

Investigation of *Dirofilaria immitis* infection in dogs of Incheon area

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Abstract

This study was attempted to survey on the prevalence of canine heartworm infection (*Dirofilaria immitis*) in the Incheon area in 2006. This study showed comparative infection rates of canine heartworm in conjunction with different geographic locations and rearing environments (i.e., indoor, outdoor or free roaming). In total, 24 dogs (6.0%) were *D. immitis* positive among a total of 400 tested dogs. The geographic distribution of detection rates was Nam-gu (2 dogs, 6.7%), Yeonsu-gu (1 dog, 3.0%), Namdong-gu (5 dogs, 8.0%), Pupyong-gu (4 dogs, 6.7%), Kanghwa-gun (8 dogs, 13.0%), and Onjin-gun (4 dogs, 11.1%). In addition, 4 dogs (2.0%) or 20 dogs (10.0%) were positive for *D. immitis* among 202 indoor dogs or 198 outdoor dogs including free roaming dogs, respectively, while 13 dogs (11.7%) were positive for *D. immitis* among 111 outdoor dogs excluding free roaming dogs. In the case of 87 free roaming dogs, 7 dogs (8.1%) among them were positive for *D. immitis*.

Key words : Heartworm infection, *Dirofilaria immitis*, Dogs, Incheon

INTRODUCTION

Canine heartworm infection disease is caused by *Dirofilaria immitis* through mosquitoes and it has been a common problem all over the world (Yoshimura and Wescott, 1987), (Soulsby, 1982). Infective larvae III through subcutaneous tissue by mosquitoes typically inhabit the right ventricle and pulmonary arteries of dogs, resulting in many symptoms from silence to endoarteritis in heart, chronic pulmonary disease, cutaneous disease and circulatory system disorders in blood vessel. (Rawlings and Calvert, 1995), (Lee, 1987), (Lee and Jo, 1996), (Prescott, 1986). Cases of canine heartworm infection in human are not as serious as in dogs, but there are a few reports: periocular dirofilariasis, tubercle in subcutaneous tissue and lung (Ciferri, 1982), (Soulsby, 1982), (Pampiglione et al, 1995). A human case

has been also reported in South Korea (Lee et al, 2000). Canine dirofilariosis can be diagnosed by various methods such as history taking, X-ray, Echocardiography, antigen test and identification of microfilariae, etc. Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) is also available for diagnosis (Lee et al, 1999). Among the methods, identification of microfilariae in blood is common method in general. But it needs a differential diagnosis against other filariae because it has the high possibility to make a wrong diagnosis in case of occult infection (Brunner et al, 1998 ; Wong and Thomford. 1991). Also, a wrong diagnosis occurs frequently when only unisexual adult worms exist in body or expellant for parasites was used (Courtney et al, 1990). Therefore, using an antigen of adult worm increases test sensitivity and specificity as well as diagnosis rates. For this reason, antigen test using a monoclonal antibody was applied to diagnosis in Dae-jeon, Chonnam and Bu-san, recently (Jang et al, 1997; Jung et al,

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2004; Beyn et al, 2007).

Studies for dirofilariosis have been in progress for a long time in America, Australia, Europe and Japan, where the pet industries have been well developed (Ciferri, 1982; Pampiglione et al, 1995; Bakiya 1997). In recent reports, canine dirofilariosis has been spread all over the world such as Mexico, Iran and Malaysia, etc (Rohela et al, 2009; Furtado et al, 2009; Azari-Hamidian et al, 2009).

In Korea, investigation of canine dirofilariosis was conducted in Jinju of Kyungnam province in 1962 for the first time. Domestic prevalence ranged from 2.7% in Incheon to 50.3% in metropolitan depending on geographic locations (Seo et al, 2001; Lee et al, 1999).

The objective of this study was to investigate the prevalence and geographic distribution of *Dirofilaria immitis* infection in conjunction with housing conditions in Incheon area in 2006 by using a commercial antigen kit.

MATERIALS AND METHODS

The study was conducted in Incheon area for 4 months during spring season (April to May) and autumn (October to November). A total of 400 blood samples collected from dogs while they were vaccinated for Rabies twice a year were subjected to testing. About 3ml of blood was collected into an 0.1% EDTA anticoa-

gulant tube from cephalic vein of the dogs and kept refrigerated until tested. These blood samples were examined for the presence of *D. immitis* microfilaria by using Canine SNAP 3Dx (IDEXX), which is based on a antigen test

RESULT

Prevalence and geographical distribution of *D. immitis* in Incheon

The overall prevalence of *D. immitis* infection in Incheon in 2006 was 6.0% (24 dogs) among a total of 400 dogs.

In the concrete, 10 areas of Incheon were investigated for this study. The number of dogs infected with *D. immitis* in each region in Incheon has been shown in Table 1. 2 of 30 dogs (6.7%) were positive in Nam-gu, 1 of 30 dogs (3.0%) were positive in Yeonsu-gu and 5 of 60 dogs (8.0%) were positive in Namdong-gu. And *D. immitis* were observed in 4 of 60 dogs (6.7%) in Pupyong-gu and 8 of 64 dogs (13.0%) in Kanghai-gun, 4 of 36 dogs (11.1%) in OngJin-gun.

