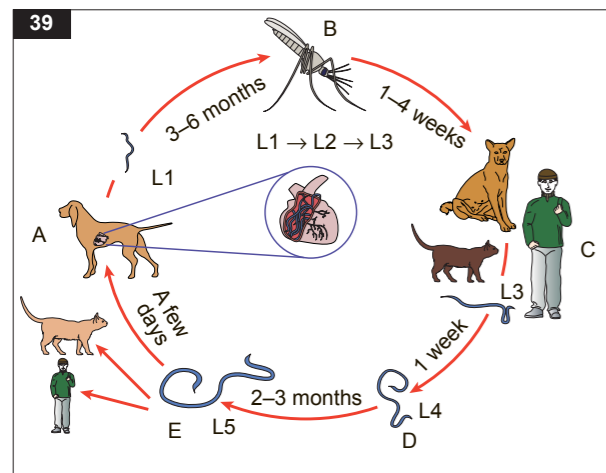


- Serous cavity filariasis (e.g. *Setaria* species, *Mansonella* species) is characterized by the presence of parasites in the pleural or peritoneal cavity.
- Cardiopulmonary filariasis (*Dirofilaria immitis*) is infection of the pulmonary arteries and the right side of the heart.
- Arterial filariasis (*Elaeophora schneideri*) is caused by the presence of adult worms in the systemic arteries.
- Ectopic filariasis is characterized by the incidental localization of a parasite in organs or tissues that are not typical of that particular species (e.g. presence of *D. immitis* in systemic arteries).

The biology and epidemiology of the filarial parasites affecting dogs and cats are shown in Table 6. The most important and geographically widespread filarial disease in the dog and cat is caused by *D. immitis* and is known as heartworm disease. *D. (Nochtiella) repens* is also frequently observed in pet animals and represents a more common zoonotic risk than *D. immitis*. *Dipetalonema reconditum* is another filarial nematode commonly found in dogs but with very little clinical significance.

Brugiasis (*B. malayi* and *B. pahangi*) is a filarial infection that affects lymph nodes and lymphatic vessels of dogs and cats in confined regions of south-east Asia.



**39** Life cycle of *Dirofilaria immitis*. (A) Adult worms in the pulmonary arteries and right ventricle of the definitive host release immature larvae (L1 or microfilariae) into the circulation. Microfilaraemia is uncommon in cats and humans. (B) Microfilariae are ingested by a mosquito during a blood meal and they mature from L1 to L3 in the insect. (C) L3 larvae penetrate the local connective tissues of the host during a later blood meal. (D) The larvae moult from L3 to L4. (E) L4 mature in the subcutaneous tissues until they reach the pre-adult stage (L5). L5 larvae migrate to the right heart and pulmonary arteries where they mature and mate, releasing microfilariae into the circulation and perpetuating the life cycle.

## CARDIOPULMONARY DIROFILARIASIS (HEARTWORM DISEASE)

### Background, aetiology and epidemiology

Dirofilariasis, or heartworm disease (HWD), is a filarial infection caused by *Dirofilaria immitis*. The parasite is primarily located in the pulmonary arteries and right heart of dogs and, less commonly, cats and ferrets. The infection can also occur in other species, such as wild canids, California sea lions, harbour seals, wild felids and humans, but these species are normally considered 'aberrant' or 'dead-end' hosts since the parasites rarely undergo final maturation to complete their biological cycle. *D. immitis* has also been described in horses, beavers, bears, raccoons, wolverines, muskrats and red pandas.

### Life cycle

Dirofilariasis is transmitted by a mosquito bite (39) and there are more than 70 mosquito species that can potentially transmit the infection (see Appendix, p. 143).

Female *D. immitis* adults are viviparous and can release immature larvae (L1 or microfilariae) into the circulation. Microfilariae are ingested by a mosquito during a blood meal. Mosquitoes are not only vectors but also obligatory intermediate hosts and infection cannot be transmitted without a sufficient period of larval maturation (from L1 to L3) in the Malpighian tubules of the insect. The maturation period is variable, depending on environmental temperature. Development cannot occur below a threshold temperature of 14°C (57.2°F) and the cycle will be temporarily suspended until warmer conditions resume. When the average daily temperature is 30°C (86°F) the maturation can be completed in eight days, while it takes approximately one month when the environmental temperature is 18°C (64.4°F). As a consequence, transmission of infective larvae is limited to warm months and it varies depending on the geographical location.

