Anthelmintics and Lungworm in Red Deer

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Abstract

A slaughter trial was conducted to assess the efficacy of febantel and ivermectin against lungworm (*Dictyocaulus viviparus*) in red deer calves (*Cervus elaphus*). Group 1 calves received febantel by mouth (7.5 mg/kg); group 2 calves, a subcutaneous injection of ivermectin (200 μg/kg); group 3 were controls. Faecal samples were collected daily. Calves were slaughtered 7 days after treatment, and lungworms were collected and counted. Control calves had an average of 219 live immature and 653 live adult lungworms. Calves drenched with febantel had an average of 32.8 live immature and 1.6 live adult lungworms, corresponding to a drug efficiency of 85% and 99.8% respectively, whereas those calves injected with ivermectin had no detectable live immature or live adult lungworm, corresponding to a drug efficiency of 100% in both cases.

Keywords: Cervus elaphus, *febantel, ivermectin, anthelmintics,* Dictyocaulus viviparus

Introduction

The lungworm *Dictyocaulus viviparus* is at present the most important parasite of farmed deer in New Zealand. Disease caused by lungworm infection was the most frequently occurring deer health problem reported by deer farmers and the second most common condition diagnosed by veterinarians in a survey of deer farms in N.Z. (Gladden 1981). Most cases of lungworm disease are seen in deer calves 3 – 6 months old in their first autumn or winter, especially when grazed on pasture at high stocking densities (Wilson 1979).

Lungworm in red deer (*Cervus elaphus*) can be controlled with an effective anthelmintic given every 3 – 4 weeks in late summer/autumn (Mason 1979). Results of preliminary field trials (Mason unpubl.) suggested that febantel[1] and ivermectin[2] were effective against lungworm in red deer, but these results were based on monitoring faecal output of the lungworm first-stage larvae (L_1) only. The trials provided no data on the efficacy of the drugs against immature lungworms; there was also a possibility that the anthelmintics merely temporarily suppressed egg production and did not kill the adult lungworm. To overcome such limitations a controlled slaughter trial was carried out using the 2 anthelmintics.

Materials and Methods

Red deer calves, weaned in mid March at 3 months of age at an average body weight of 40 kg, were used. The 15 calves were run together on pasture which adult red deer had recently grazed. Faecal samples were collected *per rectum* at weaning and at approximately 2-weekly intervals for the next 10 weeks. All 15 calves were orally dosed with infective third-stage *D. viviparus* larvae (L_3) on 3 occasions before the start of anthelmintic treatment (*see* Table 1).

On the basis of larval counts on 19 May, the 15 calves fell into 3 groups: namely those with high counts ($n = 6$, 185 – 667 L_1/g faeces), intermediate counts ($n = 3$, 26 – 84 L_1/g), or low counts ($n = 6$, < 3 L_1/g); therefore the calves were divided into 3 groups of 5 by stratified random sampling. On 24 May the 15 calves were brought indoors; they were fed hay and concentrates for the next 8 days until slaughter on June 1.

On 25 May group 1 calves received febantel by mouth at a dose rate of 7.5 mg/kg liveweight; group 2 calves received ivermectin by subcutaneous injection at a clipped site on the neck at a dose rate of 200 μg/kg liveweight. Group 3 calves acted as controls and received a similar subcutaneous injection of the carrier vehicle used in Ivomec without the active ingredient. Faecal samples were collected daily and the injection sites examined to assess skin reaction to ivermectin.

The calves were killed by captive bolt and exsanguination on 1 June. The lungs were removed, the bronchi slit open, and all lungworms were picked out. The lungs were then soaked in

[1]Rintal, Bayer (NZ) Ltd, Petone, Wellington
[2]Ivomec, MSD (NZ) Ltd, Papatoetoe, Auckland

water for 2 – 3 hours and washed into a 60 mesh/in sieve to collect any remaining lungworms. All lungworms were sexed, classified as immature or adult and as live or dead by their appearance under a stereoscopic microscope. All faeces were examined for lungworm larvae using the Baermann technique.

Results

Counts of faecal lungworm larvae for the 10 weeks before and the 7 days after anthelmintic treatment are presented in Tables 1 and 2. In both anthelmintic groups the larval counts had fallen to low levels by 3 days after treatment reaching negligible levels by the fourth day. In contrast the mean faecal larval count of the control group rose after the trial began. At slaughter the control calves had a mean faecal larvae count of 496 compared with less than 1 for the treated calves.

