Evaluation of control programmes for echinococcosis/hydatidosis in Cyprus

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Summary

In Cyprus, echinococcosis (Echinococcus granulosus) was an important public and animal health problem until the 1970s. In 1971, the Department of Veterinary Services instigated a control programme, which was based on an island model, using arecoline testing, euthanasia of positive dogs, control of dog breeding, elimination of stray dogs and control measures in slaughterhouses. The first programme ended in 1985 with excellent results and E. granulosus was considered to have been eradicated from both the definitive hosts (dogs) and the intermediate hosts (livestock). However, surveillance from 1985 to 1993 demonstrated that the life-cycle of E. granulosus was continuing at very low levels. Control measures were therefore reintroduced in 1993.

The second programme commenced in 1993 and was based on surveillance of intermediate hosts, control of infected flocks, and testing and treatment of owned and stray dogs in infected areas. A continental model was employed for the second programme, due to the division of the island in 1974. The experience gained from the two programmes is described.

Keywords

Introduction

Echinococcosis/hydatidosis (Echinococcus granulosus) was widespread in Cyprus before the 1970s. The disease heavily infected almost all intermediate hosts (i.e. cows, sheep and goats over two years of age) and was also a very serious public health problem. The annual surgical incidence rate was 12.9 per 100,000 inhabitants, one of the highest rates world-wide. The large number of stray dogs, the uncontrolled slaughter of animals and the disposal of infected offal in the vicinity of abattoirs or in fields, in addition to public ignorance of the disease, were the factors contributing to the perpetuation of the disease in Cyprus.

As a result of the seriousness of the disease, an echinococcosis control campaign was initiated by the Department of Veterinary Services in 1971. The principal measures included the following:
- control of stray dogs
- registration of all owned dogs
- spaying of bitches
- control of livestock slaughter
- arecoline testing of all dogs
- education of the public.

After the division of Cyprus in 1974, the 'island' control programme became a 'continental' programme, since Cyprus was divided into two areas. In the Government controlled areas, the programme continued, while in the occupied areas, control was abandoned. Active transmission of the disease continues and a very high incidence of disease is reported in humans and livestock in the occupied areas.
In contrast, the actively enforced measures in the Government controlled areas provided rapid results. By 1985, the parasite was considered to have been eradicated from both livestock and dogs, and the campaign was officially terminated in that year (8, 9).

For the first few years after 1985, sporadic cases of hydatid cysts, which were detected upon slaughter of livestock, were considered to have been due to animals smuggled from the non-Government controlled areas.

Subsequent studies commencing in 1989, revealed that the parasite was present in 79 villages, in either dogs or livestock or both, and control was reintroduced in 1993 in the 'consolidation' phase, with emphasis on surveillance of intermediate hosts, control of animal movement and treatment of dogs in 'infected' villages.

For the successful implementation of this phase, two principal problems had to be overcome, as follows:

a) the lack of a diagnostic test to detect dogs with a low burden of *Echinococcus* worms

b) the absence of a method to determine the length of time an animal had been infected.

To overcome these problems, the Veterinary Services of Cyprus, in co-operation with the Institute of Parasitology, University of Zurich, introduced the coproantigen enzyme-linked immunosorbent assay (ELISA), which has shown very promising results (1). Preliminary studies have been able to detect infected dogs as early as 8-10 days after infection. The specificity of the test is 98.8% and the sensitivity 90.9%, with low cross-reactivity with other *Taenia* spp. The detection of *Cysticercus tenuicollis* due to *Taenia hydatigena* during the slaughter of lambs and kids is considered as an 'early warning' which enables the instigation of measures against *Echinococcus* in the area from which the animals originated. The presence of these lesions indicates that dogs in the area of origin of the lambs and kids have access to raw offal of sheep or goats.

The present paper describes the experience gained in Cyprus in echinococcosis control and contributes to the understanding of the problems that may be encountered where eradication *sensu strictu* of *E. granulosus* is the objective.

### Materials and methods

From 1993, a detailed surveillance programme was undertaken at all slaughterhouses during meat inspection. Any cysts detected were sent to the Central Laboratory of the Department of Veterinary Services for confirmation of macroscopic diagnosis. Veterinarians visited the farms of immediate origin of the infected animals and case histories of all infected animals were obtained.

