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Canine *Filaroides* Infection (14 June 2000)

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Summary

Filaroides species in dogs are unlike other lungworm nematodes that require a mollusk or annelid intermediate host. Infective first-stage larvae require no period of development outside the body of the host. *Filaroides hirthei* is an infrequent cause of severe, potentially fatal, respiratory tract disease of immunocompetent dogs. There have been subclinical reports in beagles. Clinical disease has been associated with immunocompromised or stressed animals. Marked focal granulomatous reactions in lung tissue are directed against dying or dead worms. These pathological alterations may be confused with drug-induced or neoplastic lesions. *Filaroides osleri* stimulates the formation of fibrous nodules in the trachea and bronchi. A dog will exhibit a chronic cough, which is exacerbated by exercise or excitement. The sedimentation-flotation method with zinc sulfate has been recommended as the best method to detect *Filaroides* larvae in feces. Treatment with fenbendazole or ivermectin is recommended for diagnosed *F. hirthei* infections. Complete resolution of *F. osleri* nodules with anthelmintic medication has not been documented.

Helminths of the respiratory tract are of minor importance in dogs compared to other domestic animals. Species of metastrongylid nematodes of the genus *Filaroides* have been recorded in various small animal hosts throughout the world [1]. The dog is the host to three species of lungworms belonging to the genus *Filaroides* (van Beneden, 1858): *F. (=Oslerus) osleri* (Cobbold, 1879), *F. hirthei* [2] and *F. milksi* (Whitlock, 1956). *Filaroides hirthei* is most likely to be confused with *F. milksi* because of the greater similarity in size and the same location of the adult nematodes in the lung [3].

Life Cycle

Filaroides species are directly infective as first-stage larvae and require no period of development outside the body of the host or in an intermediate host [4]. The ovoviviparous females deposit thin-shelled eggs in the lung parenchyma. Development through all 5 stages (L1-adult) is completed in the lung tissue of dogs. The worms mature and begin laying eggs containing larvae 32 to 35 days after infection [5]. Infection is acquired through the ingestion of saliva or regurgitated stomach contents containing larvated eggs and first stage larvae from the bitch to pups during feeding [6,7]. Infection through the ingestion of lung tissue, or feces of infected dogs has also been reported [8]. Autoinfection (i.e., reinfection of the host with first-stage larvae before the larvae leave the host) may increase the potential of serious infection [5, 8]. This phenomenon occurs in the life cycle of only a few nematodes of domestic animals or humans (*Probstmayria vivipara*, *Capillaria philippinensis*, *Ollulanus tricuspis* and *Strongyloides stercoralis*).

Clinical Importance and Diagnosis

Filaroides hirthei is an infrequent cause of severe, potentially fatal, respiratory tract disease of immunocompetent dogs [9,10]. Genta and Schad [11] found larvae in the mesenteric lymph nodes, intestinal walls, and liver of two experimentally immunosuppressed beagles. Hirth and Hottendorf [12] first described *F. hirthei* in an experimental beagle colony in the USA. No clinical disturbance was reported. Subsequently, there have been a number of other reports of subclinical infestation in beagles [13,14]. Sporadic cases of

clinical disease, mainly in toy breeds, were associated with stressed or immunocompromised animals [9,10,15,16]. Dogs that are chronically infected show minimal cellular reactions around living worms, but marked focal granulomatous reactions directed against dying or dead worms (Fig. 1). These pathological alterations may be confused with drug-induced or neoplastic lesions [12,14,17]. Small (1-5 mm) subpleural nodules of tan, gray, or green color may be dispersed throughout any or all lobes, particularly in the left apical lobe [3]. Dense fibrous tissue may surround the nodules, and areas of extensive pleural fibrosis sometimes are present. Radiographically, interstitial linear and nodular infiltrates are the most prominent lung parenchymal changes discernible [18]. The radiographic detection of peribronchial, alveolar, and interstitial linear and nodular densities is consistent with the reported pathological changes of bronchiolitis, peribronchitis, perivascularitis, focal pneumonitis, interstitial pneumonia, granuloma formation, and pleural fibrosis [3].



Figure 1. *Filaroides hirthi* larvae in sectioned adult female worms from lungs of a dog with chronic nonproductive cough. Notice distinctive large basophilic granules in the larval bodies. Mononuclear reaction in the peribronchial area is modest. H&E stain; X 315. - To view this image in full size go to the IVIS website at www.ivis.org -

Filaroides milksi, also found in the lung parenchyma, has occasionally been associated with signs of anorexia and dyspnea, with or without coughing [19]. *Filaroides hirthi* adults elicit significant tissue reactions in the majority of cases whereas reaction to larvae is minimal [12]. In contrast, adults of *F. milksi* elicit a minimal tissue response with the main response directed at the larvae [19].