The infective L3 larvae migrate from the Malpighian tubules to the lumen of the labial sheath in the vector's mouth and, during a later blood meal on an appropriate host, the L3 will exit the labium, enter the bite wound and penetrate local connective tissues. After approximately one week the larvae moult from L3 to L4 and, after a migration of 2–3 months in the subcutaneous tissues, moult to immature adults (L5). The L5 larvae penetrate a systemic vein and migrate to the right heart and pulmonary arteries within a few days, where they mature and mate. After approximately 3–6 months, releasing microfilariae into the circulation and perpetuating their life cycle.

The life expectancy of *D. immitis* is approximately five years in dogs and two years in cats. In experimental infections the adult worms in cats do not reach the same size as in dogs, and their development is slower; therefore, the average prepatent period is longer in cats (eight months) than in dogs (5–6 months). Furthermore, the

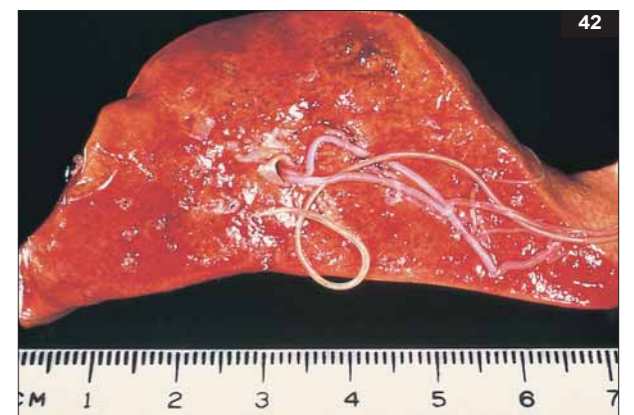
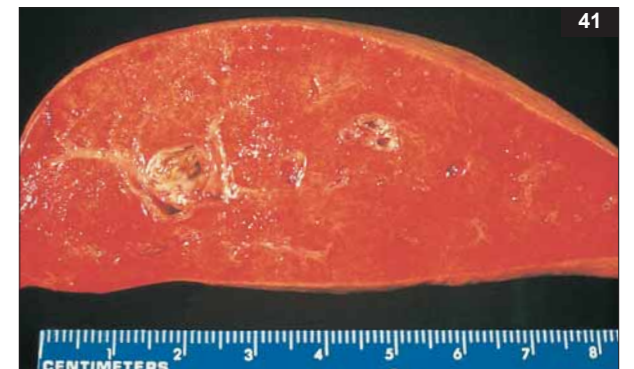
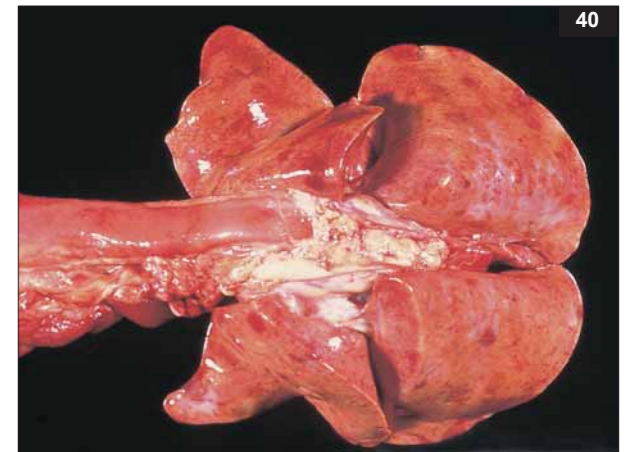
worm burden in cats is typically lower than in dogs and microfilaraemia is uncommon (less than 20% of infested cats) and, when present, it is inconstant and transient. Thus, cats are poor reservoirs of infection, as *D. immitis* is less likely to mature in this species and adults are short-lived when present.