Prevalence of *D. immitis* in indoor dogs and outdoor dogs + free-roaming dogs

The prevalence of *D. immitis* infection in indoor dogs and outdoor dogs including free-roaming dogs in Incheon in 2006 is shown in Table 2, 4 cases among 202 dogs (2.0%) were positive in the case of indoor dogs, while 20 of 198 dogs (10.0%) were positive in the case of outdoor dogs including free-roaming dogs.

The prevalence in indoor dogs by geographic distribution showed as follows: 7.0%(3 of 42 dogs) in Pupyong-gu and 33.0% (1 of 3 dogs) in Nam-gu. In the case of outdoor dogs including free-roaming dogs, *D. immitis* were observed in 1 of 27 dogs (3.7%) in Nam-gu, 1 of 5 dogs (20.0%) in Yeonsu-gu, 5 of 25 dogs (20.0%) in Namdong-gu, 1 of 18 dogs (5.6%) in Pupyong-gu and 8 of 52 dogs (15.4%) in Kanghai-gun, 4 of 36 dogs (11.1%) in OngJin-gun.

Table 1. Prevalence and geographic distribution *Dirofilaria immitis* infection in Incheon

Districts*	No of examined	No of positive	Infection rate (%)
JG	30	0	—
DG	30	0	—
NG	30	2	6.7
YSG	30	1	3.0
NDG	60	5	8.0
PYG	60	4	6.7
GYG	30	0	—
SG	30	0	—
KHG	64	8	13.0
OJG	36	4	11.1
Total	400	24	6.0

*JG: Jung-gu, DG: Dong-gu, NG: Nam-gu, NDG: Namdong-gu, YSG: Yeonsu-gu, PYG: Pupyong-gu, GYG: Gyeyang-gu, SG: Seo-gu, OJG: OngJin-gun, KHG: Kanghai-gun

Table 2. Prevalence of *Dirofilaria immitis* among indoor dogs or outdoor dogs which including free-roaming dogs in Incheon

Districts*	Indoor			Outdoor (Inc. Free roaming dogs)		
	No. of examined	No. of positive	Infection rate (%)	No. of examined	No. of positive	Infection rate (%)
JG	28	0	—	2	0	—
DG	30	0	—	0	0	—
NG	3	1	33.0	27	1	3.7
YSG	25	0	—	5	1	20.0
NDG	35	0	—	25	5	20.0
PYG	42	3	7.0	18	1	5.6
GYG	0	0	—	30	0	—
SG	27	0	—	3	0	—
KHG	12	0	—	52	8	15.4
OJG	0	0	—	36	4	11.1
Total	202	4	2.0	198	20	10.0

*JG: Jung-gu, DG: Dong-gu, NG: Nam-gu, NDG: Namdong-gu, YSG: Yeonsu-gu, PYG: Pupyong-gu, GYG: Gyeyang-gu, SG: Seo-gu, OJG: OngJin-gun, KHG: Kanghai-gun

Table 3. Prevalence of *Dirofilaria immitis* among indoor dogs or outdoor dogs which exclude including free-roaming dogs in Incheon (Exp. free roaming dogs)

Districts*	No. of examined	No. of positive	Infection rate (%)	Housing					
				Indoor			Outdoor (Exp. free roaming dogs)		
				No. of examined	No. of positive	Infection rate (%)	No. of examined	No. of positive	Infection rate (%)
JG	30	0	—	28	0	—	2	0	—
DG	30	0	—	30	0	—	0	0	—
NG	6	1	16.7	3	1	33.3	3	0	—
YSG	30	1	3.3	25	0	—	5	1	20.0
NDG	45	0	—	35	0	—	10	0	—
PYG	42	3	7.1	42	3	7.1	0	0	—
GYG	0	0	—	0	0	—	0	0	—
SG	30	0	—	27	0	—	3	0	—
KHG	64	8	12.5	12	0	—	52	8	15.4
OJG	36	4	11.1	0	0	—	36	4	11.1
Total	313	17	5.4	202	4	2.0	111	13	11.7

*JG: Jung-gu, DG: Dong-gu, NG: Nam-gu, NDG: Namdong-gu, YSG: Yeonsu-gu, PYG: Pupyong-gu, GYG: Gyeyang-gu, SG: Seo-gu, OJG: OngJin-gun, KHG: Kanghai-gun

Prevalence of *D. immitis* in indoor dogs and outdoor dogs excepting free-roaming dogs

The infection rate of *D. immitis* in indoor dogs and outdoor dogs excepting free-roaming dogs in Incheon in 2006 was shown in Table 3, 4 cases among 202 dogs (2.0%) were positive in the case of indoor dogs, while 13 of 111 dogs (11.7%) were positive in the case of outdoor dogs excepting free-roaming dogs.

