ANGIOSTRONGYLUS INFECTIONS IN RATS AND SNAILS
IN NORTHEAST THAILAND

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Abstract. A survey of Angiostrongylus infections in rats and snails was carried out in the provinces of Ubon Ratchathani, Udon Thani, Kalasin, Chaiyaphum and Khon Kaen in northeast Thailand. Only two Rattus norvegicus (3.8%) and one Bandicota indica (1.4%) out of 151 R. rattus, 52 R. norvegicus and 69 B. indica examined were infected with adult lung worms. All worms recovered were A. cantonensis. Prevalence of infection in 423 Pila polita was 0.9% while all of 77 P. ampullacea were negative for larvae. In contrast to this 36.4% of 500 Achatina fulica harbored L₃ of Angiostrongylus (with variations of between 29% and 46% in the five provinces). The average infection intensity in A. fulica was 13.6 L₃ (1 to 441). Experimental infection of Wistar rats with L₃ (isolated from A. fulica resulted in a recovery rate of 48.3% of adult worms of which 9.7% and 8.3% were identified as A. cantonensis and A. malaysiensis, respectively. This is the first proven finding of A. malaysiensis in northeast Thailand.

INTRODUCTION

Among the 20 species of the nematode genus Angiostrongylus described so far (Bhaibulaya, 1991), three are known to occur in Thailand. The most important is A. cantonensis, the larvae of which are the causative agents of human eosinophilic meningoencephalitis. The distribution of this species covers all parts of the country. This is different with the other two representatives of the genus in Thailand: A. malaysiensis, a sibling species of A. cantonensis, was found only in the central and western regions (Bhaibulaya and Techasoponmani, 1972; Jeradit, 1977), whereas A. siamensis is known only from Nakhon Nayok Province (Kamiya et al, 1979; Ohbayashi et al, 1979, 1983; Ohbayashi, 1988).

The main definitive hosts of all three species are Muridae of the genera Rattus and Bandicota. The adult worms live either in the lung arteries and right ventricle (A. cantonensis, A. malaysiensis) or are located in the mesenteric arteries (A. siamensis) of their hosts.

Several species of fresh water and land snails serve as intermediate hosts for A. cantonensis and A. malaysiensis with Achatina fulica as the most important for the maintenance of the parasites’ life cycles and with apple snails of the genus Pila as the most important sources of human infection. The intermediate hosts of A. siamensis are not known yet.

The northeast of Thailand shows the highest incidence of human eosinophilic meningoencephalitis within the country (Punyagupta et al, 1970). Results on A. cantonensis infections of definitive and/or intermediate hosts are available for 15 of the former 17 provinces (Harinasuta et al, 1965, 1970; Crook et al, 1968; Punyagupta et al, 1970; Jeradit, 1977; Panha, 1988), however nothing is yet known about the role A. fulica may play there in the epidemiology of the parasite and whether or not A. malaysiensis and A. siamensis also occur in this region. To close this deficit a field survey was carried out in five provinces of the northeast.
MATERIALS AND METHODS

The following five provinces were chosen randomly: Ubon Ratchathani, Udon Thani, Kalasin, Chaiyaphum and Khon Kaen. In each of these provinces 100 Pila spp and about 50 to 60 rodents were sampled. Snails were digested by pepsin-HCl and Angiostrongylus larvae (L3) suspended in 0.85% NaCl and counted. Rats were dissected, their lung arteries, right ventricle and mesenteric arteries inspected, adult worms removed and identified under the microscope. Identification of L3 isolated from A. fulica, was carried out by infecting five Wistar rats each for isolates from the five provinces by oral application (stomach tube) of 20 larvae per rat. Dissection of rats was performed six weeks after infection using the same procedures as with the naturally infected rodents.

RESULTS

Infection in rats

Altogether 272 rats (151 Rattus rattus, 52 R. norvegicus, 69 Bandicota indica) were examined for Angiostrongylus infections (Table 1). The prevalence was very low (Fig 1) as only 2 R. norvegicus (3.8%) and 1 B. indica (1.4%) carried adult worms, all being A. cantonensis. The same is true for the infection intensity. One R. norvegicus from Ubon Ratchathani harbored 4 males and 4 females of the parasite, another from Khon Kaen 2 males and 1 female, while in the single B. indica from Udon Thani only one female worm was found.

Infection in snails

Of 500 Pila snails examined only 4 out of 423 P. polita (0.9%) contained third-stage larvae (L3), whereas all of 77 Pampaclacea were negative for L3 (Table 2).

