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

Chengwu Liu¹, Na Yang²*, Jianbin He³, Min Yang¹ and Ming Sun¹

¹Shenyang Police Dog Technical College, 4 BaiShan Road, Shenyang, Liaoning Province 110034, China; ²College of Animal Science and Veterinary Medicine, Shenyang Agricultural University, DongLing Road No. 120, Shenyang, Liaoning Province 110866, China

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) larve 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 dirofilariosis 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 km² 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°C, 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 statistically 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...
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.

**ACKNOWLEDGMENT**

This study was supported by Natural Fund in Liaoning Province (201202078) and The Ministry of Public Security Application Innovation Project, P.R. China (2012YYCXSyJQ161).

**REFERENCES**

1. Mccall JW, Genchi C, Kramer LH, Guerrero J, Venco L. Heartworm disease in animals and humans. Adv Parasitol 2008; 66: 193-285.
2. Theist JH. Public health aspects of dirofilariasis in the United States. Vet Parasitol 2005; 133: 157-180.
3. Pantchev N, Ezold M, Daugschies A, Dychenko V. Diagnosis of imported canine filarial infections in Germany 2008 - 2010. Parasitol Res 2011; 109: S61-S76.
4. Miterpáková M, Humlíková Z, Antolová D, Dubinský P. Climate changes implicated for *Dirofilaria* dissemination in Slovakia. Wiadomosci Parazytologiczne 2009; 55: 429-431.
5. Huang H, Wang T, Yang G, Zhang Z, Wang C, Yang Z, Luo L, Liu L, Han X. Molecular characterization and phylogenetic analysis of *Dirofilaria immitis* of China based on COI and 12S rDNA genes. Vet Parasitol 2009; 160: 175-179.
6. Xia Z, Yu D, Mao J, Zhang Z, Yu J. The occurrence of *Dirofilaria immitis*, *Borrelia burgdorferi*, *Ehrlichia canis* and *Anaplasma phagocytophium* in dogs in China. J Helminthol 2012; 86: 619-622.
7. Copland MD, O’Callaghan MG, Hajduk P, O’Donoghue PJ. The occurrence of *Dirofilaria immitis* in dogs in South Australia. Aust Vet J 1992; 69: 31-32.
8. Reifur I, Thomaz-Soccol V, Montiani-Ferreira F. Epidemiological aspects of filariosis in dogs on the coast of Paraná state, Brazil: with emphasis on *Dirofilaria immitis*. Vet Parasitol 2004; 122: 273-286.
9. Montoya-Alonso JA, Carretón E, Juste MC, Mellado I, Mochón R, Simón F. Epidemiological survey of canine heartworm disease on the island of Gran Canaria (Canary Islands-Spain) between 2000 and 2008. Vet Parasitol 2010; 173: 165-168.
10. Song KH, Park JE, Lee DH, Lee SH, Shin HJ. Serological update and molecular characterization of *Dirofilaria immitis* in dogs, South Korea. Res Vet Sci 2010; 88: 467-469.
11. Schawn EV, Durand DT. Canine filariosis caused by *Dirofilaria*
immitis in Mozambique: a small survey based on the identification of microfilariae. J S Afr Vet Assoc 2002; 73: 124-126.
12. Fan CK, Su KE, Lin YH, Liao CW, Du WY, Chiou HY. Seroepidemiologic survey of Dirofilaria immitis infection among domestic dogs in Taipei city and mountain aboriginal districts in Taiwan (1998-1999). Vet Parasitol 2001; 102: 113-120.
13. Miterpáková M, Antolová D, Hurníková Z, Dubinský P, Pavlacka A, Németh J. Dirofilaria infections in working dogs in Slovakia. J Helminthol. 2010; 84: 173-176.
14. Zhang DX, Xie HY, Zeng QQ, Hong WR. Investigation of canine dirofilariosis antigen, antibody against lyme disease and canine ehrlichiosis in Dongwan. Guangdong Anim Husbandry Vet Sci Technol 2010; 25: 45-47.
15. Ye QH, Chen T. Survey of canine dirofilariosis in working dogs in Sichuan Province. J Gansu Sci 2012; 24: 39-41.
16. Hou HL, Zhang XC. Serological survey of canine dirofilariasis in Dandong. J Laiyang Agr Coll 2005; 22: 210-212.
17. Hou HL. Survey of canine dirofilariosis in Dandong. Anim Husbandry Vet Med 2006; 38: 62-63.
18. Hou H, Shen G, Wu W, Gong P, Liu Q, You J, Cai Y, Li J, Zhang X. Prevalence of Dirofilaria immitis infection in dogs from Dandong, China. Vet Parasitol 2011; 183: 189-193.
19. He HQ, Yu SK, Lin Q, Ma QY, Cao GX, Tan J. Detection of microfilariae of Dirofilaria immitis in police dogs in Xian. Prog Vet Med 2005; 26: 114-115.
20. Rao ZX, Zhang FN, Ye H. Survey of Dirofilaria immitis infection in domestic dog in Chongqing. Sichuan J Zool 1999; 2.