The infection rate of *D. immitis* in outdoor dogs excepting free-roaming dogs by geographic distribution showed as follows: 20.0% (1 of 5 dogs) in Yeonsu-gu, 15.4% (8 of 52 dogs) in Kanghai-gun, and 11.1% (4 of 36 dogs) in OngJin-gun.

Prevalence of *D. immitis* in outdoor dogs and free-roaming dogs

As presented in Table 4, the prevalence of dirofilariasis was 11.7% (13 cases) or 8.1% (7 cases) for outdoor dogs or free-roaming dogs, respectively. one of 5 dogs (20.0%) in Yeonsu-gu and 8 of 52 dogs (15.4%) in Kanghai-gun were filaria-positive in the case of outdoor dogs, while 1 of 24 dogs (4.2%) in Nam-gu, 5 of 15 dogs (33.3%) in Namdong-gu and 1 of 18 dogs (5.6%) in Pupyong-gu were positive in the case of free-roaming dogs.

Table 4. Prevalence of *Dirofilaria immitis* among outdoor dogs or free-roaming dogs in Incheon

Districts*	No. of examined	No. of positive	Infection rate (%)	Outdoor			Free roaming dogs		
				No of examined	No. of positive	Infection rate (%)	No. of examined	No. of positive	Infection rate (%)
JG	2	0	—	2	0	—	0	0	—
DG	0	0	—	0	0	—	0	0	—
NG	27	1	3.7	3	0	—	24	1	4.2
YSG	5	1	20.0	5	1	20.0	0	0	—
NDG	25	5	20.0	10	0	—	15	5	33.3
PYG	18	1	5.6	0	0	—	18	1	5.6
GYG	30	0	—	0	0	—	30	0	—
SG	3	0	—	3	0	—	0	0	—
KHG	52	8	15.4	52	8	15.4	0	0	—
OJG	36	4	11.1	36	4	11.1	0	0	—
Total	198	20	10.1	111	13	11.7	87	7	8.1

*JG: Jung-gu, DG: Dong-gu, NG: Nam-gu, NDG: Namdong-gu, YSG: Yeonsu-gu, PYG: Pupyong-gu, GYG: Gyeyang-gu, SG: Seo-gu, OJG: OngJin-gun, KHG: Kanghwa-gun

DISCUSSION

We investigated the prevalence of *D. immitis* infection in dogs of In-cheon in 2006 to provide surveillance for improvement of the citizens health and to take preventive measures for dirofilariosis.

The overall prevalence of *D. immitis* infection was 6.0% (24 dogs) among a total of 400 dogs, which was within the range of the study by Lee et al.(1996) who reported that the domestic prevalence was from 3.1% to 23.0%.

Eight of 64 dogs (13.0%) in Kanghwa-gun were filaria-positive, which was the highest in the prevalence by geographic distribution. The prevalence in outdoor dogs of OngJin-gun was 11.1% (4 of 36 dogs), which was a little lower than 36.4% reported by Jang et al. (2004). This is because most dogs in Kanghwa-gun and OngJin-gun are raised outdoors as both agriculture areas, so they can be more exposed to mosquitoes which are source of infection. In addition, vaccination rate against dirofilariosis is lower than other cities because most people in Kanghwa-gun and OngJin-gun generally lack awareness of dirofilariosis.

In the case of downtown area, 5 cases among 60 dogs (8.0%) were positive in Namdong-gu, which was the highest rate. It might be because there are so-many wide spaces enough to raise the dogs in Namdong-gu, compared with other downtown areas, so the dogs in Namdong-gu have higher chance of being exposed to the

mosquitos. On the other hand, 1 case among 30 dogs (3.0%) were positive in Yeonsu-gu, which was lowest rate.

In the case of indoor dogs, 4 cases among 202 dogs (2.0%) were positive, while 20 of 198 outdoor and free-roaming dogs (10.0%) were positive for *D. immitis*. The detection rates were lower than what were reported by Jang et al. (2004): 4% and 36.4% for indoor and outdoor dogs, respectively. It was speculated that the higher prevalence of *D. immitis* in the outdoor dogs was due to a higher chance of exposure to mosquitoes compared to the indoor dogs.

In the case of outdoor dogs which exclude free-roaming dogs, 13 of 111 dogs (11.7%) were positive for *D. immitis*, suggesting that the detection rate was fairly high in the outdoor dogs without reference to the different housing conditions. Finally, the prevalence of canine dirofilariosis was 8.1% (7 cases) in the case of free-roaming dogs. It was suspected that the prevalence of free-roaming dogs for *D. immitis* was lower than outdoor dogs because they used to be reared indoor and under better protection and control against *D. immitis* before abandoned

These results collectively imply that the prevalence of the dogs seemed to be high when the dogs were raised outdoors and there were not concerns about a basic knowledge and prevention for *D. immitis*.

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