Efficacy of levamisole pour-on compared with levamisole subcutaneous injection against *Dictyocaulus viviparus* infection in calves

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(Accepted for publication 8 August 1990)

ABSTRACT

Vanparijs O and Quick, J.M., 1991 Efficacy of levamisole pour-on compared with levamisole subcutaneous injection against *Dictyocaulus viviparus* infection in calves Vet Parasitol, 38 75-79

The efficacy of levamisole pour-on against *Dictyocaulus viviparus* was compared to that of subcutaneous levamisole injection. Eighteen calves were raised individually and artificially infected with *D. viviparus* larvae. Faecal samples were collected 27 and 28 days later and larvae per gram (l.p.g.) determined. The animals were then divided into three comparable groups. Group 1 animals remained untreated as controls, Group 2 animals received levamisole 10% w/v subcutaneous injection at a dose of 5 mg kg⁻¹ and Group 3 received levamisole pour-on 20% w/v at a rate of 10 mg kg⁻¹ applied transdermally.

Results of l.p.g. measurements from faecal samples taken 7 and 8 days post-treatment indicated a dramatic reduction in the worm burden of animals in both treatment groups. Necropsies at 14 days post-treatment revealed few adult worms in these groups, indicating a 99 and 98% kill rate for pour-on and subcutaneous injection, respectively.

INTRODUCTION

Levamisole pour-on is now widely used around the world for the prevention and treatment of cattle helminthiosis. It is the second most used cattle anthelmintic in the United Kingdom.

The bioequivalence of levamisole pour-on and levamisole injection at dose rates of 10 mg kg⁻¹ transdermally and 5 mg kg⁻¹ subcutaneously has been demonstrated (Michiels et al., 1984). Similarly the efficacy of levamisole pour-on, as well as being established in its own right, has been proven to be comparable to that of the subcutaneous injectable formulation (Bogan and Armour, 1981; Newcomb et al., 1983; Guerrero et al., 1984).
The incidence of lungworm (*Dictyocaulus viviparus*) disease in the U.K. has increased recently. Ministry of Agriculture Veterinary Investigation Diagnostic Analysis (VIDA) returns indicate 102 reports of clinical disease in 1988 compared with 88 during 1985 (J. Wilesmith, personal communication, 1990). There are two possible reasons for the apparent recent increases in incidence. First, the warm, wet summers of 1987 and 1988 have resulted in proliferation of the parasite, which can subsequently overwinter on the pasture. Second, there has been a 50% reduction in vaccination of young calves against lungworm infection over the last 4 years (Sly, 1989). Protection against lungworm infection therefore depends on an effective anthelmintic dosing strategy and pasture management.

The efficacy of Ripercol® pour-on against *Dictyocaulus viviparus* has recently been confirmed in a controlled study conducted in Belgium, and compared to that of levamisole subcutaneous injection.

**Materials and Methods**

*Animals and artificial infection*

Eighteen calves of mixed breeds, weighing about 150 kg, were purchased from local markets. Each was housed individually and the absence of lungworm was confirmed by coprological examination. The trial schedule is summarized in Table 1.

Each calf was artificially infected by gavage with 4000 L₃ *D. viviparus* larvae on Day 0. One calf died on Day 20 from acute dyspnoea resulting from infection. Faecal samples were collected from the remaining 17 calves on Days 27 and 28, once the infection had reached the patent phase. The mean number of larvae per gram (l.p.g.) of faeces was determined using the Baermann method (Ministry of Agriculture, Fisheries and Food, 1986). The calves were then allocated into groups of six, six and five animals, on the basis of infection level, to form three comparable groups.

*Anthelmintic treatment*

Group 1 (five calves) was left untreated and served as control. On Day 28 Group 2 was treated with levamisole 10% w/v subcutaneous injection (Ri-

<table>
<thead>
<tr>
<th>Day</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Artificial infection</td>
</tr>
<tr>
<td>27 28</td>
<td>Faecal sampling</td>
</tr>
<tr>
<td>28</td>
<td>Treatment (Groups 2 and 3)</td>
</tr>
<tr>
<td>35 36</td>
<td>Faecal sampling</td>
</tr>
<tr>
<td>42</td>
<td>Necropsy</td>
</tr>
</tbody>
</table>
percol® injection) at a dose rate of 5 mg kg⁻¹. Group 3 was treated with levamisole pour-on 20% w/v (Ripercol® pour-on) at a dose rate of 10 mg kg⁻¹ applied over a 6-inch area along the back between the pin bones.