Filaroides osleri stimulates the formation of fibrous nodules in the trachea and bronchi, especially around the carina. Some infections are asymptomatic, the nodules appearing as an incidental necropsy finding. The typical clinical picture is a dog with a chronic cough, which is exacerbated by exercise or excitement. The more severe cases show respiratory distress (i.e., dyspnea, exercise intolerance, cyanosis) and emaciation [20]. Clayton and Lindsay [20] recommended direct visualization of the parasitic nodules via tracheobronchoscopy as the most reliable diagnostic method as well as the most reliable method of monitoring response to treatment. It is often difficult to maintain ventilation during bronchoscopy. Advantages of high-frequency jet ventilation (HFJV) relative to standard mechanical ventilation include maintenance of adequate ventilation and oxygenation with low peak and mean airway pressures and lessened cardiovascular impairment [21].

The infective first-stage larvae of *Filaroides* species are lethargic and do not migrate out of the fecal mass. The Baermann technique is not a recommended diagnostic technique [23]. The sedimentation-flotation method with zinc sulfate (sp. gr., 1.18) has been recommended as the best method to detect *Filaroides* larvae in feces [22]. The larvae measure approximately 250 μm in length and have a characteristic S-shaped tail with a slight kink (Fig. 2, Fig. 3a and Fig. 3b). *Filaroides* species larvae are significantly smaller than the larvae of *Angiostrongylus vasorum* (330 μm), and lack the prominent dorsal spine of that nematode. The larvae of *Crenosoma vulpis*, an occasional parasite of the bronchi and bronchioles of dogs, have a straight tail.

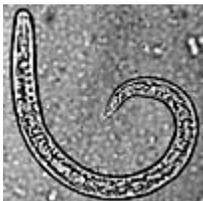


Figure 2. *Filaroides hirthi* larva. The larva's tail has a slight kink. Fixed in 5% formalin, X 400. - To view this image in full size go to the IVIS website at www.ivis.org -



Figure 3a. *Filaroides hirthi* larva. In a fecal flotation, larvae usually are coiled, and the tail may not be visible. Fixed in 5% formalin, X 400. - To view this image in full size go to the IVIS website at www.ivis.org -



Figure 3b. *Filaroides hirathi* larva. In a fecal flotation, larvae usually are coiled, and the tail may not be visible. Fixed in 5% formalin, X 400. - To view this image in full size go to the IVIS website at www.ivis.org -

Upon necropsy, the number of lungworms that can be recovered from a dog lung tissue is usually small, although a few may have a considerably larger number. The best method to recover *F. hirathi* nematodes is the examination of the pleural surface in areas of normal-appearing lung with a dissecting microscope. The presence of lungworms beneath the pleura is indicated by small, dark, thread-like structures that are visible through the intact pleura. If these areas are carefully dissected out, they will yield one or a pair (male and female) of mature lungworms. The detailed description of the morphologic aspects of *F. hirathi* has been reported by Georgi and Anderson [2].

Treatment

The clinical signs of worsening respiratory noise, dyspnea and cyanosis should direct the clinician to assess for intra-luminal airway obstruction. Endoscopic examination and removal of obstructing *F. osleri* nodules is essential for a successful outcome. Therapeutic regimes using ivermectin, thiabendazole, fenbendazole, albendazole and levamisole have all been reported to give good clinical response but without consistently clearing the nodules on follow-up bronchoscopy or necropsy examination. At present, there appears to be no documented report of satisfactory anthelmintic medication for *F. osleri* [23].

Results of fecal examination for eggs or larvae may be negative for several weeks after treatment. Fecal examinations should be repeated in 6 to 8 weeks to evaluate effects of anthelmintic therapy. Fenbendazole (Panacur granules®, 22.2%), 50 mg/kg, PO q 24 h for 14 days cleared a dog of infection [16]. Avermectins are fat-soluble, persist in tissues for up to 30 days, and have a relatively long period of activity after a single administration. Seemingly, ivermectin will be effective against respiratory nematodes in small animals, but few trials have been conducted [23].

In a breeding colony, bitches should be treated before whelping, and pups should be separated from older infected dogs to prevent horizontal transmission by ingestion of infected feces [24]. In infected dogs, good hygiene is essential, and pups could be hand-raised or foster-reared on uninfected bitches.

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