Dogs were tested for *E. granulosus* using arecoline hydrobromide at 2.5 mg/kg and treated with praziquantel at 5 mg/kg. The arecoline testing method used is the flotation technique as described by Le Riche and Jorgensen (7). This method detects worms or segments of *Taenia* present in the faeces of dogs.

Praziquantel baits were produced locally by incorporating two tablets of 50 mg praziquantel in a piece of cooked meat of size 3 x 3 cm. The buffer zone along the dividing line of Cyprus and infected areas where stray dogs roamed were covered with 20-25 baits per km$^2$.

Post-mortem examinations of stray dogs before the use of baits revealed severe infection with parasites. After the introduction of baits, a significant reduction of parasites was observed in stray dogs (Table I).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1997 Number of dogs examined</th>
<th>Percentage</th>
<th>1998 Number of dogs examined</th>
<th>Percentage</th>
<th>1999 Number of dogs examined</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsuitable for examination</td>
<td>4</td>
<td>13</td>
<td>3</td>
<td>10</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Negative for parasites</td>
<td>13</td>
<td>42</td>
<td>8</td>
<td>27</td>
<td>50</td>
<td>64</td>
</tr>
<tr>
<td>Ascarids</td>
<td>7</td>
<td>23</td>
<td>6</td>
<td>20</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Dipylidium</td>
<td>4</td>
<td>13</td>
<td>3</td>
<td>10</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Ascarids + Dipylidium</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><em>Taenia hydatigena</em></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Ascarids + <em>Taenia hydatigena</em></td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>13</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dipylidium + <em>Taenia hydatigena</em></td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Echinococcus granulosus</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total number of dogs examined</td>
<td>31</td>
<td></td>
<td>30</td>
<td></td>
<td>78</td>
<td></td>
</tr>
</tbody>
</table>
Results

After 1985, sporadic reports of livestock with hydatid cysts which were detected upon slaughter were considered to have been due to livestock smuggled from the non-Government controlled area. However, evidence was obtained that echinococcosis was being transmitted between dogs and livestock within the Government controlled area (Table II).

### Table II

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Sheep</td>
<td>22</td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>42</td>
</tr>
<tr>
<td>Goats</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Pigs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>13</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>58</td>
</tr>
</tbody>
</table>

Infected villages 11 7 2 1 4 2 4 22

Transmission between dogs and livestock

Table III presents the number of dogs found infected from 1993-1999. In May 1993, 2,391 dogs from 48 villages, where infected animals were found, were tested by arecoline and 16 were found to be infected with *E. granulosus*. These dogs originated from eight villages, six of which were in Nicosia district and two of which were remote villages in Paphos district, situated far from the non-Government controlled area. The general arecoline testing was reintroduced in March 1994 and revealed 6 out of 7,440 dogs examined to be infected with *E. granulosus*. Two dogs originated from Nicosia district, one from Limassol, one from Paphos and one from Larnaca district.

In 1995, no surveys were undertaken with arecoline hydrobromide, but in 1996, 700 dogs from 70 villages were tested using the coproantigen ELISA for *E. granulosus*, resulting in one positive reaction (4, 5). During 1997 and 1998, 4,858 dogs were tested with coproantigen ELISA and none were positive for *E. granulosus*. In addition, during the same period, 61 stray dogs were necropsied in the laboratory and none were found to be infected. During 1999, no coproantigen ELISA or arecoline hydrobromide surveys were performed, but on post-mortem examination of 78 stray dogs, none were found to be infected. From 1993 to 1999, *E. granulosus* infection was detected in 23 dogs from 11 villages (Fig. 1).

### Transmission between dogs and livestock

Table III shows the number of livestock found to be infected during slaughter, from 1993 to 1999. Overall, between 1993 and 1999 inclusive, infection with *E. granulosus* was detected in one or more animals in 79 villages (Fig. 2) This comprised

### Table III

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of dogs tested</td>
<td>2,391</td>
<td>7,440</td>
<td>-</td>
<td>706</td>
<td>3,106</td>
<td>1,613</td>
<td>78</td>
<td>15,528</td>
</tr>
<tr>
<td>Number of dogs infected</td>
<td>16</td>
<td>6</td>
<td>-</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
</tr>
</tbody>
</table>