Dirofilariasis is present in several countries, with a variable prevalence that depends on the canine population, the presence of mosquito vectors and the climate. The climate must be sufficiently warm to allow the presence of mosquitoes and the development of larval stages in the insects. For this reason, the prevalence of dirofilariasis varies with both geographical area and season. This is an important concept to consider when screening for the disease or planning a chemoprophylactic schedule.

The disease has been diagnosed throughout North America, in most countries of southern Europe and in Africa, Asia and Australia. In non-endemic countries, dirofilariasis may be diagnosed in dogs that have travelled from or through countries where infection is prevalent. However, at present, despite the presence of potential vectors and infected dogs, spread of disease is limited because of low average daily temperatures that do not support larval maturation within the mosquito. Climate change may result in the spread of infection into these areas in the future.

### Pathogenesis

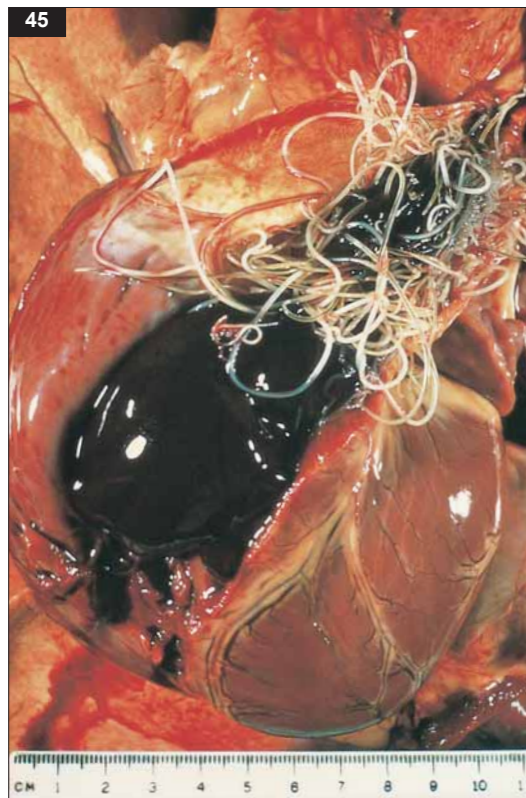
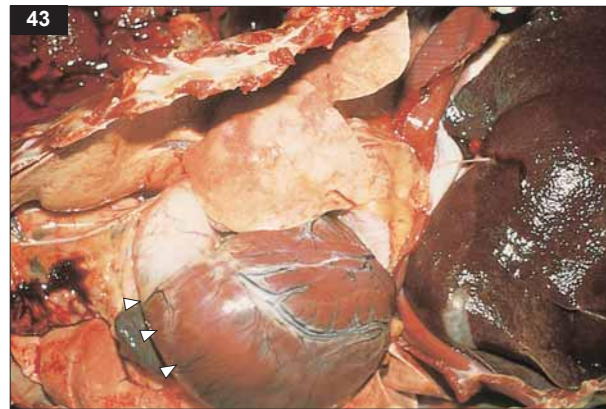
Dirofilariasis is primarily a cardiopulmonary disease. The presence of adult nematodes in the pulmonary arteries causes proliferation of the intima with consequent narrowing and occlusion of the vessels (40–42). Direct blockage by the adult worms is a less likely possibility. The severity and extent of lesions depend on the number and location of adult worms. The caudal lobar arteries are usually the most heavily parasitized. Severe pulmonary arterial disease may cause an increased permeability of lung vessels, with periarterial oedema and interstitial and alveolar cellular infiltrate, which can result in irreversible pulmonary fibrosis. Pulmonary thromboembolism (PTE) is another sequela of dirofilariasis. It is initiated as a consequence of platelet aggregation following exposure of collagen secondary to endothelial damage induced by the parasite (40–42). Platelet aggregation may also be responsible for the release of platelet-derived growth factor (PDGF), which promotes proliferation of medial smooth muscle cells and fibroblasts. PTE can also occur in response to adult worm death either as a spontaneous event or induced by adulticidal treatment. Experimental intravenous administration of *D. immitis* extract induces shock in dogs as a consequence of mast-cell degranulation and histamine release. This phenomenon seems to be caused by an unknown substance contained in the extract and may explain the circulatory collapse that is occasionally seen in dogs after the spontaneous death of parasites or adulticidal treatment.



