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The anti-parasitic efficacy of ivermectin and pyrantel pamoate compound against canine *Toxocara canis* and *Trichuris vulpis*

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Abstract : *Toxocara* (*T.*) *canis* and *Trichuris* (*T.*) *vulpis* are very important canine parasitic nematodes. *T. canis* parasitize in small intestine and *T. vulpis* parasitize in large intestine. In order to control of these nematodes, ivermectin and pyrantel pamoate compound was applied to the dogs infected with these parasites naturally and artificially. This drug was composed of 68.0 μg of ivermectin and 57.0 mg of pyrantel pamoate for small animal, 136.0 μg of ivermectin and 114.0 mg of pyrantel pamoate for middle animal, and 272.0 μg of ivermectin and 227.0 mg of pyrantel pamoate for large animal. Ivermectin in this drug is activity to nematodes and ectoparisites. Pyrantel pamoate in this drug is also activity to nematodes. In this experiment, this drug had a good efficacy against *T. canis* and *T. vulpis* in the infected dogs.

Keywords : ivermectin, ivermectin and pyrantel pamoate compound, pyrantel pamoate, *Toxocara canis*, *Trichuris vulpis*

Introduction

Companion animals are very important to human and families, because they give many comfortable, communications, and human-relationship between their families. If they are infected with parasites and zoonotic parasites, their parasites can infect to human. Military dogs and police dogs are frequently infected with parasites. The major parasites in dogs are *T. canis*, *T. vulpis*, and *Dirofilaria* (*D.*) *immitis* in helminth, *Isospora* (*I.*) *canis* and *Giardia* (*G.*) *canis* in protozoa, and sarcoptic mite [20]. Ivermectin is a kind of good anti-parasitic drug against nematodes, such as *Toxocara* (*T.*) *canis*, *Trichuris* (*T.*) *vulpis*, ect and ectoparasites in dogs [1, 7]. Pyrantel pamoate is also very good anti-parasitic drug against canine nematodes, such as *Ancylostoma caninum*, *T. canis*, *T. vulpis*, and *so on* [10, 12, 14, 18]. This is the research on the anti-parasitic efficacy and safety of ivermectin and pyrantel pamoate compound (IPPC) against *T. canis* and *T. vulpis* of companion animals. After the anti-parasitic activities of the IPPC were evaluated in the center of strayed dogs and private animal clinics, its were re-evaluated in the private animal clinics.

Materials and Methods

Experimental Animals and feed

Experimental animals are companion animals (dogs) and deserted dogs infected with *T. canis* and *T. vulpis*. They were investigated eggs of parasites. In the field trial, the experimental dogs from the private animal clinics in Seoul were used in this experiment. Feed and water were supplied ad libitum.

Drugs and parasites

The components and dosages of IPPC were as follows. This experiment was used drug for middle animal and other ivermectin drug. For small animals, the effective components of IPPC were 68.0 μg of ivermectin and 57.0 mg of pyrantel pamoate in 1 tablet. And for large animals, those were 272.0 μg of ivermectin and 227.0 mg of pyrantel pamoate in 1 tablet.

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These drugs were evaluated the anti-parasitic activity against *T. canis* and *T. vulpis* in the center of stray dogs and private clinics.

IPPC was used in this experiment. The dogs infected with *T. canis* and *T. vulpis* were used in this experiment.

Methods

T. canis and *T. vulpis* was investigated in the center of stray dogs and private animal clinics. After investigation of parasites infection in the stray dogs, the infected dogs were used this experiment. Experimental groups and investigated items were as follow Tables 1 and 2. The dogs were raised by use of in the center of stray dogs and private animal owners. After the parasitic infections of the dogs were diagnosed by use of feces in animal clinics, IPPC were administered orally to the dogs infected with *T. canis* and *T. vulpis*. In the private animal clinics trials, the experimental groups and investigated items were as follow Tables 3 and 4. The drugs also were administered per oral. The dogs were raised by use of in the private animal owners.

Experimental groups

Forty five dogs infected with *T. canis* and *T. vulpis* were divided three groups, each group was 3 dogs, such as IPPC (1, 2 and 4 doses) treated group, other ivermectin drug group and infected control group. These experiments were replied 3 times, respectively. In the field trial, twenty dogs in the private animal clinics were selected and were experimented. One group was control group and other group was IPPC treated group.

