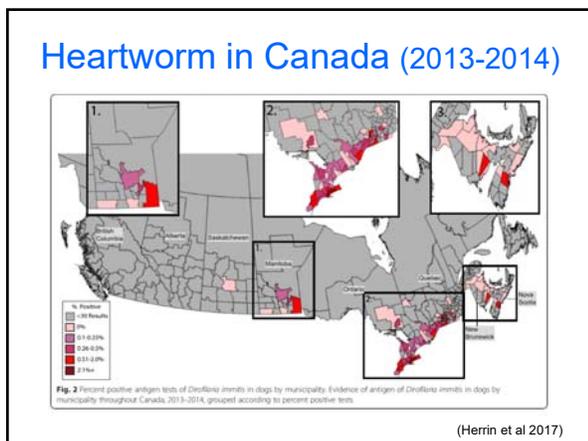
- 289,229 tested
- 382 “heartworm positive” (new in 2010)
- overall “prevalence” = 0.13%
- ≥ 51% infections acquired in Ontario
- importation of heartworm: 47 (12%) = “Katrina dogs”
 55 (14%) = imports from other states/countries
 13 (3%) = travelled outside Canada
- 83% positive dogs not on heartworm prevention in previous year



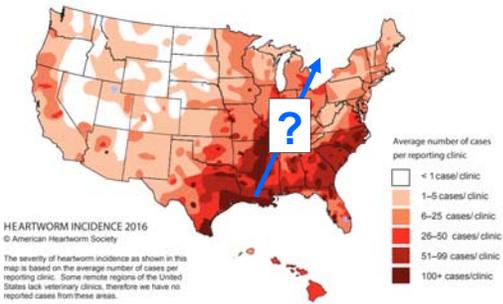
Heartworm in Ontario dogs (2010)

How prevalent is disease ?

- 46/382 (~12%) heartworm-positive dogs had clinical signs



Heartworm risk in USA - 2016



Heartworm in Canada



Is the risk of heartworm in Canada changing in dogs/cats?
- What has been the impact of "Katrina" dogs ?

Impact of hurricane Katrina dogs ?

- Still being imported in to Ontario ?
- Tested for heartworm in Louisiana immediately prior to departure for Canada:
 - If test negative, sold as heartworm negative
 - If test positive, often treated with one dose of melarsomine
- Some owners refusing to pay for adulticide treatment



Detection of heartworm infection

- Earliest antigen can be detected = ~5 months
- Earliest microfilariae can be detected = ~6 months
- No justification for testing <7 months of age

Testing for heartworm infection – what has changed?

- Some dogs infected with *D. immitis* are microfilaria positive but test negative for antigen
↔ immune complex formation (Little et al 2014)
- Shelter dogs in southeast USA:
 - 7.1% of dogs infected with heartworm:
 - antigen negative / microfilaria positive (Velasquez et al 2014)

American Heartworm Association now recommends annual testing for antigen and microfilariae (AHS 2014)

Testing for heartworm

Antigen and microfilaria test recommended if:

- high degree of suspicion of infection
- heartworm prevention history unknown

(AHS 2014)

Testing protocol for new dogs

Before initiating heartworm preventive regimen on dogs ≥ 7 months old - perform antigen + microfilaria test:

- i. immediately
- ii. 6 months later
- iii. 6 months later
- iv. annually thereafter

(AHS 2014)

Is drug resistance developing in heartworm ?

- Anecdotal evidence from parts of southern USA (Hampshire, 2005):
 - Increased number of heartworm cases in dogs on heartworm prevention reported to Food and Drug Administration
 - Reason(s) ?



Is drug resistance developing in heartworm ?

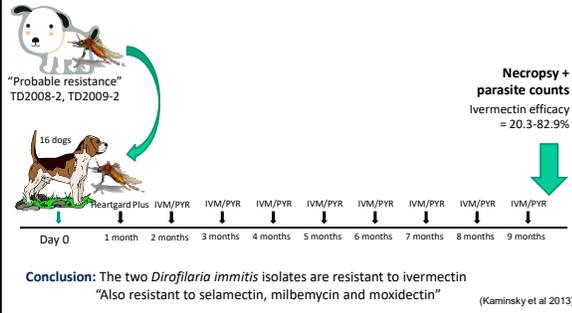
- Louisiana dog in Niagara area – heartworm antigen positive + microfilaremic
- Treated with 3-dose protocol of melarsomine (Immiticide):

