Efficacy of ivermectin in calves in a farm occurring sudden-death type of strongyloidosis

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Summary

A field study of an anthelmintic evaluation against *Strongyloides papillosus* (SPL) infection in calves was carried out at a farm afflicted with sudden-death. Thirty-six calves with 15800 to 191200 SPL eggs per gram of faeces (EPG) were subcutaneously injected at least once with ivermectin at 0.1 mg or 0.2 mg/kg body weight (BW). After the medication, 2 calves died, one after 4 and the other after 17 hrs. However, the other calves showed EPG reductions ranging from 94.4 % to 100 % at 3 days after medication. Ivermectin injected once with the dose of 0.1 mg/kg or 0.2 mg/kg BW resulted in a SPL-EPG reduction and also had a restorative effect against the sudden-death type of strongyloidosis.

Key words: calves; hyperinfection; ivermectin; *Strongyloides papillosus*; sudden-death

Introduction

Since around 1980, calves maintained in sawdust-litter confinement pens in cattle farms (Taira *et al.*, 2003) had been dying suddenly day-by-day during the late summer to early autumn in Japan, and the causal agents had been unidentified. Thereafter, several parasitological investigations found evidences of *Strongyloides papillosus* (SPL) infection in the sudden-death of calves, and experimental infection studies demonstrated the disease caused by SPL infection in calves (Taira *et al.*, 1992; Ura *et al.*, 1992; Nakanishi *et al.*, 1993; Ura *et al.*, 1993). Thus, those researchers coined this disease as "the sudden-death type of strongyloidosis" (Taira & Ura, 1991).
Nowadays, the sudden-death type of strongyloidosis is a major problem in cattle farms in Japan where calves maintained in sawdust-litter confinement pens. Treatment with anthelmintics might be an urgent prime remedy against this disease.
However, no reports have been found about preventive effects of the anthelmintic administration on the sudden-death type of strongyloidosis. Thus, this report describes the results of a field experiment, which was carried out during the year 1989 to evaluate the efficacy and the safety of ivermectin medication on the cattle in a farm occurring the sudden-death type of strongyloidosis.

Materials and Methods

Experimental design and medication: The experiment was carried out in a farm, Kumamoto Prefecture, Japan, where the sudden-death type of strongyloidosis was occurring (Taira & Ura 1991). Thirty-six calves infected naturally with SPL were divided into 6 groups, labelled A to F, with 6 calves per group. Each six group was housed separately. The ivermectin product, a 1 % injectable solution (IVO-MEC; Merck & Co., Inc.), was injected subcutaneously into the neck of the calf. Group A was injected once with the dose of 0.1 mg/kg body weight (BW). For groups B, C, D, and E, the dose of 0.2 mg/kg BW was injected. Group B was medicated once, group C twice on 2 consecutive days, group D three times on 3 consecutive days and group E twice at a 7-day interval. Group F, the control, received no medication in principle. However, when calves in this group showed critical distress, emergency medications were conducted for rescue. The medication in each group is marked with arrows in Table 1.
Faecal examination: Rectal contents were taken from each calf at -2, 0, 3, 7, 14, and 21 days after the initial medication. The faeces were weighed 1.1 g and the faecal consistency was determined by "the sampling ring for 1 ml vo-

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lume" (Taira *et al.*, 2003). The consistency was recorded as either solid, soft, diarrhoeal, or watery diarrhoeal; Table 1 shows solid faeces marked as "SL", soft faeces as "SF" and diarrhoeal faces as "DI". The EPG was counted by the O-ring technique (modified McMaster technique; Taira *et al.*, 2003). One O-ring chamber containing 1/200 g faeces was inspected under a microscope. Therefore, the EPG values in Table 1 indicate the number of eggs counted multiplied by 200. The description for EPG values less than 200 was replaced as 0 in Table 1.

Calculation of medication efficacy: Reduction percentages of SPL-EPG after medication in each experimental group were considered as the restorative efficacy. SPL-EPG fluctuation between each experimental groups (A, B, C, D and E) and no-medication control group (F) was also compared.

Results

The results of the faecal examination are shown in Table 1. Only *Strongyloides papillosus* (SPL) eggs were found, and no other helminth eggs were detected at the faecal examination. A small number of coccidial oocysts were found in some specimens.