Table 1: Faecal counts of *Dictyocaulus viviparus* larvae in 15 calves before anthelmintic treatment

Date (1982)	Dose of larvae (L_3/calf)	Faecal larval count (L_1/g faeces) Mean ± s.e.	Range
12/3	–	46.0 ± 13.4	3.6 – 135
25/3	–	52.0 ± 9.7	17.3 – 105
31/3	–	31.1 ± 7.2	0.9 – 82.8
14/4	–	59.4 ± 16.6	2.1 – 183
28/4	850	46.8 ± 14.7	2.4 – 201
10/5	350	64.7 ± 21.6	1.7 – 213
19/5	1400	179 ± 60.4	0 – 667
24/5	–	131 ± 68.1	0.3 – 1007

Table 2: Faecal output of larvae in 3 groups of calves for the day before and for 7 days after treatment

Date	Faecal output of larvae (L_1/g faeces) mean ± s.e. Febantel	Ivermectin	Control
24/5	55 ± 33	230 ± 195	109 ± 75
25/5		Treatment	
26/5	105 ± 67	160 ± 90	73 ± 36
27/5	108 ± 66	279 ± 244	490 ± 453
28/5	32 ± 30	13 ± 12	176 ± 128
29/5	0	0.8 ± 0.6	619 ± 555
30/5	0	0.2 ± 0.1	441 ± 377
31/5	0.1	0	1422 ± 1332
1/6	0	0.2 ± 0.1	496 ± 301

Data for the numbers of worms present in the lungs of calves at slaughter are presented in Table 3. The control calves had an average of 219 live immature and 653 live adult lungworms. The calves dosed with febantel had an average of 32.8 live immature and 1.6 live adult lungworms, corresponding to drug efficiency of 85% and 99.8% against immatures and adults respectively. The calves injected with ivermectin had no detectable live lungworms, corresponding to a drug efficiency of 100% for both immatures and adults.

Table 3: Numbers of *D. viviparus* lungworms present in lungs of deer calves at slaughter 7 days after anthelmintic treatment ($n = 5$ deer/group)

	Febantel	Ivermectin	Control
Live lungworms			
Immature	32.8	0	219
Mature	1.6	0	653
Dead lungworms			
Immature	25	1	5.6
Mature	4.8	8.8	2
Drug efficiency %[1]			
Immature	85	100	–
Mature	99.8	100	–

[1] Mean reduction associated with treatment = $\frac{100\ (\text{control-treatment})}{\text{control}}$

Most calves reacted mildly to the injection of Ivomec or the vehicle by flinching or looking round quickly 2 or 3 seconds later. Mild subcutaneous swellings were detected at the injection sites the following day in most calves; however, the swellings were undetectable by 7 days after injection.

None of the calves showed any signs of clinical disease due to lungworm from the time of weaning to slaughter, and during this 11-week period they gained an average of 10 kg body weight.

Discussion

For accurate assessment of drug efficiency it is necessary to start with moderately heavy burdens of parasites. To achieve a high larval count the calves were exposed to a natural source of infection coupled with a programme of dosing with third-stage (L_3) larvae cultured from earlier faecal samples from the group of calves. Unfortunately, although they all received the same dose of L_3 larvae, some of the calves had developed some natural resistance to infection. Thus the larval output of the 4 calves with the lowest larval counts prior to larval dosing remained low. In contrast, in those calves with the highest larval counts prior to dosing outputs rose dramatically 3 weeks after the first dose of infective larvae, while the output of the calves with intermediate counts rose moderately. Consequently, it was necessary to stratify the random allocation of calves to treatment groups.

When lungworms collected from the calves at slaughter were examined, some were obviously

dead and degenerating, and some were being invaded by leucocytes. The death of these worms in the control calves was probably due to natural attrition and the effects of the host's natural defence mechanisms against immature and mature worms. Some of the dead worms in the treated calves may have resulted from the effects of the anthelmintics, although in these calves most of the worms had been eliminated by this time.

Of the 10 treated calves, 3 were still excreting larvae, albeit at very low levels, 7 days after treatment. One of these had 3 adult female lungworm in the lungs, but no live lungworms were recovered from the others. These very low counts must have resulted from eggs which were shed around the time of treatment which had experienced a long transit time from bronchus to rectum. This would suggest that *Dictyocaulus* eggs and first-stage larvae may be refractory to anthelmintic treatment.

Ivomec and the vehicle alone both caused minimal discomfort on injection and resulted in a mild subcutaneous swelling which resolved in less than 7 days. There was no evidence of abscess formation at the injection site as reported by Elliot and Julian (1981) in cattle treated with an ivermectin formulation.

In conclusion, febantel was highly effective against mature lungworms and moderately effective against immature lungworms. Ivermectin was completely effective against mature and immature lungworms.

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