* stray dogs euthanised and subjected to post-mortem examination
Table IV
Slaughter surveillance: number of intermediate hosts infected with *Echinococcus granulosus* (1993-1999)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Animals infected (examined)</td>
<td>Animals infected (examined)</td>
<td>Animals infected (examined)</td>
<td>Animals infected (examined)</td>
<td>Animals infected (examined)</td>
<td>Animals infected (examined)</td>
<td>Animals infected (examined)</td>
</tr>
<tr>
<td>Cattle</td>
<td>16 (14,366)</td>
<td>13 (14,747)</td>
<td>6 (16,444)</td>
<td>3 (16,226)</td>
<td>3 (21,245)</td>
<td>4 (17,776)</td>
<td>2 (17,424)</td>
</tr>
<tr>
<td>Sheep</td>
<td>42 (148,407)</td>
<td>52 (156,152)</td>
<td>39 (153,317)</td>
<td>12 (146,533)</td>
<td>9 (150,598)</td>
<td>9 (146,415)</td>
<td>10 (132,203)</td>
</tr>
<tr>
<td>Goats</td>
<td>0 (140,041)</td>
<td>16 (142,735)</td>
<td>8 (146,233)</td>
<td>1 (149,522)</td>
<td>0 (180,105)</td>
<td>5 (154,803)</td>
<td>1 (156,876)</td>
</tr>
<tr>
<td>Pigs</td>
<td>0 (498,752)</td>
<td>0 (546,315)</td>
<td>0 (554,372)</td>
<td>0 (565,019)</td>
<td>0 (563,519)</td>
<td>0 (577,232)</td>
<td>0 (592,885)</td>
</tr>
<tr>
<td>Total</td>
<td>58 (801,566)</td>
<td>81 (859,949)</td>
<td>53 (870,366)</td>
<td>16 (880,701)</td>
<td>12 (895,471)</td>
<td>18 (896,228)</td>
<td>13 (889,368)</td>
</tr>
</tbody>
</table>

47 cattle, 173 sheep and 31 goats aged between 5 and 10 years. In 1993, strong evidence was obtained that some transmission was autochthonous, as 16 dairy cattle from 11 farms in 8 villages were infected with cysts of *E. granulosus*. All of the infected cattle were born and raised on the farms in question.

Due to distance from the non-Government controlled area and/or location at birth, some infections may be considered as autochthonous, rather than involving transmission through animals smuggled from occupied areas (2).

The percentage of infection (based upon the total number of animals slaughtered) is detailed in Table V. Comparing percentage infection levels in 1994 and 1999 demonstrates that the disease was controlled and incidence dropped significantly in all species (from 0.088% to 0.011% in cattle, from 0.033% to 0.007% in sheep and from 0.0112% to 0.0006% in goats) (Fig. 3).

### Transmission between dogs and humans

A survey of the cases of cystic echinococcosis treated in Government hospitals between 1980 and 1994 revealed that 122 patients were operated for cystic echinococcosis during this period (S. Demetriou and A. Nouska, unpublished findings). A study undertaken in 1994 demonstrated that between 1990 and 1993, no cases of cystic echinococcosis were reported in humans under the age of twenty in the areas controlled by the Government, although in the occupied areas, three cases were recorded in patients under this age (M.A. Gemmell, unpublished findings). This implies that the cases observed in the general survey were mainly latent infections and that transmission between dogs and humans ceased in the Government controlled area of Cyprus shortly after the introduction of control. However, in the occupied areas, the disease is very common and has reached worrying proportions (Table VI). More data regarding the disease in humans and livestock in the non-Government controlled areas are presented below. Figure 4 shows the number of operations performed in both areas from 1969 to 1998.

Table V
Percentage of infection with *Echinococcus granulosus* in livestock (1994-1999)

