

Seroprevalence of Dogs with *Dirofilaria immitis*, *Anaplasma phagocytophilum*, *Borrelia burgdorferi* and *Ehrlichia canis* Infection in the Daejeon City and Kangwon Province

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(Accepted: December 09, 2010)

Abstract : This study was conducted to survey *Dirofilaria (D.) immitis* antigen, and *Anaplasma (A.) phagocytophilum*, *Borrelia (B.) burgdorferi*, and *Ehrlichia (E.) canis* antibodies among clinically healthy dogs in the Daejeon city and Kangwon province. Whole blood samples were collected from two hundred and fifty two dogs (127 females and 125 males, 147 outdoors and 105 indoors), and they were tested by using ELISA kit (SNAP 4Dx, IDEXX Laboratories, USA). Chi-squared analysis showed that *A. phagocytophilum* of female dogs in outdoors group was significantly higher prevalence than that of female dogs in indoors group ($p < 0.05$). In addition, infection rate of *A. phagocytophilum* of over 7 year-old-dogs in outdoors group revealed significantly higher prevalence than that of indoors group ($p < 0.01$). In *E. canis*, the under 4 year-old-dogs ($p < 0.05$), 4~7 year-old-dogs ($p < 0.05$) and over 7 year-old-dogs ($p < 0.01$) in outdoor group showed significantly higher prevalence than that of indoors group, respectively. In conclusion, this study is the large scale survey of canine *D. immitis* antigen, *A. phagocytophilum*, *B. burgdorferi*, and *E. canis* antibodies in the Daejeon city and Kangwon province, and it provides an useful reference for clinicians.

Key words : *Dirofilaria immitis*, *Anaplasma phagocytophilum*, *Borrelia burgdorferi*, *Ehrlichia canis*, seroprevalence, dog.

Introduction

Dirofilaria (D.) immitis infection causes a chronic circulatory disorder and finally results in congestive heart failure. In addition to several vertebrate animals, cats and humans can be infected (9). *Anaplasma (A.) phagocytophilum* infection results in a mild, flu-like disease that is self-limiting or in a subclinical infection. Animals with clinical disease associated with acute infection often have vague signs of illness including fever, lethargy, malaise, anorexia, and general muscle pain resulting in reluctance to move (1). Dogs with *Borrelia (B.) burgdorferi* show myocarditis, cardiomyopathy, arrhythmias, arthritis, arthralgia, meningitis, neuropathies and fascial nerve palsy (5). Canine ehrlichiosis presents as a rather non-specific multisystemic disorder with the primary complaints being depressed, lethargy, mild weight loss, vomiting, diarrhea, and anorexia, with or without hemorrhagic tendencies. Furthermore, patients may present with uveitis and/or retinal petechiae, polymyositis, polyarthritis, and central nervous system signs (11).

Many epidemiological surveys of *D. immitis*, *A. phagocytophilum*, *B. burgdorferi*, and *E. canis* have been performed in many countries (2,4,7,10,12,14). In Korea, serological survey

was carried out for the prevalence of *D. immitis*, *B. burgdorferi*, and *E. canis* in dogs, and also molecular survey was performed for the prevalence of *Anaplasma* and *Ehrlichia* spp. in ticks, (3,8). This study was performed to survey of *D. immitis* antigen, *A. phagocytophilum*, *B. burgdorferi*, and *E. canis* antibodies of dogs in the Daejeon city and Kangwon province.

Materials and Methods

Animals

The present survey was carried out in the province of Kangwon (mountain area) and Daejeon city (urban area). The 252 investigated dogs (127 females and 125 males, 147 outdoors and 105 indoors) were German Shepherd, Maltese, Shih-Tzu, Schnauzer, Siberian Husky, Malinois, Poodle, Yorkshire terrier, Pomeranian, Golden retriever, English Setter, Pekingese, Bulldog, Chihuahua, Beagle, Jindo dog, Dachshund and mongrel breed. The sample population was randomly chosen to enter the veterinary clinics for health examination. All dogs were conducted by monthly chemoprophylaxis of *D. immitis*, however, there were not conducted for *A. phagocytophilum*, *B. burgdorferi*, and *E. canis*. Their age range was from less than one year to over fifteen years (mean 5.18 years old). Whole blood was collected from cephalic vein of the dogs and it was immediately tested by ELISA kit.

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ELISA test

Blood samples were examined for *D. immitis* antigen and antibodies of *A. phagocytophilum*, *B. burgdorferi* and *E. canis* by using a commercial ELISA kit (SNAP 4Dx; IDEXX Laboratories, USA).

Statistical analysis

Statistical analysis was carried out with Chi-squared analysis. The prevalence was compared, among age-groups (<4years, 4~7 years and >7 years old), between genders in outdoor and indoor groups, version 10.0 of the SPSS for Windows software package (USA).

