THE DISTRIBUTION OF ANGIOSTRONGYLUS CANTONENSIS (CHEN) IN THE CENTRAL NERVOUS SYSTEM OF LABORATORY RATS

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Abstract. The distribution of preadult Angiostrongylus cantonensis helminths in various regions of the central nervous system of rats, infected with varying doses of larvae, was studied. A dose of 10,000 larvae proved to be lethal; the rats showed paralytic symptoms and loss of vision prior to death. A very low dose of 15 larvae also proved to be infective to the central nervous system. Incidence of eye involvement was observed in two rats receiving a dose of 50 larva. Maximum number of helminths were recovered from the cerebral hemisphere region but their involvement per unit weight of the tissue was found to be highest in the region of medulla oblongata.

Angiostrongylus cantonensis (Chen) Dougherty,*) a metastrongyloid lungworm of rats, was first recovered from the brain of man in Hawaii in the year 1961 (Rosen et al. 1962). Since then this has become principal suspect in the search for the etiologic agent of eosinophilic meningitis in human beings in the Pacific area (Bailey 1948, Franco et al. 1960, Rosen et al. 1961). This neutropic parasite requires a period of development in the central nervous system of the definitive host, rat, and behaves similarly in man, an accidental host (Cross 1979). It has been demonstrated in experimental per os infection of A. cantonensis in rats that the larva migrate through the stomach, intestine, circulatory system and then reach the brain where they attain the preadult stage of development (Mackerras and Sandars 1955). In man, partial loss of vision due to Angiostrongylus infection has been reported from Thailand (Promminda roj et al. 1962). The following observations on the behaviour of A. cantonensis larvae in the central nervous system of rats may be of value in suggesting their probable role in ocular invasion and their distribution in the central nervous system of man.

MATERIAL AND METHODS

Infected larvae of Angiostrongylus cantonensis were recovered from the slugs (Laricea Risae alfa fennanea) collected from Bombay City. The slugs were thoroughly washed, homogenized and the larvae were obtained by pepsin digestion using Berrmann apparatus (Cross 1979). The larvae were then counted by the dilution method of Scott (1928).

A batch of eighteen albino rats of either sex, weighing 45 g, were used for the experimental infection. In order to observe the clinical symptoms two more rats were given a heavy dose of 10,000 larvae per rat.

All the surviving rats were sacrificed 21 days post infection. Various regions of the central nervous system (olfactory lobes, cerebral hemispheres, cerebellum, medulla oblongata and spinal cord) were examined separately. In addition to these regions, eye-balls were also examined. Examination and counting of worms in the olfactory lobes, eyeballs and spinal cord were made by pressing the tissue individually between two glass slides under low magnification as described by Burren (1971). Isolation of helminths from the cerebral hemispheres, cerebellum and medulla oblongata was per-

*) In his revision of Angiostrongylinae, Chabaud (Ann. paras. hum. comp. 47: 735—744, 1972) placed this species in the genus Parasstrongylus Baylis, 1928. The commonly spread name is used in this paper.
formed by digesting them separately in artificial gastric juice (Soh 1958) for four hours. Average weight of each region of the brain before putting for digestion was taken to calculate the number of worms per unit weight of the tissue.

**RESULTS**

All the rats survived the infection for the period of the experiment except the two receiving a very heavy dose of 10,000 larvae. These rats could survive only for a period of 6 days after infection. They manifested symptoms of paralysis, loss of sense, heavy body weight loss and blindness. Contrary to expectation, the paralyzed rats (10,000 larval dose) had no helminth in their eye balls or CNS and those rats which survived for 21 days showed the predominance of preadult helminths throughout the CNS. The overall helminth recovery progressively increased from the low (15 larvae) only up to the normal (100 larvae) dose of infection but it decreased as the dose of infection further increased (Fig. 1). In rats receiving normal dose (100 larvae), the maximum total percent helminth recovery (47%) was made from CNS and eye balls, it included cerebral hemisphere (31%), medulla oblongata (9%), cerebral (6%) and spinal cord (1%) regions (Table 1). The helminths were found in greatest number in the cerebral hemisphere. The helminth yield per unit weight of the medulla oblongata was, however, higher almost at all doses of infection (Table 2).