*Clinical symptoms*

During the experimental period calves were observed for clinical signs of lungworm infection. Rectal temperatures and signs of local reactions at the site of the injection or pour-on administration were monitored daily.

*Faecal examinations and necropsies*

Two faecal samples were collected from each calf on Days 35 and 36 (7 and 8 days after treatment) and the mean l.p.g. determined. On Day 42 (14 days post-treatment) all calves were necropsied and the number of adult *D. viviparus* worms in the lungs was counted.

**RESULTS**

Results of the parasitological examinations are presented in Table 2.

*Deaths*

Two calves died in Group 1 (control) on Days 20 and 35, respectively, and were immediately necropsied. Both died as a direct result of the lungworm infection, which was evident by the number of adult *D. viviparus* present in the lungs. Necropsy of the first calf revealed extensive lesions of typical primary parasitic bronchitis with severe interstitial emphysema. The second calf, which died on Day 35, suffered acute pneumonia, showing severe alveolar and interstitial emphysema of the dorsal lobes and catarrhal to fibrous pneumonia of the apical and ventral part of the diaphragmatic lobes. One calf in Group 2 (subcutaneous injection) died on Day 35, also from acute pneumonia. No worms were discovered in the lungs of this calf, and the faecal larvae count was negative.

*Clinical symptoms*

Typical symptoms of lungworm infection – high respiratory rates and severe coughing – were evident in all calves until treatment at Day 28. On Day 21 after infection the temperatures of the calves were raised to between 39 and 40.8°C. By the end of the experiment temperatures were reduced to normal levels (38.3–39°C) in all groups. No local reactions were evident at the site of drug administration.
TABLE 2

Individual results of parasitological examinations of calves infected with *D. viviparus*

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean l.p.g Days 27 and 28</th>
<th>Mean l.p.g Days 35 and 36</th>
<th>No worms at necropsy Day 42</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls (Group 1)</td>
<td></td>
<td></td>
<td></td>
<td>Died on Day 35</td>
</tr>
<tr>
<td></td>
<td>279</td>
<td>1230&lt;sup&gt;1&lt;/sup&gt;</td>
<td>925&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>51</td>
<td>15</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>20</td>
<td>263&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Died on Day 20</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>21</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>19</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>74</td>
<td>259</td>
<td>213</td>
<td></td>
</tr>
<tr>
<td>Levamisole 5 mg kg&lt;sup&gt;-1&lt;/sup&gt; body weight subcutaneous (Group 2)</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>277</td>
<td>19</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>0&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Died on Day 35</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>76</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>66</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>% Reduction vs controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levamisole 10 mg kg&lt;sup&gt;-1&lt;/sup&gt; body weight transdermal (Group 3)</td>
<td>15</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>212</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>58</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>% Reduction vs controls</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<sup>1</sup>At Day 35 only  
<sup>2</sup>Necropsy on Day 35  
<sup>3</sup>Necropsy on Day 20  
<sup>4</sup>Necropsy at Day 35 only

**Faecal examinations**

The mean l.p.g. in Groups 1, 2 and 3 were comparable, yet variable, at the time of treatment. Within 7 to 8 days of dosing, animals in the treatment groups showed a dramatic reduction in l.p.g. (Table 2).

**Necropsy results**

The worm recovery at necropsy, 14 days post-treatment, also differed dramatically between the two treatment groups and the untreated control group.
(Table 2). These necropsy results indicated a 99 and 98% kill rate of adult *D. viviparous* for levamisole pour-on and subcutaneous injection, respectively.

**DISCUSSION**

The results of this trial indicate that the levamisole pour-on 20% w/v formulation was as efficacious as levamisole 10% w/v injectable in treating *D. viviparous* infections at dose rates of 10 mg kg\(^{-1}\) and 5 mg kg\(^{-1}\) body weight, respectively. This indication is evident from the reductions in l.p.g. at Days 7 and 8 post-treatment, when any eggs laid by adult worms surviving treatment would have developed into larvae. Similarly, necropsy at 42 days after initial infection and 14 days post-treatment revealed a minimal worm burden in the lungs of animals in both treatment groups. It is concluded that levamisole pour-on (Ripercol\textsuperscript{®} pour-on) is an effective drug for the treatment of lungworm infections.

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