In A. fulica prevalence was much higher with an average of 36.4%. There were variations between the five provinces (Table 2, Fig 1), prevalence in Khon Kaen (29%) being significantly lower (p<0.05) if compared to Chaiyaphum (46%) and Ubon Ratchathani (44%). The infection intensity in A. fulica varied between 1 and 441 L3 with an average of 13.6 larvae per snail (m = 0.78). There was no direct correlation between size of the snail and infection intensity. The number of larvae found correlated well with the number of snails in the respective size class (r = 0.945; Fig 2). There is no evidence of older snails accumulating higher numbers of L3.

Experimental infection of rats

Of the 25 rats infected experimentally 20 survived until dissection took place six weeks p.i. Altogether 193 adult Angiostrongylus (84 males, 109 females) were recovered (recovery rate = 48.25%). Of these, 177 worms were identified as A. cantonensis (77 males, 100 females) and 16 as A. malaysiensis (7 males, 9 females). The latter species was detected only in rats which infected with larvae isolated from A. fulica collected in Khon Kaen. All of these rats showed mixed infections of both Angiostrongylus species.

DISCUSSION

The occurrence of A. malaysiensis in northeastern Thailand has been established for the first time. A. malaysiensis was discovered in Peninsular Malaysia (Bhaibulaya and Cross, 1971), where it has a wide distribution (Lim and Ramachandran, 1979; Lim and Mak, 1983). Later it was also found in western and central Thailand (Bhaibulaya and Techasoponmani, 1972; Jeradit, 1977), Indonesia (Carney and Stafford, 1979) and Japan (Makiya and Sawabe, 1992). One can therefore assume that its distribution includes other parts of Southeast and East Asia. Prior to the discovery of A. malaysiensis, adults of the genus Angiostrongylus which were found in the lung arteries and the right ventricle of rats and larvae which were isolated from snails were thought to be solely A. cantonensis. Most probably this was not the case. Consequently, results published before 1971 have to be revised and the diagnosis “A. cantonensis” be replaced by “A. cantonensis” and/or “A. malaysiensis”.

If compared with surveys carried out 25 to 30 years ago (Harinasuta et al, 1965, 1970; Crook et al, 1968), our study exhibits a much lower prevalence in the definitive hosts. However, infections in apple snails of the genus Pila conform roughly to the results of other authors (Harinasuta et al, 1965, 1970; Crook et al 1968, Punyagupta et al, 1970; Jeradit, 1977). Up to 1977 an average of 1.4% of P. polita harbored Angiostrongylus larvae, while in our own findings the prevalence in this species came to 0.95%.
Table 1

_Angiostrongylus cantonensis_ infection in rodents in five provinces of Northeast Thailand.

<table>
<thead>
<tr>
<th>Province</th>
<th>Rattus rattus</th>
<th>Rattus norvegicus</th>
<th>Bandicota indica</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. exam</td>
<td>No. pos</td>
<td>No. exam</td>
<td>No. pos</td>
</tr>
<tr>
<td>Ubon Ratchathani</td>
<td>16</td>
<td>0</td>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>Udon Thani</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Kalasin</td>
<td>43</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Chaiyaphum</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Khon Kaen</td>
<td>37</td>
<td>0</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>151</td>
<td>0</td>
<td>52</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2

_Angiostrongylus_ infection in snails in five provinces of Northeast Thailand.

<table>
<thead>
<tr>
<th>Province</th>
<th>Pila polita</th>
<th>Pila ampullacea</th>
<th>Achatina fulica</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. exam</td>
<td>No. pos</td>
<td>No. exam</td>
</tr>
<tr>
<td>Ubon Ratchathani</td>
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<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Udon Thani</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kalasin</td>
<td>100</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chaiyaphum</td>
<td>54</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>Khon Kaen</td>
<td>69</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>423</td>
<td>4</td>
<td>77</td>
</tr>
</tbody>
</table>

Fig 1 - _Angiostrongylus_ infection (%) in rats and snails in five provinces of northeast Thailand.

Fig 2 - Percentage distribution of 500 _Achatina fulica_ according to size (mm) and of 2,482 _Angiostrongylus_ larvae (L3) in these snails.
With regard to *A. fulica*, this snail species has not been examined before in northeast Thailand. Our results now show that since its spread into this region, it has become an important intermediate host of *Angiostrongylus* with an average prevalence of 36.4%. Furthermore, it carries L. not only of *A. cantonensis* but also of *A. malaysiensis*. In prevalence it is only surpassed by *Hemiplecta distincta* with 67 out of 137 (= 48.9%) found infected in the five provinces concerned (Panha, 1988). Thus, *A. fulica* and *H. distincta* have to be considered as most important for the maintenance of the life cycle of *Angiostrongylus* in northeast Thailand.

REFERENCES


Jeradit C. Comparative studies on *Angiostrongylus malaysiensis* and *Angiostrongylus cantonensis*. 1. Prevalence in rodents and snails. 2. Development in the snail intermediate host: Bangkok, Faculty of Tropical Medicine Mahidol University. 1977. MSc Thesis.