Investigated items

Eggs of *T. canis* and *T. vulpis* were investigated in the feces at 0, 2, and 4 weeks before and after treatment. Egg reduction rates were calculated each week after treatment. To evaluate drug safety, the side-effects of 2- and 4-fold treated groups were investigated at 0, 2, and

Table 1. The anti-parasitic efficacies of ivermectin and pyrantel pamoate compound (IPPC) against *Toxocara (T.) canis* in the center of stray dogs

Groups	No. of animals	Replication	Treatment	Investigated items		
				Reduction rates of eggs (Infected rates)		Symptoms
				2 weeks	4 weeks	
Infected control	3	3	No	–7.1 (0.0)	13.1 (0.0)	No
IPPC	3	3	Yes	94.4 (66.7)	100.0 (100.0)	No
Ivermectin	3	3	Yes	88.6 (44.4)	100.0 (100.0)	No
IPPC (2D)	3	3	Yes	97.4 (77.8)	100.0 (100.0)	No
IPPC (4D)	3	3	Yes	100.0 (100.0)	100.0 (100.0)	No

No. of Dog	Treatment	Weeks after treatment		
		0	2	4
Control	Total	16,800 (9/9)	18,000 (9/9)	14,600 (9/9)
	Mean	1,867	2,000	1,622
	± SD	1,330	1,661	891
IPPC 1D	Total	18,000 (9/9)	1,000 (3/9)	0 (0/9)
	Mean	2,000	111	0
	± SD	1,723	176	0
Ivermectin	Total	14,000 (9/9)	1,600 (5/9)	0 (0/9)
	Mean	1,556	178	0
	± SD	646	211	0
IPPC 2D	Total	15,400 (9/9)	400 (2/9)	0 (0/9)
	Mean	1,711	44	0
	± SD	813	88	0
IPPC 4D	Total	14,400 (9/9)	0 (0/9)	0 (0/9)
	Mean	1,600	0	0
	± SD	447	0	0

4 weeks before and after treatment.

Statistic analysis

Statistic analysis were accompanied by student's *t* test by use of SigmaPlot (ver. 5.0; Jandel, USA).

Results

The anti-parasitic efficacies of IPPC against *T. canis* and *T. vulpis* in the center of stray dogs

In the results of Anti-parasitic efficacy of IPPC against *T. canis*, the egg reduction rate of IPPC treated group was 94.4% and other Ivermectin treated group was 88.6% after 2 weeks post treatment. Those of 2- and 4-doses groups were 97.4% and 100%, respectively. The individual egg reduction rates of IPPC treated group and other ivermectin treated group were 66.7% and 44.4%, respectively. The egg reduction rates of all treated groups were 100% after 4 weeks post treatment (Table 1).

In the results of Anti-parasitic efficacy of IPPC against *T. vulpis*, the egg reduction rate of IPPC treated group was 84.4% and other ivermectin group was 85.7% after 2 weeks post treatment. Those of 2- and 4-doses groups were 93.5% and 97.2%, respectively. The individual egg reduction rates of IPPC treated group and other ivermectin group were 44.4%, respectively. Those of 2- and 4-doses groups were 55.6% and 77.8%, respectively. The egg reduction rate of IPPC treated group was 96.7% and other ivermectin group was 97.1% after 4 weeks post treatment. Those of 2- and 4-doses groups were 98.7% and 100.0%, respectively. The individual egg reduction rates of IPPC treated group and other ivermectin group were 77.8%, respectively. Those of 2- and 4-doses groups were 88.9% and 100.0%, respectively (Table 2).

The anti-parasitic efficacies of IPPC to *T. canis* and *T. vulpis* in the private clinics

Egg reduction rate of *T. canis* in blood was 95.0% in the group treated with IPPC. Individual egg reduction

Table 2. The anti-parasitic efficacies of IPPC against *Trichuris (T.) vulpis* in the center of stray dogs

Groups	No. of animals	Replication	Treatment	Investigated items		
				Reduction rates of eggs (Infected rates)		Symptoms
				2 weeks	4 weeks	
Infected control	3	3	No	–8.0 (11.1)	14.7 (0.0)	No
IPPC	3	3	Yes	84.4 (44.4)	96.7 (77.8)	No
Ivermectin	3	3	Yes	85.7 (44.4)	97.1 (77.8)	No
IPPC (2D)	3	3	Yes	93.5 (55.6)	98.7 (88.9)	No
IPPC (4D)	3	3	Yes	97.2 (77.8)	100.0 (100.0)	No

