Feline Heartworm-Associated Respiratory Disease

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Heartworm infections in dogs were first described in 1626. However, feline heartworm infections were not documented in the United States until 1922. Although canine and feline infections are caused by the same parasite, *Dirofilaria immitis*, there are few similarities between the infections in dogs and cats (TABLE 1). The prevalence of feline heartworm infection continues to increase, likely including more than 16 countries and well over 30 US states. Because of increased awareness and improved diagnostic methods, feline heartworm infection (and disease) caused by adult heartworms is now diagnosed with increasing frequency in veterinary hospitals. The spectrum of clinical signs in infected cats includes coughing, dyspnea, vomiting, and sudden death. However, up to 28% of infected cats may remain asymptomatic. The latter is likely the result of the characteristic inactive lifestyle of most pet cats. Interestingly, given the potential for heartworms to cause severe disease or death in cats, some have estimated that less than 5% of cats in the United States receive a heartworm preventive medication.

Initially, feline heartworm disease was thought to be due to the presence and/or subsequent death of mature heartworms in the heart or lungs of cats. However, recent research suggests that premature death of immature heartworms in cats can evoke severe and potentially fatal pulmonary reactions. Moreover, these infections cannot be easily diagnosed using antigen tests, antibody tests, or radiography because of the absence of adult female heartworms, potentially waning antibody levels, and/or the similarity of lung lesions to those associated with other feline pulmonary diseases. A. R. Dillon and I recently reproduced this condition in experimentally infected cats and coined the term *heartworm-associated respiratory disease* and the acronym *HARD* to characterize the potential for cats to present with heartworm disease that is not due to adult worms. HARD poses an additional difficulty in that no specific therapy is known.

Cats harbor inflammatory cells in their lungs and have a unique response to pulmonary pathogens, often resulting in an exaggerated reaction to pulmonary parasites and other infectious agents. Based on cases of feline heartworm infection that we had seen, Dillon and I speculated that many immature heartworms that arrive in cats’ lungs at 70 to 90 days after infection are killed and do not survive to the adult heartworm stage. The intense inflammation caused by the death of these worms could result in coughing and difficult breathing that would not likely be recognized as heartworm infection by veterinarians or veterinary technicians. This was previously referred to as the 3-month disease cycle because it occurred just 90 days (3 months) after exposure to heartworm-infected mosquitoes.

To reproduce the 3-month disease cycle in cats, Dillon

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**Protecting Pets and People From Parasites**

The Companion Animal Parasite Council (CAPC) is an independent association of veterinarians and other animal health care professionals established to create guidelines for the optimal control of internal and external parasites that threaten the health of pets and people. It brings together broad expertise in parasitology, internal medicine, public health, veterinary law, private practice, and association leadership. Initially convened in 2002, the CAPC was formed with the expressed purpose of changing the way veterinary professionals and pet owners approach parasite management. The CAPC advocates best practices for protecting pets from parasitic infections and reducing the risk for zoonotic parasite transmission. Sponsoring the peer-reviewed Parasite 100 column is one more avenue for reaching veterinary technicians on important topics and issues related to the prevention of parasitic transmission and disease.
and 1 experimentally infected cats with infective larvae of *D. immitis* and treated them strategically with ivermectine to eliminate 70- to 90-day-old immature heartworms (*D. immitis*) and treated them strategically with ivermectine to eliminate 70- to 90-day-old immature heartworms (*D. immitis*).

We observed that treated cats developed signs of pulmonary disease similar to those seen in cats with adult heartworms or the 3-month disease cycle. Signs included coughing, dyspnea, and, in one case, even death. Lung lesions consisted of arteritis (including occlusive vessel hypertrophy), bronchiitis, bronchiolitis, and interstitial lung disease (alveolitis; FIGURES 1 AND 2), which were similar to lesions in cats with classic heartworm disease and other pulmonary diseases, such as feline asthma. Because these signs and lesions were caused by the death of immature heartworms, we coined the term **HARD** to characterize this unique respiratory infection.