<table>
<thead>
<tr>
<th>Year</th>
<th>Slaughtered</th>
<th>Infected</th>
<th>Percentage infection</th>
<th>Slaughtered</th>
<th>Infected</th>
<th>Percentage infection</th>
<th>Slaughtered</th>
<th>Infected</th>
<th>Percentage infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>14,747</td>
<td>13</td>
<td>0.086</td>
<td>158,152</td>
<td>32</td>
<td>0.033</td>
<td>142,735</td>
<td>16</td>
<td>0.0112</td>
</tr>
<tr>
<td>1995</td>
<td>16,714</td>
<td>6</td>
<td>0.036</td>
<td>153,317</td>
<td>39</td>
<td>0.025</td>
<td>146,243</td>
<td>8</td>
<td>0.0055</td>
</tr>
<tr>
<td>1996</td>
<td>16,228</td>
<td>3</td>
<td>0.018</td>
<td>149,833</td>
<td>12</td>
<td>0.006</td>
<td>148,522</td>
<td>1</td>
<td>0.0007</td>
</tr>
<tr>
<td>1997</td>
<td>21,245</td>
<td>3</td>
<td>0.014</td>
<td>150,598</td>
<td>9</td>
<td>0.006</td>
<td>160,109</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1998</td>
<td>17,776</td>
<td>4</td>
<td>0.022</td>
<td>146,415</td>
<td>9</td>
<td>0.006</td>
<td>154,803</td>
<td>5</td>
<td>0.0032</td>
</tr>
<tr>
<td>1999</td>
<td>17,424</td>
<td>2</td>
<td>0.011</td>
<td>132,203</td>
<td>10</td>
<td>0.007</td>
<td>156,876</td>
<td>1</td>
<td>0.0009</td>
</tr>
<tr>
<td>Total</td>
<td>104,134</td>
<td>31</td>
<td>0.030</td>
<td>885,618</td>
<td>131</td>
<td>0.015</td>
<td>909,288</td>
<td>31</td>
<td>0.0034</td>
</tr>
</tbody>
</table>
Table VI
Number of Turkish Cypriots operated for *Echinococcus granulosus* cysts (1990-1998)

<table>
<thead>
<tr>
<th>Year</th>
<th>Operations (per 100,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>8.5</td>
</tr>
<tr>
<td>1991</td>
<td>8.5</td>
</tr>
<tr>
<td>1992</td>
<td>4.5</td>
</tr>
<tr>
<td>1993</td>
<td>5</td>
</tr>
<tr>
<td>1994</td>
<td>3.5</td>
</tr>
<tr>
<td>1995</td>
<td>5</td>
</tr>
<tr>
<td>1996</td>
<td>5</td>
</tr>
<tr>
<td>1997</td>
<td>8</td>
</tr>
<tr>
<td>1998</td>
<td>8</td>
</tr>
</tbody>
</table>

Echinococcosis in the non-Government controlled areas

Echinococcosis in the non-Government controlled areas is very serious in both animals and humans. For many years, no control programmes have been implemented and the problem continues.

The incidence of echinococcosis in livestock is presented in Table VII. The level of infection reached 90.65% in adult sheep (1994) and 58.25% in cattle (1997). This high incidence is due to the lack of control of stray dogs and of slaughter of animals. Slaughterhouses exist in only 19 out of 28 'municipalities' and veterinary supervision is present in only 11 of these.

Regarding the incidence in humans, the surgical cases reported in Turkish Cypriots are presented in Table VI. One case in 1997 concerned a child of 10 years old and this indicates the seriousness of the problem. In 1995, 40 people travelled abroad for surgical operations of hydatid disease, in addition to those operated locally.

**Discussion and conclusion**

**Evidence for autochthonous transmission**

In the area controlled by the Government of the Republic of Cyprus, *E. granulosus* was driven almost to extinction by determined control of dogs, arecoline testing and euthanasia of positive dogs in the 'attack' phase. This continued from 1971 to 1985, when transmission between dogs and livestock appeared to have ceased. This experience underlines that definite confirmation of eradication is almost impossible and affirms the need to enter an indefinite consolidation phase before and immediately after the attack phase has been completed.

Difficulties have arisen in determining the degree to which transmission resulted from smuggling of animals from the non-Government control area, as opposed to a recrudescence from minor endemic sites overlooked when the parasite was considered to have been eradicated in 1985. Cases reported far from the border with the occupied area were probably autochthonous.
Reintroduction of control

To limit any recurrence of transmission due either to smuggling or autochthonous infections, the Department of Veterinary Services reintroduced control in 1993, using the concept that control in the consolidation phase should follow a successful attack phase. As a general principle, this phase retains the following:

- registration of owned dogs
- control, but not necessarily euthanasia, of stray dogs
- treatment of imported dogs with praziquantel
- regular use of praziquantel baits for the treatment of stray dogs in areas adjacent to the infected areas
- prevention of smuggling of animals from the non-Government controlled areas
- burial or safe destruction of carcasses or offal of livestock
- safe slaughter and inspection for echinococcosis or *T. hydatigena* cysts
- continuing health education.

