

Canine Dirofilariasis in Central Indiana

NEIL J. PARKE AND CHARLES E. MAYS

Department of Biological Sciences

DePauw University, Greencastle, Indiana 46135

Introduction

The heartworm, *Dirofilaria immitis*, is primarily a parasite of the domestic dog (10). The incidence of heartworm disease (dirofilariasis) was at one time thought to have been confined primarily to southern regions of the United States (11). However, there is increasing concern of its prevalence in northern parts of the country (16).

Dirofilaria immitis (microfilariae) are transmitted to dogs by mosquitoes when they feed on or near the muzzle, eye, or pelvic regions. Microfilariae feed on blood and circulate to the heart where they reach maturity in about nine weeks. Approximately fourteen weeks later, the adults release new microfilariae (1).

Initial stages of dirofilariasis generally occur in the right ventricle or the pulmonary artery followed by intrusion into the lungs and liver (5). Among the symptoms associated with the disease are loss of stamina and body weight, vomiting, poor haircoat, and dehydration (1). In advanced stages, the infection can be fatal (3, 4, 5).

The literature on heartworm disease is somewhat spotty. Most studies have been conducted in southern and eastern coastal states (5, 14, 15, 17). The present study was made to determine the extent of canine dirofilariasis in Central Indiana. Among the issues addressed are: (1) the current status of the disease in different locations, (2) the effect of the breed and living environment of the dog, and (3) the effect of age.

Materials and Methods

Blood samples analyzed in this study were obtained from dogs in the four Central Indiana communities of Greencastle, Greenfield, Indianapolis, and Lafayette. All dogs surveyed were one year of age or older. Distinctions regarding sex, age, breed, year of occurrence and location of occurrence were made.

Most of the heartworm analyses were made using direct blood smears and a modified Knott technique (13). A few samples were analyzed by a micropore filter technique (1). Differentiation of *D. immitis* microfilariae from those of the other primary canine-infecting filariid of the United States, *Dipetalonema reconditum* was based on previously described characteristics (9, 10, 17).

The Chi-square method was used for statistical analysis of the data; $p < 0.05$ was considered to be significant.

Results and Discussion

A total of 3424 dogs in Central Indiana was surveyed for dirofilariasis in 1983 and 1984. Of this total, 1654 specimens were from American Kennel Club recognized breeds, and 770 were from dogs of mixed breeding. The average size of the *D. immitis* microfilariae encountered in this study ranged from 286 to 340 microns in length and 6.1 to 7.2 microns in width. These dimensions are in a general size range with those previously reported (2).

An analysis was made regarding geographic location and the incidence of heartworm disease. The four localities selected for this study represent rural (Greencastle), semi-rural (Greenfield), small city (Lafayette), and large metropolitan (Indianapolis) communities. There is a definite trend between the type of community surveyed and the incidence of dirofilariasis (Table 1). It is significantly higher in the Greencastle

TABLE 1. Incidence of dirofilariasis in Central Indiana.

| Locality | No. dogs examined | No. dogs infected | % infected |
|--------------|-------------------|-------------------|-------------------|
| Greencastle | 181 | 14 | 7.8 |
| Greenfield | 200 | 5 | 2.5 |
| Indianapolis | 2021 | 37 | 1.8 |
| Lafayette | 1022 | 24 | 2.3 |
| Totals | 3424 | 80 | 2.3 (\bar{x}) |

area (7.8%) than the other three localities. Indianapolis (1.8%) had the lowest occurrence of the disease, whereas Greenfield (2.5%) and Lafayette (2.3%) were intermediate. The mean incidence of dirofilariasis in the four communities is 2.3%, which is in general agreement with that reported for neighboring states (2, 7, 8, 18, 19).

The occurrence of infection in relation to breed and type of living environment was determined. Breed categories were modified from those listed in another study (3). Dogs were classified according to the environment in which they lived. Dogs that were allowed out-of-doors only for exercise and elimination were classified as "inside" dogs; those spending approximately equal time in the house and out-of-doors, as "inside-outside" dogs; and those which were kept exclusively out-of-doors as "outside" dogs.

The data indicate that hounds have the highest incidence (4.8%) of heartworm disease, followed by mixed breeds (3.8%), working dogs (2.7%), and sporting dogs (1.6) (Table 2). No infection was recorded among the miscellaneous breeds (e.g., Bichon Frise, Lhasa Apso, Chow Chow, etc.), which are typically inside dogs.