No. of Dog	Treatment	Weeks after treatment		
		0	2	4
Control	Total	15,000 (9/9)	16,200 (8/9)	12,800 (9/9)
	Mean	1,667	1,800	1,422
	± SD	1,330	1,661	891
IPPC 1D	Total	18,000 (9/9)	2,800 (5/9)	600 (2/9)
	Mean	2,000	311.1	66.7
	± SD	1,723	401.4	141.4
Ivermectin	Total	14,000 (9/9)	2,000 (5/9)	400 (2/9)
	Mean	1,556	222.2	44.4
	±SD	646	253.9	88.2
IPPC 2D	Total	15,400 (9/9)	1,000 (4/9)	200 (1/9)
	Mean	1,711	111.1	22.2
	± SD	813	145.3	66.6
IPPC 4D	Total	14,400 (9/9)	400 (2/9)	0.0 (0/9)
	Mean	1,600	44.4	0.0
	± SD	447	88.2	0.0

Table 3. The anti-parasitic efficacies of IPPC against *T. canis* in the private clinics

Groups	No. of animals	Treatment	Investigated items		
			Reduction rates of eggs in feces		Symptoms
			2 weeks	4 weeks	
Infected control	10	No	7.8 (0.0)	2.6 (0.0)	No
IPPC	10	Yes	95.0 (80.0)	100.0 (100.0)	No

No. of Dog	Treatment	No. of infected eggs in feces (Weeks after treatment)		
		0	2	4
Control	Total	15,400 (10/10)	14,200 (10/10)	15,000 (10/10)
	Mean	1,540	1,420	1,500
	± SD	869.5	635.6	634.2
IPPC	Total	12,000 (10/10)	600 (2/10)	0 (0/10)
	Mean	1,200	60	0
	± SD	549.7	135.0	0

Table 4. The anti-parasitic efficacies of IPPC against *T. vulpis* in the private clinics

Groups	No. of animals	Treatment	Investigated items		
			Reduction rates of eggs in feces		Symptoms
			2 weeks	4 weeks	
Infected control	10	No	9.0 (0.0)	3.0 (0.0)	No
IPPC	10	Yes	84.8 (60.0)	95.7 (80.0)	No

No. of Dog	Treatment	Weeks after treatment		
		0	2	4
Control	Total	13,400 (10/10)	12,200 (10/10)	13,000 (10/10)
	Mean	1,340	1,220	1,300
	± SD	869.5	635.6	634.2
IPPC	Total	9,200 (10/10)	1,400 (4/10)	400 (2/10)
	Mean	920	140	40
	± SD	413.1	211.9	84.3

rate of *T. canis* in blood was 80.0% in the group treated with IPPC at 2 weeks after treatment. Egg reduction rate of *T. canis* in blood was 100% in the group treated with IPPC (Table 3).

Egg reduction rate of *T. vulpis* in blood was 84.7% in the group treated with IPPC. Individual egg reduction rate of *T. vulpis* in blood was 60.0% in the group treated with IPPC at 2 weeks after treatment. Egg reduction rate of *T. vulpis* in blood was 95.7% in the group treated with IPPC. Individual egg reduction rate of *T. vulpis* in blood was 80.0% in the group treated with IPPC at 4 weeks after treatment (Table 4).

Discussion

The major canine parasites are round-worm, whip-worm and heart-worm in nematodes, *Isospora canis* and *Giardia canis*, in protozoa, and mite in arthropods. In the results of anti-parasitic activity of IPPC against *T. canis* in this experiment, the egg reduction rate of IPPC treated and other ivermectin groups were 94.4% and 88.6% at 2 weeks after treatment, respectively. Those of 2 and 4 doses of IPPC group were 97.4% and 100%, at 2 weeks after treatment, respectively. Otherwise, the individual egg reduction rate of IPPC treated and other ivermectin groups were 66.7% and 44.4% at 2 weeks