The presence of helminths in the right eye ball was noticed only in two rats; one male helminth in each individual infected with 500 larval dose was retrieved.

**DISCUSSION**

The present studies indicate that *Angiostrongylus cantonensis* invade all the regions of the central nervous system and occasionally eye balls. Since each part of the central nervous system is responsible for carrying out specific functions, experimental evidence of invasion of all the parts by the parasite reflects significantly on the clinical symptoms exhibited in human infection. In our studies, rats given a lethal dose of 10,000 larvae showed paralytic symptom and loss of vision prior to death that could be postulated to occur due to a blockage caused by the larvae in the blood circulation to the CNS. The neuropathology of human angiostrongyliasis reveals both arterial and venous dilatation in the subarachnoid space (Cross 1979). The ocular involvement did not reveal the exact route of entrance of the helminth into the eye. They probably entered through the arterial system as suggested by Irvine and Irvine (1950) for *Toxocara canis* larvae. According to Sprent (1955), in the rats, the reduction in the *T. canis* larvae from the brain subsequently was attributed to their having left the region via the meninges and ventricular spaces. Although the cerebral hemisphere showed maximum number of helminth yield for all the doses, the medulla oblongata was also affected by helminths per unit weight of the tissue. This suggests that the parasite has an affinity for the medulla oblongata region of the CNS. The nematodes like *Toxocara canis* and *Angiostrongylus cantonensis* have also shown a similar predilection for the cerebellum and cerebral hemisphere respectively when infected in mice (Burren 1971, Bhopale and Johri 1978).

**Table 2. Average number of preadult helminths recovered from the central nervous system of rats per unit weight of the tissue**

<table>
<thead>
<tr>
<th>Site</th>
<th>Average number of helminths recovered/gg. wt. of the tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low dose 15</td>
</tr>
<tr>
<td>Eye balls</td>
<td>0.005</td>
</tr>
<tr>
<td>Olfactory lobes</td>
<td>0.033</td>
</tr>
<tr>
<td>Cerebral hemispheres</td>
<td>0.025</td>
</tr>
<tr>
<td>Medulla oblongata</td>
<td>0.008</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>0.027</td>
</tr>
<tr>
<td>Total helminths in CNS and eye balls</td>
<td>0.004</td>
</tr>
</tbody>
</table>

**Table 1. Recovery of *Angiostrongylus cantonensis* preadult helminths from the central nervous system of rat on 21st day post infection**

<table>
<thead>
<tr>
<th>Site</th>
<th>Average number of helminths recovered (%)</th>
<th>Low dose infection</th>
<th>Normal dose infection</th>
<th>High dose infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>100</td>
<td>500</td>
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</table>

Eyes balls 3 3 4 3 2
Olfactory lobes 2(3.3) 3(31.0) 20(22.0) 20(2.0) 20(2.0)
Cerebral hemispheres 2(3.3) 3(31.0) 20(22.0) 20(2.0) 20(2.0)
Cerebellum 6(0.6) 24(8.8) 28(2.8) 46(2.3) 96(1.1)
Medulla oblongata 10(6.0) 9(0.0) 15(2.0) 26(2.6) 42(2.1) 51(1.0)
Spinal cord 14(1.0) 30(0.0) 30(0.0) 30(0.0) 20(0.0) 40(0.2)
Total helminths in CNS and eye balls 3(20) 47(47.0) 182(36.0) 266(26.6) 309(15.4) 462(9.2)
REFERENCES


CROSS J. H., Studies on angiostrongyliasis in Eastern Asia and Australia. A special publication of the U. S. Naval Medical Research Unit No. 2 Taipei, Taiwan, NAMRU-2-op-44, 1979.


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