**40–42** Lungs of a dog with dirofilariasis. The presence of adult nematodes in the pulmonary arteries causes proliferation of the intima, with consequent narrowing and occlusion of the vessels. Severe pulmonary arterial disease may cause increased permeability of lung vessels, with periarterial oedema and interstitial and alveolar cellular infiltrate. (40) The entire lungs appear oedematous, with areas of haemorrhagic infarction. (41) Section of a lung lobe showing inflammatory oedema and a large area of infarction. (42) Adult parasites in the lumen of a large pulmonary artery.

In cases of severe infection, particularly where a large number of parasites mature concurrently, retrograde migration from the pulmonary artery to the right ventricle, right atrium and venae cavae may occur (43–45). This induces incompetence of the tricuspid valve, which, in association with the concurrent pulmonary hypertension, is the cause of backward, right-sided heart failure (jugular distension, liver congestion, ascites) (46). Additionally, in heavy burdens, erythrocyte membranes may be damaged as cells pass through the mass of intravascular parasites, causing haemolysis and haemoglobinaemia. The presence of tricuspid incompetence,

right-sided heart failure with hepatomegaly, poor cardiac output and intravascular haemolysis with resultant haemoglobinaemia and haemoglobinuria is referred to as 'caval syndrome'. Severe cases of caval syndrome can also be characterized by the presence of adult worms in the caudal vena cava and thromboembolic events accompanied by disseminated intravascular coagulation (DIC). The pathogenesis of caval syndrome is not fully understood, even though the retrograde migration of adult nematodes from the pulmonary arteries to the right ventricle, right atrium and venae cavae seems the most convincing explanation.



**43–45** Necropsy specimens from a case of canine dirofilariasis. Right-side enlargement is primarily a consequence of the concomitant pulmonary hypertension. In cases of severe infection, migration of the parasites into the right ventricle and right atrium can contribute to the development of right heart enlargement. (43) Severe right ventricular enlargement (arrowheads). Hepatomegaly and liver congestion may also be appreciated. (44) Magnification of the same heart. The right side appears significantly larger than the left and there is gross dilation of the pulmonary artery. (45) Section of the right ventricle and pulmonary artery showing numerous adult parasites.

Immune-complex glomerular disease is also commonly reported in dogs with dirofilariasis. It is characterized by a protein losing nephropathy (PLN), with hypoalbuminaemia and, eventually, reduced plasma antithrombin III (ATIII), which may exacerbate the development of PTE. The antigen that causes the immune-complex disease is unknown but it could be a substance released by circulating microfilariae.

In cats, pulmonary hypertension, right-sided heart failure and caval syndrome are less common. In this species the presence of parasites in the distal pulmonary arteries may induce a diffuse pulmonary infiltrate and eosinophilic pneumonia. As in dogs, the subsequent death of adult parasites may cause acute pulmonary arterial infarction and the lung lobe involved can become haemorrhagic, with areas of oedema. If the cat survives the initial embolic lesion, recanalization around the obstruction occurs rapidly and pulmonary function can improve markedly within days, with remission of the clinical signs.

Occasionally, adult worms can migrate to sites other than the heart and the pulmonary arteries, and caused ectopic infection. Localization of *D. immitis* has been reported in the eye, CNS (cerebral arteries and lateral ventricles), systemic arteries and subcutaneous tissue. Ectopic infections are more commonly seen in cats than in dogs, suggesting that the parasite is not well adapted to feline hosts.



**46** Chronic hepatic congestion in a dog with caval syndrome. Hepatomegaly is present and the parenchyma appears dark as a consequence of blood stasis. Eventually, the liver parenchyma may become fibrotic, with increased connective tissue and atrophy of the hepatocytes. These lesions are responsible for the portal hypertension and ascites.