Before medication, calves had high SPL-EPG values ranged from 15800 to 191200. In group A, one calf No. 6, died after the medication, however, all the other calves in this group showed a 100 % reduction in EPG. Likewise, in group B one calf No. 12, died after the medication, but the five remaining calves showed a EPG reduction of 99.8 % at 3 days after medication. In groups C, D, and E, the medication reduced EPG by 94.4 %, 96.4 %, and 98.4 %, respectively. The EPG reduction percentages of no-medica-

Table 1. Reduction of *Strongyloides papillosus* EPG after ivermectin (IVM) medication on calves in a farm occurring a serious outbreak of the sudden-death type of strongyloidosis

Group IVM dose/kg x times	Calf No.	Body weight kg	Days after medication with IVM					
			-2	0	3	7	14	21
			Strongyloides papillosus EPG and faecal consistency[1]					
A	1	65	nd	191200 SL ↓	0 SL	0 SL	0 SL	0 SL
	2	64	104600 SL	62200 SL	0 SL	0 SL	0 SL	0 SL
0.1mg	3	66	113800 SL	99800 SL	0 SL	0 SL	0 SL	0 SL
x 1	4	75	93200 SL	82200 SL	0 SL	0 SL	0 SL	0 SL
Day 0	5	78	92000 SL	34000 SL	0 SL	0 SL	0 SL	0 SL
	6	66	132800 SL	49000 SL	Died at 4 hrs after medication			
	Mean	69.0	107280.0	86400.0	0	0	0	0
	% Reduction	-		0 %	100 %	100 %	100 %	100 %
B	7	41	122200 SF	118000 SD ↓	200 SL	200 SL	1000 SL	1000 SL
	8	54	80200 SF	44600 SD	0 SL	200 SL	200 SL	0 SL
0.2mg	9	61	21800 SF	15800 SD	20 SL	400 SL	600 SL	0 SL
x 1	10	55	37000 SL	42600 SF	0 SL	2000 SL	800 SL	4200 SL
Day 0	11	70	nd	40800 SF	200 SL	1200 SL	1800 SL	4000 SL
	12	70	nd	116200 SF	Died at 17 hrs after medication			
	Mean	58.5	65300.0	63000.0	120.0	800.0	880.0	1840.0
	% Reduction	-		0 %	99.8 %	98.7 %	98.6 %	97.1 %
C	13	49	nd	35000 DI ↓ ↓	11600 SL	2800 SL	0 SL	0 SL
	14	71	nd	53000 SF	600 SL	0 SL	0 SL	0 SL
0.2mg	15	83	nd	46800 SL	1800 SL	400 SL	0 SL	0 SL
x 2	16	85	nd	62400 SL	400 SL	0 SL	0 SL	0 SL
Days 0 and 1	17	75	nd	41200 SL	200 SL	0 SL	0 SL	0 SL
	18	47	nd	21000 SL	0 SF	0 SL	0 SL	0 SL
	Mean	68.3	-	43233.3	2433.3	533.3	0	0
	% Reduction	-	-	0 %	94.4 %	98.8 %	100 %	100 %
D	19	100	55400 SL	103800 SL ↓ ↓↓	4400 SL	0 SL	0 SL	0 SL
	20	57	74400 SL	77800 SL	0 SL	0 SL	0 SL	0 SL
0.2mg	21	64	76400 SL	77000 SL	1000 SL	0 SL	0 SL	0 SL