The data regarding environment shows that outside dogs have a significantly higher incidence of dirofilariasis than either inside dogs or inside-outside dogs. (Table 2). This significant trend is similar to that reported in studies done in Georgia (15) and Louisiana (14, 16). Mixed breeds show the highest incidence in each environmental category.

The prevalence of dirofilariasis relative to age was analyzed. Results indicate that the incidence of heartworm disease increases at age 4 and reaches a peak between ages 9 and 11. After that period, the infection rate seems to level off. The incidence at age 10 was statistically significant (Table 3).

TABLE 2. Incidence of dirofilariasis as related to breed and environment.

| Breed or breed type | Environment | | | | | | | | | Tot. exam. | Tot. % infec. |
|---------------------|-------------|------------|-------------------|---------------------|------------|-------------------|--------------|------------|-------------------|------------|---------------|
| | Inside dogs | | | Inside-outside dogs | | | Outside dogs | | | | |
| | No. exam. | No. infec. | % infec. | No. exam. | No. infec. | % infec. | No. exam. | No. infec. | % infec. | | |
| Mixed | 194 | 2 | 1.0 | 387 | 14 | 3.6 | 189 | 13 | 6.9 | 770 | 3.8 |
| Working | 0 | 0 | 0 | 179 | 3 | 1.7 | 538 | 16 | 3.0 | 717 | 2.7 |
| Sporting | 0 | 0 | 0 | 153 | 1 | 0.7 | 457 | 9 | 2.0 | 610 | 1.6 |
| Hound | 0 | 0 | 0 | 0 | 0 | 0 | 331 | 16 | 4.8 | 331 | 4.8 |
| Nonsporting | 84 | 0 | 0 | 161 | 1 | 0.6 | 76 | 1 | 1.3 | 321 | 0.6 |
| Toy | 289 | 2 | 0.7 | 0 | 0 | 0 | 0 | 0 | 0 | 289 | 0.7 |
| Terrier | 140 | 0 | 0 | 127 | 2 | 1.6 | 0 | 0 | 0 | 267 | 0.8 |
| Miscellaneous | 119 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 |
| Totals | 826 | 4 | 0.5 (\bar{x}) | 1007 | 21 | 2.1 (\bar{x}) | 1591 | 55 | 3.4 (\bar{x}) | 3424 | 2.3 |

TABLE 3. Incidence of dirofilariasis as related to age.

| Age in years (approx.) | No. of dogs examined | No. of dogs infected | % of dogs infected |
|------------------------|----------------------|----------------------|--------------------|
| 1 | 346 | 5 | 1.5 |
| 2 | 355 | 5 | 1.4 |
| 3 | 329 | 6 | 1.8 |
| 4 | 300 | 9 | 3.0 |
| 5 | 423 | 13 | 3.1 |
| 6 | 409 | 10 | 2.5 |
| 7 | 275 | 9 | 3.3 |
| 8 | 250 | 0 | 0 |
| 9 | 151 | 5 | 3.3 |
| 10 | 164 | 9 | 5.5 |
| 11 | 122 | 3 | 2.5 |
| 12 | 117 | 2 | 1.7 |
| 13 | 91 | 3 | 3.3 |
| 14 | 57 | 1 | 1.8 |
| 15 | 35 | 0 | 0 |

The incidence of heartworm disease has been shown to be highest in regions which favor the breeding of mosquitos, such as the southern and southeastern sections of the United States (10). Infection rates in excess of 40% have been recorded in these areas (5, 15). Rural communities tend to have numerous breeding areas, and often do not have regular private and municipal spraying programs found in metropolitan areas (personal communication, Jerry Rud, Biologist, Indiana State Board of Health). This may partly account for the significant difference in the prevalence of dirofilariasis between Greencastle (7.8%) and Indianapolis (1.8%). A Michigan study recorded an incidence of *D. immitis* infection of 1.6% in the Detroit area, but noted a sharp increase in infection rate along the marsh areas east of the city (19).

There is also a tendency for rural areas to have a greater percentage of outside dogs than to urban areas. Such dogs would be more susceptible to mosquito bite. Various studies have shown that larger outdoor breeds, especially hunting and working dogs have a significantly higher rate of infection than other breeds (3, 6, 12).

The difference in dirofilariasis between rural and urban areas may also have a socioeconomic basis. A number of surveys have shown a significantly higher prevalence of the infection in pound dogs than in privately owned dogs (6, 16).

In animals under 4 years of age, the incidence of *D. immitis* infection is low (Table 3). It then rises somewhat and peaks at age 10 before declining. This trend is similar to that reported in other studies (8, 17).