The principal measure applied in the consolidation phase is surveillance of all livestock in slaughtering establishments with 'trace-back' or, where appropriate, 'trace-forward' of infected animals to or from the site of origin. A village is designated as an infected area where an infected dog or food animal with either *E. granulosus* or *T. hydatigena* is found on any individual premises.

Great significance is attributed to *T. hydatigena* lesions found in the livers of lambs and kids during meat inspection. These lesions develop 3-4 weeks after infection with *T. hydatigena* ova from infected dogs, while the *E. granulosus* cysts require 15-16 months to become macroscopically visible. Considering that an infected dog can infect approximately 2,700 food animals per day, the lesions of *T. hydatigena* produced in the livers of lambs and kids serve as an important 'early warning' for the detection of dogs fed on raw offal.

Additional measures applied in infected villages include the following:

- treatment of all dogs with praziquantel two to three times per year
- strict control of stray dogs
- movement control of dogs and livestock
- prosecution for illegal slaughtering
- the use of praziquantel baits for treatment of stray dogs or foxes in infected areas
- the use of arecoline or coproantigen testing to identify individual infected dogs.

The necropsy of stray dogs from infected villages or areas and examination for worms in these animals is considered to be the most reliable indicator of the presence of echinococcosis. In the consolidation phase, this measure may be of limited value as almost all infections will consist of very few worms. If used, this measure does not reduce the need to treat all dogs in the controlled area with praziquantel.

Release from quarantine may be considered for individual premises in an infected area if no further evidence of infection with *E. granulosus* or *T. hydatigena* is detected in livestock for at least three years (2).

Transmission of echinococcosis from the occupied area to the Government controlled area

The high incidence of the disease in the non-Government controlled areas is a cause of concern, and measures must be applied on a continuous basis to prevent transmission into the Government controlled areas.

Transmission is believed to occur in the following ways:

- movement of dogs from the occupied to the free areas
- smuggling of infected livestock into the free areas
- smuggling of contaminated animal fodder
- air-borne or insect transmission.
Table VIII
Number of *Echinococcus granulosus* cysts in infected animals (cattle, sheep and goats)

<table>
<thead>
<tr>
<th>Year</th>
<th>Animals with 1-2 cysts</th>
<th>Percentage infection</th>
<th>Animals with 3-5 cysts</th>
<th>Percentage infection</th>
<th>Animals with more than 6 cysts</th>
<th>Percentage infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>16</td>
<td>27.6</td>
<td>15</td>
<td>25.9</td>
<td>27</td>
<td>46.5</td>
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<tr>
<td>1994</td>
<td>27</td>
<td>33.3</td>
<td>16</td>
<td>19.8</td>
<td>36</td>
<td>46.9</td>
</tr>
<tr>
<td>1995</td>
<td>33</td>
<td>62.3</td>
<td>3</td>
<td>5.5</td>
<td>17</td>
<td>32.1</td>
</tr>
<tr>
<td>1996</td>
<td>9</td>
<td>52.9</td>
<td>4</td>
<td>23.6</td>
<td>4</td>
<td>23.55</td>
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<tr>
<td>1997</td>
<td>4</td>
<td>30.8</td>
<td>2</td>
<td>15.4</td>
<td>7</td>
<td>53.8</td>
</tr>
<tr>
<td>1998</td>
<td>8</td>
<td>42.1</td>
<td>4</td>
<td>21.0</td>
<td>7</td>
<td>36.9</td>
</tr>
<tr>
<td>1999</td>
<td>6</td>
<td>46.2</td>
<td>0</td>
<td>0.0</td>
<td>7</td>
<td>53.9</td>
</tr>
</tbody>
</table>

Gemnell *et al.* note that, at the near-eradication level, infection with *E. granulosus* occurs in individual animals in 'storms' of massive cyst infection, because immunity is low (6). However, this was not the experience in Cyprus.

From the analysis of epidemiological information collected from 1993 to 1999, the majority of the infected sheep with more than six hydatid cysts are thought to originate from the non-Government controlled area.

In 1995 and 1996, of the animals found to be infected, 62.3% and 52.9% respectively, were harbouring 1-2 cysts (Table VIII). These animals were kept in villages situated near the occupied areas. These findings strongly suggest that air-borne or insect transmission of the disease may occur from the occupied to the free areas of the country.

The main measures applied for the prevention and control of transmission of echinococcosis to the Government controlled areas are as follows:
- control of stray dogs
- use of praziquantel baits for the treatment of stray dogs in the areas neighbouring the occupied zone
- prohibition of movement of animals from the occupied areas
- control of smuggling of animals and animal fodder.