(NB Standard microfilaricidal treatment = milbemycin at 0.5 mg/kg)

Days after last melarsomine treatment	Heartworm antigen	Microfilariae concentration in blood	Milbemycin treatment
207	Negative	$\geq 100/\text{ml}$	0.74 mg/kg every 2 weeks for 6 weeks
263		$\geq 100/\text{ml}$	1.1 mg/kg every 2 weeks for 10 weeks
340	Negative	6,530/ml	2.0 mg/kg daily for 7 days
385		355/ml	2.0 mg/kg daily for 8 days
445	Negative	1,810/ml	

(Bourguinat et al 2011)

Resistance of heartworm to preventive drugs ?



Implications of drug resistance in heartworm?

- Note: most cases currently (2013) in Mississippi River Valley.
- Avoid moving heartworm-infected dogs out of areas with reports of resistance.
- Confirm that adulticide treatment protocol eliminates both adult parasites and microfilariae.
- Avoid selective pressure against microfilariae, such as underdosing or slow-kill treatments.

(Kaminsky et al 2013)

Managing dogs infected with *Dirofilaria immitis*



Treating dogs infected with *Dirofilaria immitis*

Originally:

- Two treatments with melarsomine at 2.5 mg/kg, IM, 24 hours apart.



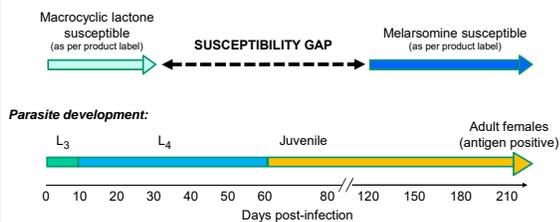
Treating dogs with melarsomine

- Two injection protocol (days 1,2) kills ~90% adult parasites.
- Three injection protocol (days 1,30,31) kills ~98% adult parasites.
- Percentage of dogs cleared of infection = less than these figures.

(Keister et al 1992; Vezzoni et al 1992)



Susceptibility of *D. immitis* to macrocyclic lactones and melarsomine



Dirofilaria immitis and Wolbachia

- Most *D. immitis* infected with *Wolbachia* (intracellular bacteria)

Treatment with doxycycline at 10 mg/kg BID for 4 weeks:

- reduces bacteria numbers in all parasite stages for ~12 months.
- reduces pulmonary pathology after melarsomine treatment.



Dirofilaria immitis and Wolbachia

Treatment with doxycycline at 10 mg/kg BID for 4 weeks:

- Helps eliminate all developing larvae during first 60 days of infection (McCall et al 2011).
- Gradually suppresses microfilaremia if given to heartworm-positive dogs (Bazzocchi et al 2008; McCall et al 2008).
- Reduces parasite transmissibility in mosquito after ingestion of microfilariae (McCall et al 2008).



Treating dogs infected with *Dirofilaria immitis*



Now: 3-dose protocol used for all infections except caval syndrome:

- On days 1, 30 and 31 treat with melarsomine at 2.5 mg/kg, IM
 - safer and more efficacious

Also:

- (i) Pre-treat with heartworm preventive on days -60, -30 and 1 (if applicable).
- (ii) Pre-treat with doxycycline for 4 weeks.
- (iii) On days 1 & 30: prednisone at 0.5 mg/kg BID 1st week, 0.5 mg/kg SID 2nd week, 0.5 mg/kg EOD 3rd & 4th week.

To evaluate efficacy of treatment:

- At 6 months post melarsomine treatment perform an antigen and microfilaria test.

If melarsomine treatment not possible or contraindicated

- Maintain continuously on macrocyclic lactone (ML) heartworm preventive (i.e. monthly treatment).
- Give doxycycline at 10 mg/kg BID for 4 weeks (can use 5 mg/kg BID ?).
- Antigen and microfilaria test every 6 months – continue ML treatment until two negative antigen tests.
- If dog antigen positive after one year, repeat doxycycline treatment.
- Restrict exercise throughout treatment protocol.

Surgery on heartworm-positive dogs?

- No evidence of an increase in perioperative complications in heartworm-positive dogs with no-to-mild clinical signs of heartworm disease (Peterson et al 2014).

(AHS 2014)

For full details see:
<https://www.heartwormsociety.org/veterinary-resources/american-heartworm-society-guidelines>
