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▣ BRIEF COMMUNICATION

Prevalence of *Dirofilaria immitis* in Dogs in Shenyang, Northeastern China

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Abstract: In the present study, we first report the seroprevalence of *Dirofilaria immitis* in dogs in Shenyang, northeastern China. Sera from 528 randomly selected dogs were examined for *D. immitis* antigen using SNAP®4Dx test kit; 12.7% tested showed seropositive. No significant difference of infection was observed in different genders and breeds ($P > 0.05$), but the difference was significant in different age groups and rearing conditions ($P < 0.05$). The result suggested that the risk of exposure to *D. immitis* in dogs is high in Shenyang, and should be given attention.

Key words: *Dirofilaria immitis*, seroprevalence, dog, SNAP®4Dx test kit

Dirofilaria immitis is commonly found in pulmonary arteries and the right ventricle of dogs and other canids, and causes canine dirofilariosis or heartworm disease. Adult heartworms cause several pathological damages, such as edema, asthma, heart failure, or even death of the infected dogs [1]. *D. immitis* can also be transmitted to humans causing zoonotic infections when they are bitten by culicid mosquitoes containing infective 3rd-stage (L3) larvae of *D. immitis*. Human cases have been reported mainly in areas of high canine abundance [2]. Moreover, dogs are often regarded as faithful friends and intimate companions of humans. Therefore, dogs may pose a health problem for humans.

In recent years, *D. immitis* has also been detected more and more frequently in dogs in many countries, including Germany [3] and the Slovak Republic [4]. In China, seroprevalences of *D. immitis* were found in Sichuan, Beijing, Shenzhen, Shanghai, and Zhengzhou [5,6]. However, there is no report on dirofilariasis infection in dogs in Shenyang, northeastern China. Therefore, in the present study, we studied on the seroprevalence of *D. immitis* infection in dogs in Shenyang, the capital of Liaoning Province, northeastern China for the first time and evaluated the main risk factors associated with exposure to *D. immitis* in this area.

Shenyang is located in the southern part of northeastern China, covering an area of 12,948 km^2 and a population of approximately 8.19 million. Its geographical position is at east longitude 122°25′-123°48′ and at north latitude 41°11′-43°2′. The area has a temperate monsoon climate, with abundant sunshine, a long winter, and a hot summer, with brief spring and autumn. The average annual temperature is 8.3℃, with a mean annual rainfall of 600-800 mm.

In total, 528 pet dogs were randomly selected to collect blood samples in Shenyang between March 2009 and March 2012. Dog owners were asked for details of the dogs breed (cross-breed or pure breed), age (<3 or ≥3 years), gender, rearing condition (indoor or outdoor), source, and medical history using a structured questionnaire. All canine serum samples were analyzed for *D. immitis* antigen using commercial SNAP®4Dx test kit (IDEXX Laboratories, Westbrook, Maine, USA) according to the manufacturer's instructions.

Statistical analysis of *D. immitis* prevalence between different breeds, age groups, genders, and rearing conditions were performed using a Chi square test with SPSS (SPSS Inc., Chicago, Illinois, USA). A P-value < 0.05 were considered statitically significant.

Canine dirofilariosis has been reported worldwide. The prevalence of *D. immitis* is 1.0% in South Australia [7], 5.5% in Brazil [8], 19.0% in Spain [9], 20.9% in South Korea [10], and 30.8% in South Africa [11]. The prevalence depends on many factors, such as the methods performed and preselection of

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Table 1. Seroprevalence of *Dirofilaria immitis* infection in dogs in Shenyang, northeastern China, as determined by SNAP®4Dx test

Variable	No. examined	No. positive	Prevalence (%)	*P*-value
Gender				
Male	266	37	13.9	>0.05
Female	262	30	11.5	
Age				
<3 years (0.5-3 years)	225	17	7.6	<0.05
≥3 years (3-12 years)	303	50	16.5	
Breed				
Pure breed	351	43	12.3	>0.05
Cross-breed	177	24	13.6	
Rearing condition				
Indoor	216	18	8.3	<0.05
Outdoor	302	49	16.2	
Time				
2009	126	17	13.5	>0.05
2010	168	20	11.9	
2011	175	21	12.0	
2012	59	9	15.3	
Total	528	67	12.7	

the samples; therefore, different prevalences for a single country exist.

The present study revealed that the overall seroprevalence of *D. immitis* infection in dogs was 12.7% in Shenyang, and continuous yearly seropositivity was 13.5%, 11.9%, 12.0%, and 15.3%, respectively, from 2009 to 2012 (Table 1). The seroprevalence of *D. immitis* in female dogs was 11.5% (30/262) and 13.9% (37/266) in males, but the difference was not statistically significant ($P>0.05$). Compared with the younger dogs (17/225, 7.6%), a higher seroprevalence of infection (50/303, 16.5%) was detected in the ≥3 years old group, which was possibly due to their longer exposure to the mosquito bites [12]. The difference among the age groups was statistically significant ($P<0.05$).

In the present study, the seroprevalence of *D. immitis* infection was 12.3% in pure dogs and 13.6% in cross-breed dogs, showing no significant difference by breed ($P>0.05$). The seroprevalence of *D. immitis* infection in outdoor dogs (16.2%) was significantly higher than that in indoor dogs (8.3%) ($P<0.05$), the similar higher prevalence was also observed in outdoor dogs by Miterpáková [13], and the possible reason is that dogs in outdoors had a greater chance of being bitten by mosquitoes.

The present result (12.7%) was higher than that surveyed as 0% in Dongwan [14], but lower than that surveyed as 20.3% in Sichuan [15], 22.6% and 24.0% in Dandong [16-18], 31.2% in Xian [19], and 61.3% in Chongqing in China [20]. In addition, Shenyang is close to Dandong, but it is difficult to compare results of the present study with surveys in Dandong because of different detection methods used, animals surveyed from different sources, and samples from different regions.

In conclusion, this is the first report of *D. immitis* infection in dogs in Shenyang, northeastern China. The present study suggested that the risk of exposure to *D. immitis* in dogs is high in Shenyang, and should be given attention.

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