**A permanent consolidation phase**

A major contribution of the present programme in Cyprus to the understanding and planning of control programmes has been to demonstrate that determination of whether eradication *sensu strictu* has been achieved is not simple. Unless a direct transfer is made from diagnosis or treatment of dogs for *E. granulosus* in the costly attack phase, to surveillance and control of movement of animals in the more cost-effective consolidation phase, transmission may gradually recur. Once established, the consolidation phase must be regarded as permanent if animal movement across borders cannot be excluded, as is the case in continental control programmes. The 'maintenance of eradication' phase can only be instigated if the consolidation phase can be reached over the entire island of Cyprus. Even in this case, vigilance would have to be maintained against reintroduction for many years (3).

The planning of a consolidation phase appears to be more complicated than the attack phase, as many experiences have been reported, not only in Cyprus, but also in other countries, such as New Zealand, Tasmania, the Falkland Islands (Islas Malvinas), etc. The consolidation phase is prolonged, but knowledge of this phase is lacking, especially in 'continental' programmes.

Observations and experiences show that slaughterhouse monitoring for *Cysticercus tenuicollis* and testing and treatment of stray dogs with praziquantel baits are extremely useful tools for the early detection and control of new cases of echinococcosis during the consolidation phase of an echinococcosis control programme.
Évaluation des programmes de lutte contre l'échinococcose/hydatidose à Chypre

P. Economides & G. Christofi

Résumé
A Chypre, l'échinococcose (Echinococcus granulosus) a constitué un grave problème de santé publique et de santé animale jusqu'aux années 1970. En 1971, la Direction des Services vétérinaires a lancé un programme de prophylaxie, fondé sur un modèle insulaire, comportant des tests à l'arécoline, le sacrifice des chiens parasités, le contrôle de la reproduction canine, l'élimination des chiens errants et des mesures de prévention dans les abattoirs.

Ce premier programme, qui a pris fin en 1985, a donné d'excellents résultats: l'éradication de E. granulosus a été considérée comme achevée chez les hôtes définitifs (chiens) du parasite, ainsi que chez les hôtes intermédiaires (bétail). Cependant, le programme de surveillance mis en œuvre entre 1985 et 1993 a montré la persistance d'un cycle de E. granulosus, à des niveaux très faibles. Des mesures de prophylaxie ont, dès lors, été réintroduites en 1993.

Le second programme, lancé en 1993, était fondé sur la surveillance des hôtes intermédiaires, le contrôle des élevages atteints ainsi que le dépistage et le traitement de tous les chiens, errants ou de compagnie, dans les zones infestées. Un modèle continental a été retenu pour le second programme, en raison de la partition de l'île en 1974. Les auteurs décrivent l'expérience acquise grâce à ces deux programmes.

Mots-clés
Chiens - Chypre - Echinococcose - Echinococcus granulosus - Éradication - Prophylaxie - Taenia hydatigena.

Evaluación de programas de lucha contra la equinococosis/hidatidosis en Chipre

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Resumen
En Chipre, la equinococosis (Echinococcus granulosus) constituyó hasta los años setenta un importante problema de salud pública y animal. En 1971, la Dirección de Servicios Veterinarios impulsó un programa de control de la enfermedad basado en un modelo insular, con uso de pruebas de arecolina, sacrificio de los perros afectados, control de la criba canina, eliminación de perros callejeros y medidas de control en los mataderos.

El primer programa concluyó en 1985 con excelentes resultados, de tal manera que Echinococcus granulosus se consideró erradicado tanto de su huésped definitivo (el perro) como de los huéspedes intermedios (ganado bovino). Sin embargo, las actividades de vigilancia realizadas entre 1985 y 1993 pusieron de manifiesto que E. granulosus seguía manteniendo su ciclo vital a niveles muy bajos. De ahí que en 1993 empezaran a aplicarse de nuevo medidas de control. En 1993 dio comienzo el segundo programa, basado en la vigilancia de los huéspedes intermedios, el control de rebaños infectados y el análisis y tratamiento de perros (tanto callejeros como de compañía) en las zonas...
infectadas. Debido a la división de la isla en 1974, para este segundo programa se utilizó un modelo adaptado a condiciones continentales. Los autores describen las enseñanzas obtenidas con la aplicación de esos dos programas.

**Palabras clave**

**References**