### Clinical signs

Dirofilariasis may be completely asymptomatic; however, clinical signs are generally present in cases with a high worm burden and/or when there is a significant allergic response of the host to the parasite. Infected patients may present with an acute onset of clinical signs but, more often, the disease develops slowly and gradually. Furthermore, clinical signs of dirofilariasis are triggered or exacerbated by exertion, and patients that perform little exercise may never show overt signs of HWD. In dogs, coughing is the most common clinical sign, followed by tachypnoea and dyspnoea, exercise intolerance, chronic weight loss and syncope. In severe cases, haemoptysis can be present as a possible consequence of pulmonary arterial rupture. Jugular distension, hepatomegaly, ascites and marked exercise intolerance are typical signs of right-sided heart failure. In these cases a systolic heart murmur or split second heart sound can be heard on thoracic auscultation, with a point of maximum intensity over the right apex. Hindlimb lameness and paresis have been described in dogs with aberrant arterial localization of the parasites.

Although the majority of infected cats are asymptomatic, cases of sudden death without any premonitory clinical signs have been described. Sometimes, sudden death is preceded by an acute respiratory crisis, probably as a consequence of filarial embolism and obstruction of a major artery. When present, clinical signs of dirofilariasis in cats are generally vague and non-specific. These may include anorexia, lethargy, coughing, vomiting, dyspnoea and collapse. In some cases the respiratory signs are very similar to those observed in cases of feline asthma.

Caval syndrome, a severe complication of HWD, is characterized by anorexia and weight loss, respiratory distress, haemoglobinuria secondary to intravascular haemolysis, signs of right-sided heart failure and possibly DIC.

### Diagnosis

All diagnostic investigations are justified only if there is a previous history of exposure to mosquitoes in an area where *D. immitis* infection is likely to be present.

### Laboratory diagnosis

A routine laboratory work-up is usually insufficient to make an aetiological diagnosis. Haematology often reveals eosinophilia and basophilia in the early stage of infection. Microfilariae can occasionally be seen on examination of the blood smear. Serum biochemistry may show changes related to secondary organ involvement (e.g. increased hepatic enzymes or increased blood urea and creatinine in cases of hepatic or renal damage respectively).

### Cytological techniques

Cytology of bronchoalveolar lavage specimens may reveal the presence of numerous eosinophils 4–7 months after infection, especially in cats. However, differential diagnosis from feline asthma is often difficult.

### Imaging

Survey radiographs of the thorax may show characteristic lesions, including main pulmonary artery bulge, enlarged and tortuous pulmonary arteries, and interstitial and/or alveolar pattern, especially in the caudal lung fields (47, 48). Moreover enlarged right ventricle and right atrium, enlarged caudal vena cava, hepatomegaly and ascites can be observed in caval syndrome. In cats the vascular changes are less frequently observed. They more commonly show radiographic changes similar to those observed in cases of feline asthma or *Aelurostrongylus abstrusus* infection, including overinflation of the lung accompanied by a broncho-interstitial, bronchial or alveolar pattern. Cats that have suffered recent episodes of pulmonary thromboembolism may show localized areas of increased lung opacity.

Non-selective angiography may help in the diagnosis of heartworm disease but it is rarely used because of the risks related to this procedure.

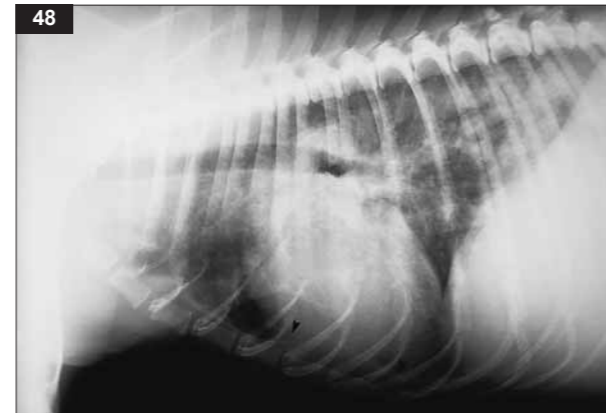
Adult heartworms can be visualized on echocardiography at the level of the main pulmonary artery, right ventricle and right atrium. They appear as a double-lined hyperechoic structure resulting from the echogenicity of the body wall of the parasite. A careful examination of the right parasternal short-axis basilar view at the level of emergence of the main pulmonary artery is especially recommended in cats in which the

antigen test is negative but dirofilariasis is still suspected based on compatible clinical signs, radiographic changes and/or positive antibody test results. In cases of severe infection, echocardiography may also show right ventricular dilation and hypertrophy and Doppler study may confirm the presence of pulmonary hypertension and tricuspid insufficiency. Ultrasonography can also be particularly useful for the identification of parasites in ectopic locations.