Results and Discussion

All dogs were conducted by monthly chemoprophylaxis of *D. immitis*, but, not for *A. phagocytophilum*, *B. burgdorferi*, and *E. canis*. In the present study, overall prevalence of *D. immitis*, *A. phagocytophilum*, *B. burgdorferi* and *E. canis* using a commercial ELISA kit were 1.98%, 7.94%, 2.38% and 9.52%, respectively (Table 1). No symptoms were observed in seropositive dogs of *D. immitis*, *A. phagocytophilum*, *B. burgdorferi* and *E. canis* in our study. In *D. immitis*, Song *et al.* (13) reported that the prevalence of *D. immitis* was 40% in Korea, and these all dogs were not conducted by chemoprophylaxis of *D. immitis*. There was no significant differences between females and males, but, the older age group showed the higher the prevalence of *D. immitis* infection. In case of outdoor dogs, *D. immitis* infection rates were 0% in female and 2.70% in male groups. In age classification, *D. immitis* infection rates were 0% in <4yrs old group, 2.56% in 4~7yrs old group and 0% in >7yrs old group. In case of indoor dogs, *D. immitis* infection rates were 5.56% in female and 1.96% in male group. In age classification, infection rates of *D. immitis* were 2.86% in <4yrs old group, 7.14% in 4~7yrs old group and 0% in >7yrs old group.

The present study showed that the mean prevalence of *D. immitis* was 1.98% in the Daejeon city and Kangwon province. There was no significant differences between females and males and among age groups (<4, 4~7 and >7 yrs old) in the present study. Low prevalence of *D. immitis* in our results were due to monthly chemoprophylaxis in recent years. In case of outdoor dogs, infection rates of *A. phagocytophilum* were 15.07% in female and 10.81% in male groups. In age classification, infection rates of *A. phagocytophilum* were 10.00% in <4yrs old group, 11.54% in 4~7yrs old group and 20.69% in >7yrs old group. In case of indoor dogs, infection rates of *A. phagocytophilum* were 0% in female and 1.96% in male groups. In age classification, infection rates of *A. phagocytophilum* were 2.86% in <4yrs group, 0% in 4~7yrs group and 0% in >7yrs group. The prevalence of *A. phagocytophilum* in female dogs was 15.07% in outdoor group and 0% in indoor group. Chi-squared analysis showed that *A. phagocytophilum* of female dogs in outdoor group was significantly higher prevalence than that of female dogs in indoor group ($p < 0.05$).

Also, the prevalence of *A. phagocytophilum* in >7 year old dogs was 20.69% in outdoor group and 0% in indoor group. Chi-squared analysis showed that *A. phagocytophilum* of >7 year-old-dogs in outdoor group revealed significantly higher prevalence than that of indoor group ($p < 0.01$). In *B. burgdorferi*, Lee *et al.* (6) reported that there was no significant difference between females and males, and among age groups. Joppert *et al.* (6) also reported that the prevalence of *B. burgdorferi* was not different between females and males. These results are similar to those of the present study. The present study revealed that there was no significant difference between females and males, and among age groups. In case of outdoor dogs, infection rates of *B. burgdorferi* were 4.11% in female and 2.70% in male groups. In age classification, infection rates of *B. burgdorferi* were 2.50% in <4yrs group, 3.85% in 4~7yrs group and 3.45% in >7yrs group. In case of indoor dogs, infection rates of *B. burgdorferi* were 0% in female and 1.96% in male groups. In age classification, infection rates of *B. burgdorferi* were 0% in <4yrs old group, 3.57% in 4~7yrs old group and 0% in >7yrs group. In *E. canis*, Lee *et al.* (8) reported that dogs of 4~6 age group were higher prevalence than the other age groups. In case of outdoor dogs, infection rates of *E. canis* were 19.18% in female and 13.51% in male groups. In age classification, infection rates of *E. canis* were 17.50% in <4yrs old group, 15.38% in 4~7yrs old group and 17.24% in >7yrs old group. In case of indoor dogs, infection rates of *E. canis* were 0% in female and 0% in male groups. In age classification, infection rates of *E. canis* were 0% in all groups. Chi-squared analysis showed that the <4 year-old-dogs ($p < 0.05$), 4~7 year-old-dogs ($p < 0.05$) and >7 year-old-dogs ($p < 0.01$) in outdoor group showed significantly higher prevalence than that of indoor group, respectively.

In conclusion, this study is the large scale survey of canine *D. immitis* antigen, *A. phagocytophilum*, *B. burgdorferi*, and *E. canis* antibodies in the Daejeon city and Kangwon province, and it provides an useful reference for clinicians.

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대전시와 강원도에서 심장사상충증, 아나플라즈마증, 보렐리아증 및 얼리키아증의 혈청학적 발생을 조사

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요 약 : 본 연구는 대전시와 강원도에서 사육중인 개 252두 (암컷: 127두, 수컷: 125두, 실외견: 147두, 실내견: 105두)를 대상으로 ELISA kit (SNAP 4Dx, IDEXX Lab. USA)를 이용하여 심장사상충증, 아나플라즈마증, 보렐리아증 및 얼리키아증에 대한 혈청학적 방법으로 발생을 조사하였다. 아나플라즈마증은 암컷에서 실내견보다 실외견에서 유의성 있는 높은 감염율을 나타내었다. 또한 얼리키아증에서는 연령별로 분석한 결과, 실외견에서 실내견보다 4세미만, 4-7세사이, 7세 이상에서 각각 유의성 있는 높은 감염율을 나타내었다. 본 연구는 임상가들에게 유용한 임상자료로 활용될 것으로 판단된다.

주요어 : 심장사상충, 아나플라즈마증, 보렐리아증, 얼리키아증, 발생율, 개