x 3	22	66	70400 SL	87600 SL	0 DI	0 SL	0 SL	0 SL
Days 0, 1,	23	82	89800 SL	70200 SL	200 SL	0 SL	0 SL	0 SL
and 2	24	61	61800 SL	50600 SF	5200 SL	0 SL	0 SL	0 SL
	Mean	71.7	71366.7	77833.3	1800.0	0	0	0
	% Reduction	-		0 %	96.4 %	100 %	100 %	100 %
				↓			↓	
E	25	95	59400 SL	34400 SL	200 SL	0 SL	0 SL	0 SL
	26	43	97600 SL	48000 SL	0 SL	400 SL	0 SL	0 SL
0.2mg	27	54	81600 SL	58600 SF	800 SL	2000 SL	0 SL	0 SL
x 2	28	78	45600 SL	38200 SL	600 SL	3000 SL	0 SL	0 SL
Days 0	29	60	99000 SL	68800 SF	3000 SL	11000 SL	0 SL	0 SL
and 7	30	78	66800 SL	72800 DI	600 SL	5200 SL	0 SL	0 SL
	Mean	68.0	75000.0	53466.7	866.7	3600.0	0	0
	% Reduction	-		0 %	98.4 %	93.3 %	100 %	100 %
						↓Emergency medication[2]		
F	31	90	57600 SL	40000 SL	10600 SL	7200 SL	0 SL	0 SL
	32	69	43800 SL	28400 SL	25800 SL	19200 SL	200 SL	0 SL
No-	33	68	49600 SL	17600 SL	17200 SL	53400 SL	0 SL	0 SL
medication	34	58	23200 SL	22200 SL	20400 SL	29200 SL	5600 SL	1400 SL
Control	35	69	37000 SL	32000 SL	26600 SL	33600 SL	14200[3] SL	0 SL
	36	70	42200 SL	54000 SL	65800 SL	49800 SL	200 SL	0 SL
	Mean	70.7	42233.3	32366.7	27733.3	32066.7	3367.0	233.3
	% Reduction	-		0 %	14.3 %	0.9 %	89.6 %	99.3 %

nd: not done; ↓: IVM medication; [1]SL: solid faeces, SF: soft faeces, DI: diarrhoeal faeces; [2]The dose of 0.2 mg/kg ivermectin was given urgently, because calves showed distress; [3]The calf was given 0.2mg/kg ivermectin one more time, because calves still showed distress

tion control group F were 14.3 % and 0.9 % at days 3 and 7, respectively, and those in treatment groups A, B, C, D and E were more than 93 %.

On the other hand, in group F, the no-medication control, calves showed critical distress; therefore, emergency medication with the dose of 0.2 mg/kg BW ivermectin was administered on day 7 for rescue. Calf No. 35 in this group was medicated one more time with the same dose on day 14 (Table 1), because this calf still showed serious distress. After these medications, an EPG reduction of 89.6 % was recorded in this group.

The faecal consistency "SL" was recorded in most of the faecal samples, and "SF" or "DI" were seen at times. Watery diarrhoea was not observed.

Discussion

Prior to the initial ivermectin medication in the present study, SPL-EPG in all groups of calves were tremendously high (min. 32367 for group F – max. 86400 for group A). Three days after the medication, EPG reduction was more than 94.4 % except for no-medication control (group F). Tassi (1990) reported that ivermectin injection of the dose 0.2 mg/kg BW resulted a 99 % SPL-EPG reduction in experimentally infected calves, in agreement with the present field experiment.

Among the calves that died suddenly in the farm, where the present study conducted, the SPL-EPG values had ranged from 52000 to 411000 EPG (Taira & Ura, 1991). In the other study, among the calves that died suddenly from the experimental infection, the EPG values ranged from 17600 to 201800 (Taira et al., 1992). In the present experiment, 2 calves No. 6 and No. 12 died at 4 and 17 hrs after medication, respectively. These deaths were not considered as a result of side effects of the medication, because the other calves in the same groups (A and B) did not show any clinical symptoms of the side effects. Instead, those 2 calves No. 6 and No. 12 might have already been on a course to sudden-death regardless of medication.

During this field experiment, the sawdust litter in some pens was exchanged for new litter, and also the sawdust litter in some pens were sprinkled with the Dichlorvos emulsion by a gardening pot (Rebollo et al., 2003). These two treatments might also affect the rate of subsequent infection with SPL in the pens. Nevertheless, the medication in calves is thought to be the most important factor in eliminating the incidence of the disease.

All calves showed tremendously high SPL-EPG prior to the medication in the present experiment. If these infected calves had remained untreated for SPL infection, all of them might have died. Above all, a single injection with the dose of 0.1 mg/kg or 0.2 mg/kg BW ivermectin resulted a clear reduction of SPL-EPG without any side effects or shock reactions of calves, and had a restorative effect against the sudden-death type of strongyloidosis.

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