### Specific laboratory testing

#### Tests to identify *microfilaria*

A direct microscopic examination can be performed by depositing a drop of fresh blood under a cover slip. The motility of microfilariae creates turbulence of the surrounding red blood cells that can be easily observed under the microscope at  $\times 100$  magnification. This is a quick, easy and inexpensive procedure but lacks both sensitivity and specificity, particularly when low parasite burdens are present. The modified Knott's technique (centrifugation and staining with methylene blue) and filtration methods are more sensitive than direct microscopic examination and allow morphological examination of the microfilariae for species identification (49). In cats, given the absence or short presence of circulating L1 larvae, these tests have very little utility.



**47, 48** Thoracic radiographs of a dog with dirofilariasis. **(47)** Dorsoventral view. The emergence of the main pulmonary artery is characterized by a prominent bulge (arrow). The right ventricle and right atrium are also enlarged. **(48)** Right lateral view. Enlarged and tortuous pulmonary arteries, and a mixed interstitial/alveolar pattern mainly affecting the caudal lung fields, are present.

**49** L1 larva (*microfilaria*) identified by the Knott's test. The larva is surrounded by red blood cells and its dark colour is due to the methylene blue staining ( $\times 100$  magnification).



### Antigen testing for dirofilariasis

The serological tests available for detecting heartworm antigens are summarized in Table 7. ELISA antigen tests detect specific circulating proteins released by the reproductive tract of the mature female worm, and a strongly positive antigen test is normally correlated with a heavy heartworm infestation. However, antigen level can also vary between animals with identical worm burdens. These tests are available either as 'in-clinic' tests or laboratory tests, and their sensitivity approaches 98% but decreases to 35% in dogs with low worm burdens. The antigen levels become undetectable 8–12 weeks after

adulticidal therapy and this should be taken into account when re-screening for heartworm disease or evaluating the response to treatment. Specificity approaches 100% for all the available kits. Small worm burdens, the presence of immature females or male-only infections are common causes of low antigen titres and false-negative results, particularly in cats, where these circumstances occur more frequently. In dogs, specific immunochromatography techniques are also available. Antigen tests should be carried out at least seven months post infection in order to allow a sufficient concentration of antigens to accrue in circulating blood.

**Table 7** Serological tests available to detect heartworm antigens in dogs and cats.

| Test kit       | Manufacturer | Type  | Sensitivity (%) (Mean [range]) | Specificity (%) (Mean [range]) | Species | Type of sample |
|----------------|--------------|-------|--------------------------------|--------------------------------|---------|----------------|
| PetChek        | IDEXX        | ELISA | 76 (66–98)                     | 97 (90–99)                     | Dogs    | S, P           |
| SNAP canine HW | IDEXX        | ELISA | 67 (53–98)                     | 98 (92–100)                    | Dogs    | S, P, WB       |
| SNAP feline HW | IDEXX        | ELISA | 73 (49–91)                     | 99 (98–100)                    | Cats    | S, P, WB       |
| SoloStep CH    | Heska        | I-C   | 60 (44–97)                     | 98 (92–100)                    | Dogs    | S, P           |
| Abboscreen     | Abbott Lab.  | I-C   | 52 (35–94)                     | 96 (89–99)                     | Dogs    | S, P           |
| DiroChek       | Synbiotics   | ELISA | 71 (59–98)                     | 94 (86–97)                     | Dogs    | S, P           |
| DiroChek       | Synbiotics   | ELISA | 79 (54–94)                     | 98 (96–99)                     | Cats    | S, P           |
| Witness        | Synbiotics   | I-C   | 71 (69–92)                     | 94                             | Dogs    | S, P, WB       |

ELISA = enzyme-linked immunosorbent assay; I-C = lateral flow immunosorbent assay; S = serum; P = plasma; WB = whole blood; NA = published data not available.