The results of this study support the growing impression that *D. immitis* infection is spreading (16, 17). Although the incidence of 2.3% in Central Indiana is in close agreement with studies done in neighboring states, the prevalence of dirofilariasis appears to vary depending on geographic location, breed, living environment, and age of the dog. Furthermore, the incidence of infection in the Greencastle area (7.8%) is similar to that reported for several southern and coastal regions of the country (3, 6, 16, 17). This suggests that dirofilariasis may pose a particular health problem for rural areas.

Acknowledgments

We wish to thank Drs. Jeffrey Hanssen (Westwood Veterinary Clinic, Greencastle, Indiana), James Albrecht (Northside Animal Hospital, Indianapolis, Indiana),

Phillip Watson, Kathryn Carter, and Todd Wheeler (16th Street Veterinary Clinic, Indianapolis, Indiana), Donald Brattain and John Scamahorn (Greencastle Veterinary Clinic, Greencastle, Indiana, and John Blair (Blair Animal Clinic, Lafayette, Indiana) for their assistance in collecting the data.

Literature Cited

1. ETTINGER, S.J. AND P.F. SUTTER. 1970. Canine cardiology. W.B. Saunders Co., Philadelphia. 616 pp.
2. GROVES, H.F. AND F.R. KOUTZ. 1964. Survey of microfilariae in Ohio dogs. J. Amer. Vet. Med. Assoc. 144:600-602.
3. HIRTH, R.S., H.W. HUIZINGA, AND S.W. NIELSEN. 1966. Dirofilariosis in Connecticut dogs. J. Amer. Vet. Med. Assoc. 148:1508-1516.
4. JACKSON, R.F. 1969. The vena cavae or liver failure syndrome of heartworm disease. J. Amer. Vet. Med. Assoc. 154:384-385.
5. JACKSON, R.F., F. VON LICHTENBERG, AND G.F. OTTO. 1962. Occurrence of adult heartworm in the vena cava of dogs. J. Amer. Vet. Med. Assoc. 141:117-121.
6. LINDSEY, J.R. 1961. Diagnosis of filarial infections in dogs. I. Microfilarial surveys. J. Parasitol. 47:695-702.
7. MCKINNEY, R.E. 1962. The prevalence of *Dirofilaria immitis* and *Dipetalonema sp.* microfilaria in dogs in Champaign County, Illinois. Ill. Vet. Med. 5:43-44.
8. MARQUARDT, W.C. AND W.E. FABIAN. 1966. The distribution in Illinois of filariids of dogs. J. Parasitol. 52:318-322.
9. NEWTON, W.L. AND W.H. WRIGHT. 1956. The occurrence of a dog filariid other than *Dirofilaria immitis* in the United States. J. Parasitol. 42:246-258.
10. OTTO, G.F. 1969. Geographical distribution, vectors, and life cycle of *Dirofilaria immitis*. J. Amer. Vet. Med. Assoc. 154:370-373.
11. OTTO, G.F. AND P.M. BAUMAN. 1959. Canine filariasis. Vet. Med. 54:87-96.
12. ROTHSTEIN, N., K.E. MCKINNON, M.L. BROWN, AND R.W. CARITHERS. 1961. Canine microfilariosis in eastern United States. J. Parasitol. 47:661-665.
13. SLOSS, M.W., AND R.L. KEMP. 1978. Veterinary clinical parasitology. Iowa State University Press, Ames. 274 pp.
14. THRASHER, J.P., AND J.R. CLANTON. 1968. Epizootiologic observations of canine filariasis in Georgia. J. Amer. Vet. Med. Assoc. 152:1517-1520.
15. THRASHER, J.P., L.R. ASH, AND M.D. LITTLE. 1963. Filarial infections of dogs in New Orleans. J. Amer. Vet. Med. Assoc. 143:605-608.
16. THRASHER, J.P., K.G. GOULD, M.L. LYNCH, AND C.C. HARRIS. 1968. Filarial infections of dogs in Atlanta, Georgia. J. Amer. Vet. Med. Assoc. 153:1059-1063.
17. WALLENSTEIN, W.L. AND B.J. TIBOLA. 1960. Survey of canine filariasis. J. Amer. Vet. Med. Assoc. 137:712-716.
18. WORLEY, D.E. 1964. Helminth parasites of dogs in southeastern Michigan. J. Amer. Vet. Med. Assoc. 144:605-608.
19. ZYDECK, F.A., I. CHODKOWSKI, AND R.R. BENNETT. 1970. Incidence of microfilariosis in dogs in Detroit, Michigan. J. Amer. Vet. Med. Assoc. 156:890-891.