In a study of heartworm-infected stray cats, Browne et al\(^7\) demonstrated a correlation between antibody, necropsy, and porcine results that were similar to those of our HARD study. They also correlated these test results with lung lesions, concluding that cats can have lung lesions consistent with heartworm infection but without serologic or necropsy confirmation of heartworm infection.\(^8\)

Our HARD study and the Browne et al study should alert veterinarians and veterinary technicians that heartworm disease in cats can be caused by immature heartworms and that diagnosis of these infections can be challenging. It is important to note that specific therapies for HARD are unknown at this time. Cats with HARD can only be treated symptomatically with oxygen, glucocorticoids, bronchodilators, fluid therapy, and thermal support. Even with adequate supportive therapy, 10% to 20% of cats with symptomatic heartworm infections will likely die from respiratory complications.\(^11\) Given the potential complications of adult heartworm infections or HARD in cats, I strongly recommend administering broad-spectrum heartworm preventive products to cats with potential exposure to heartworm-infected mosquitoes.

### TABLE 1. Comparison of Canine and Feline Heartworm Infections\(^2\)

<table>
<thead>
<tr>
<th>Dogs</th>
<th>Cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be infected with many heartworms</td>
<td>Usually infected with few heartworms</td>
</tr>
<tr>
<td>Likely to be antigen positive because of the presence of female heartworms</td>
<td>Unlikely to be antigen positive because of few worms, thus few female heartworms</td>
</tr>
<tr>
<td>Microfilariae are usually present</td>
<td>Microfilariae are seldom present</td>
</tr>
<tr>
<td>Antibodies are usually not helpful in the diagnosis</td>
<td>Antibodies may be helpful in the diagnosis</td>
</tr>
<tr>
<td>The heart and lungs are involved in disease</td>
<td>The heart is not usually involved in disease; the lungs are more severely affected</td>
</tr>
<tr>
<td>Disease depends on the number of worms and the dog’s activity level</td>
<td>Disease can be caused by few adult heartworms</td>
</tr>
<tr>
<td>HARD is not described in dogs</td>
<td>HARD is suspected in an unknown number of feline heartworm cases</td>
</tr>
</tbody>
</table>

**REFERENCES**

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1. Approximately what percentage of cats with heartworm infection remains asymptomatic?
   a. 7%  
   b. 12%  
   c. 28%  
   d. 34%

2. Less than 5% of cats in the United States
   a. are diagnosed with heartworm disease.  
   b. receive preventive therapy for heartworm disease.  
   c. are exposed to heartworm infection.  
   d. receive treatment for heartworm infection.

3. In cats, HARD reflects
   a. the death of immature heartworms in the respiratory system.  
   b. the presence of adult heartworms in the respiratory system.  
   c. the death of adult heartworms in the respiratory system.  
   d. an exponential increase in D. immitis-specific antibody levels.

4. Heartworm antibody test results in cats with heartworm infection are
   a. always positive.  
   b. negative until 90 days after infection.  
   c. often negative.  
   d. never positive.

5. Signs arising from heartworm infection in cats are likely due to
   a. an autoimmune reaction.  
   b. pulmonary vascular and interstitial inflammation.  
   c. reduced cardiac output.  
   d. malnutrition.

6. Pulmonary lesions in cats with heartworm infection often include
   a. pulmonary edema.  
   b. a pulmonary embolism caused by thrombi formed in the right ventricle.  
   c. bronchitis and interstitial lung disease.  
   d. pulmonary hypertension and pneumothorax.

7. Recommended curative therapy for HARD in cats
   a. consists of a course of ivermectin.  
   b. consists of treatment with melarsomine dihydrochloride.  
   c. must be administered within 90 days of infection.  
   d. does not exist at this time.

8. Symptomatic treatment for feline HARD includes
   a. bronchodilators.  
   b. fluid therapy.  
   c. glucocorticoids.  
   d. all of the above.

9. Even when treated, what percentage of cats with symptomatic heartworm infection is likely to die?
   a. 5% to 10%  
   b. 10% to 20%  
   c. 30% to 40%  
   d. 50% to 75%

10. Which cats should receive heartworm preventive products?
   a. cats with potential exposure to heartworm-infected mosquitoes  
   b. cats living in the southeastern United States  
   c. only outdoor cats  
   d. cats that test positive for FIV or FeLV

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