**Antibody testing for dirofilariasis**

Antibody tests are currently available for routine screening of feline heartworm infection, either as 'in-clinic tests' or laboratory tests. They are summarized in *Table 8*. Antibody testing provides information about previous exposure but not necessarily about current infection. Consequently, antibody tests are more useful to rule out rather than confirm the infection. These tests are no longer used in dogs, given their low specificity and the widespread availability of highly reliable antigen tests.

**PCR testing for dirofilariasis**

PCR may represent a very sensitive and specific diagnostic tool for routine identification of mature and immature adult worms, especially in unconventional hosts. However, at present, this test is not widely available.

**Treatment****Adulticidal treatment**

The severity of the heartworm infestation should be carefully evaluated to determine the optimum treatment

**Table 8 Serological tests available to detect heartworm antibodies in cats.**

| Test kit                     | Manufacturer | Type  | Sensitivity (%)<br>Mean (range) | Specificity (%)<br>Mean (range) | Type of sample |
|------------------------------|--------------|-------|---------------------------------|---------------------------------|----------------|
| SoloStep FH (5' incubation)  | Heska        | ELISA | 32 (13–57)                      | 99 (97–100)                     | S, P, WB       |
| SoloStep FH (10' incubation) | Heska        | ELISA | 47 (24–71)                      | 94 (91–97)                      | S, P, WB       |
| SoloStep FH (20' incubation) | Heska        | ELISA | 84 (60–97)                      | 85 (81–89)                      | S, P, WB       |
| Assure FH                    | Synbiotics   | ELISA | 68 (43–87)                      | 93 (89–95)                      | S, P           |
| Witness                      | Synbiotics   | I-C   | NA                              | NA                              | S, P, WB       |

ELISA = enzyme-linked immunosorbent assay; I-C = lateral flow immunosorbent assay; S = serum; P = plasma; WB = whole blood; NA = published data not available.

**Table 9 Classification of severity of heartworm infection in dogs.**

|                           | Class 1                  | Class 2  | Class 3   |
|---------------------------|--------------------------|--|---|
| Grade of severity         | Mild                     | Moderate   | Severe  |
| Clinical complaints       | None or occasional cough | Occasional cough, mild exercise intolerance                                      | Persistent cough ( $\pm$ haemoptysis), moderate or severe exercise intolerance, weight loss, enlarged abdomen                             |
| Physical findings         | Unremarkable             | Mildly increased lung sounds   | Abnormal auscultatory findings (split S2, gallop sounds, heart murmur, increased lung sounds); tachypnoea/dyspnoea, ascites               |
| Radiographic changes      | Unremarkable             | Mild enlargement of pulmonary arteries, patchy alveolar/interstitial infiltrates | Right heart enlargement, patchy or diffuse alveolar/interstitial pattern, enlarged and tortuous pulmonary arteries, hepatomegaly, ascites |
| Echocardiographic changes | Unremarkable             | Mildly enlarged pulmonary arteries and mild pulmonary hypertension               | Severely enlarged pulmonary arteries and pulmonary hypertension, right ventricular and atrial enlargement                                 |
| Prognosis                 | Excellent                | Good in cases of successful treatment  | Guarded   |

protocol and an accurate prognosis. A simple classification is available to assess the severity of the disease (*Table 9*). Dogs in class 1 carry a good-to-excellent prognosis after adulticidal therapy. However, if clinical signs are not apparent, immediate adulticide therapy may not be considered necessary and periodic clinical and radiographic monitoring could be a reasonable alternative. Dogs in class 2 may have a positive outcome but for those in class 3 the prognosis is guarded due to the high risk of therapy-induced parasitic thromboembolism. In the latter cases it is often difficult to decide whether adulticide treatment is warranted, and all the possible complications of adulticidal therapy should be thoroughly discussed with the owners.