after treatment, respectively. Those of 2 and 4 doses of IPPC group were 77.8% and 100%, at 2 weeks after treatment, respectively. *T. canis* were treated in the all of the medicated groups at 4 weeks after treatment. In the field trials, the results of anti-parasitic activity of IPPC against *T. canis*, the egg reduction rate of IPPC treated group was 95.0% at 2 weeks after treatment. The individual egg reduction rate of IPPC treated group were 80.0% at 2 weeks after treatment. All of *T. canis* were entirely treated in the medicated groups at 4 weeks after treatment. Some researchers published the anti-parasitic efficacies of pyrantel parmoate and ivermectin against *T. canis* and *T. vulpis*. Miró *et al.* [16] reported that in the dogs, the anti-parasitic activities of pyrantel, fenbendazole, and febantel-pyrantel-praziquantel were 100%, 80~100% and 97~100% against *T. canis*, respectively. Grandemange *et al.* [8] reported that in the dogs, the anti-parasitic activities of oxantel/pyrantel/praziquantel against *T. canis* were 99.1%, 98.8% and 98.9% at 7, 14 and 21 after medication. McTier *et al.* [15] reported that in the dogs, the results of anti-parasitic activity of selamectin and pyrantel against *T. canis* were 84.6~100.0%. Dryden and Ridley [6] reported that in the dogs, the anti-parasitic activities of egg reduction rates of fenbendazole and pyrantel pamoate suspension against *T. canis* were 95.8%, 99.8% and 96.8~99.8%, 85.8%, 88.3% and 71.4~98.3% at 10, 31 and 31~128 days after treatment, respectively. Lloyd and Gemmell [13] reported that in the dogs, the anti-parasitic activities of a compound of praziquantel, pyrantel embonate, and febantel were 100% in the artificial infection and 97~98% in the field trial. Clark *et al.* [3] reported that in the dogs, the anti-parasitic activity of beef-based chewable formulation of Ivermectin and pyrantel pamoate against *T. canis* was 90.1%, respectively. Clark *et al.* [2] reported that in the dogs, the anti-parasitic activities of pyrantel pamoate with 2.5, 5 or 10 mg/kg of weight against *T. canis* adult worms were 76.1, 94.2, 91.2%, respectively. Jacobs [11] reported that in the dogs, the anti-parasitic activities of pyrantel pamoate and piperazine against *T. canis* adult worms were 83.5 and 82.5%, respectively. Sharp and McCurdy [19] reported that in the dogs, the anti-parasitic activities of 10 and 1 mg/kg of body weight of febantel and praziquantel against *T. canis* adult worms were 100%, respectively. Corwin *et al.* [5] reported that the anti-parasitic activities of a compound of 3.40% febantel and 0.34% praziquantel against *T. vulpis* (10), *T. canis* (2), *D. immitis* (3) in the dogs and *Toxocara cati* (10/11) in the cats at 1 time per day during 3 days were 100%, respectively. Corwin *et al.* [4] reported that febantel were good efficacy against nematodes, such as *Ancylostoma caninum*, *T. vulpis*, *Uncinaria stenocephala*, *T. canis*, *Toxascaris leonina* and cestodes, such as *Taenia* sp and *Dipylidium caninum*. In these experiments, the results of anti-parasitic activities of IPPC against *T. canis* were like as those of previous researchers.

The egg reduction rates of IPPC in the dogs artificially infected with *T. vulpis* were 84.4% in 1 dose, 93.5% in 2 doses, 97.2% in 4 doses and 85.7% in control drug treated group at 2 weeks after treatment. The individual egg reduction rates of IPPC against *T. vulpis* were 44.4% in 1 dose, 55.6% in 2 doses, 77.8% in 4 doses and 44.4% in control drug treated group at 2 weeks after treatment. The egg reduction rates of IPPC against *T. vulpis* were 96.7% in 1 dose, 98.7% in 2 doses, 100.0% in 4 doses and 97.1% in control drug treated group at 4 weeks after treatment. The individual egg reduction rates of IPPC against *T. vulpis* were 77.8% in 1 dose, 88.9% in 2 doses, 100.0% in 4 doses and 77.8% in control drug treated group at 4 weeks after treatment. In the field trials, the egg reduction rates of IPPC in the dogs infected with *T. vulpis* were 84.7% and 95.7% at 2 and 4 weeks after treatment. The individual egg reduction rates of IPPC in the dogs infected with *T. vulpis* were 60.0% and 80.0% at 2 and 4 weeks after treatment. Grandemange *et al.* [8] reported that the egg reduction rates of a compound of oxantel/pyrantel/praziquantel against *T. vulpis* were 97.3%, 97.2% and 98.4% at 7, 14 and 21 days after treatment, respectively. Prelezov and Bauer [17] reported that the worm reduction rates of Flubenol and Drontal Plus against *T. vulpis* were 99.4%, respectively. Lloyd and Gemmell [13] reported that the anti-parasitic activities of a compound of praziquantel, pyrantel embonate and febantel were over 92% in the dogs naturally infected with *T. vulpis*. Greiner *et al.* [9] reported that the anti-parasitic activities of febantel/praziquantel paste and febantel tablet were 95.8% and 99.7% in the dogs naturally infected with *T. vulpis*, respectively. Sharp and McCurdy [19] reported that the anti-parasitic activities of a compound of 10 mg/kg febantel and 1 mg/kg praziquantel was 99.5% in the dogs infected with *T. vulpis* at 1 time per day during 3 days. Corwin *et al.* [5] reported that the anti-parasitic activities of a compound of 3.40% febantel and 0.34% praziquantel

against *T. vulpis* were 99.9% at 1 time per day during 3 days. The results of anti-parasitic activities of IPPC against *T. vulpis* also were like as those of previous researchers.

So that IPPC is a good drug for control of intestinal nematode parasites.

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