In cats, adulticidal treatment can be dangerous even in patients with low-grade infection, and the risk of pulmonary thromboembolism due to premature parasite death is high. Some cats undergo spontaneous clinical remission after the natural death of *D. immitis* adults and, therefore, adulticidal treatment may not be warranted. Cats that show respiratory signs can be treated symptomatically as for feline asthma, with decreasing doses of prednisolone, starting at 2 mg/kg p/o daily and diminishing gradually until the lowest effective dose administered on an alternate daily basis is achieved. Cage rest, oxygen supplementation, fluid therapy, bronchodilators and injectable steroids (e.g. dexamethasone) can be used to stabilize those cats that become acutely ill. Adulticidal treatment can be considered as the last resort for cats in a stable condition but with clinical signs that cannot be successfully controlled by the supportive therapy.

Melarsomine dihydrochloride is a new generation arsenical adulticide that is more expensive but offers several advantages over its predecessor thiacetarsamide. It is less nephrotoxic and hepatotoxic, requires only a two-dose protocol compared to the four required with thiacetarsamide, and has higher efficacy. Melarsomine is injected intramuscularly into the lumbar muscles at a recommended dose of 2.5 mg/kg and repeated after 24 hours. In order to reduce the post-adulticidal complications in class 3 dogs, only a single dose should be injected, followed one month later by the standard protocol of two injections 24 hours apart. This therapeutic strategy results in fewer worms being killed with the first injection and minimizes the risk of thromboembolism. Restricted exercise or cage rest, and corticosteroids at an anti-inflammatory dose, may help in minimizing PTE in the 7–10 days that follow the administration of melarsomine.

Sodium thiacetarsamide is an arsenical compound that has been used for decades in the treatment of HWD. The recommended treatment regimen is 2.2 mg/kg twice daily for two days by careful intravenous injection. However, production of thiacetarsamide has ceased and it is no longer available.

**Macrolides**

Macrolides are an alternative option when adulticidal treatment has been declined, as monthly administration of prophylactic doses will limit further infection. Furthermore, it has been shown that ivermectin and milbemycin may kill some adult nematodes.

**Surgical removal of adult *D. immitis* in caval syndrome**

Surgical heartworm removal has been well documented both in dogs and cats. Dogs with severe caval syndrome may benefit from the physical removal of worms from the right heart and pulmonary arteries with flexible crocodile or basket-type retrieval forceps. This procedure can reduce the risk of thromboembolism following adulticidal treatment and is also indicated for systemic arterial infections. The forceps technique requires general anaesthesia and fluoroscopic imaging. In dogs the expected outcome of this surgical procedure is positive in approximately 80% of cases. However, the anaesthetic risk, possible damage to cardiac structures and the potential hazard of postoperative ventricular arrhythmias should be carefully evaluated.

**Microfilaricidal treatment**

After recovery from adulticidal treatment (4–6 weeks), circulating microfilariae should be eliminated. There are no approved drugs for microfilaricidal treatment but a single administration of ivermectin (50  $\mu$ g/kg p/o) or milbemycin oxime (500  $\mu$ g/kg p/o) in dogs has been shown to be highly effective in eliminating the microfilariae from the circulation within a few hours. Moxidectin and selamectin are also known to be potent microfilaricides but, at present, there are still minimal data on the use of these drugs as microfilaricides. The sudden death of a large number of microfilariae can cause anaphylactoid reactions associated with vomiting, diarrhoea, ptialism and circulatory collapse. These adverse effects can be limited by simultaneously administering corticosteroids (e.g. prednisolone 1–2 mg/kg p/o or i/m) with the microfilaricidal drug.

**Prevention**

Chemoprophylaxis is recommended for all pets living in endemic areas during the transmission period. In northern Italy, for example, where there is a high prevalence of HWD, mosquitoes are present only during the warm months and chemoprophylaxis is only recommended between May and October. Veterinarians should be aware of the seasonality of mosquitoes in their geographical regions in order to prescribe chemoprophylaxis at the appropriate time of year. It is strategically important to rule out the presence of the infection with adequate tests before starting the administration of chemoprophylactic drugs.