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STUDIES ON TOXOPLASMOSIS AS REGARDS ITS NATURAL FOCALITY IN SLOVAKIA

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Dedicated to Professor B. Rosický, D.Sc., on the occasion of his 50th birthday

Abstract. The occurrence of natural foci of toxoplasmosis was studied in wild animals from 4 geographically different localities of Slovakia. In view of the pantropic character of the parasite *Toxoplasma gondii*, the author considers the territory of Slovakia to be a dynamic natural focus of toxoplasmosis with a typical range of hosts enabling the circulation of the toxoplasma organisms.

The unusually wide distribution of toxoplasmosis in domestic and wild animals increased the interest in studies of the natural focality of this infection in the sense of Pavlovsky's theory. This problem was first raised by Jírovec (1952); two years later Havlík and Zástěra (1954) suggested that toxoplasmosis may be an infection with a natural focus. They tested the susceptibility to toxoplasmosis of several animals, which may play an important role in a natural focus of infection, and found the suslik to be highly susceptible to intraperitoneally introduced toxoplasmosis. Serological trials revealed high antibody titers in 3 of the 7 wild hedgehogs examined. The author himself (Čatár 1958) examined 146 mammals of 18 species and 16 birds of 6 species obtained from the reservation Topoľčianky both microscopically in brain smears and in histological preparations, but obtained only negative results. The same applied to isolation trials on white mice with 86 brains of small mammals. He ascribed this failure to the latency of infection and to the unsatisfactory method employed.

Various authors, e.g., Galuzo et al. (1964) and Zasukhin (1965) from the U.S.S.R. and Jíra et al. (1965) from Czechoslovakia, analyzed a complex of problems from both theoretical and practical aspects and concluded that toxoplasmosis carries all signs of a typical natural focus infection. The author presents his results of studies on toxoplasmosis as an anthropozoonosis with a natural focus character. His studies commenced in 1957, were performed on wild animals from 4 localities of Slovakia.

MATERIAL AND METHODS

We examined microscopically a total of 634 small mammals belonging to 15 species (Table 1). Examination methods: a) microscopical inspection of the organs of wild animals (either trapped or shot); b) serological trials—the complement-fixation test (CFT) routinely used in our laboratory (Čatár 1961). Most of the blood samples were obtained with Kramář's method (1965) on filtration paper; c) isolation tests from the muscle or brain in experiments with white mice (Jacobs and Melton 1957).

Geographical areas: The regional character of Slovakia is central European. The Carpathian arch extends from the Lesser and White Carpathian Mts. eastwards to the High and Low Tatra Mts. An important feature is the extensive breeding of domestic animals, mainly sheep, goat and bovine animals, in field and forest areas. The climate is central European with a considerable amount of precipitation. We selected 4 areas of different geographical character in the eastern-, SW-, central- and SE- (High Tatra Mts.) parts of Slovakia. The first two areas are intensively cultivated arrable lowlands with an occasional small forest; the second two areas are mountainous.

RESULTS

Of the 634 small mammals examined, toxoplasma cysts were found twice, in *Apodemus flavicollis* and *Microtus arvalis*. In both cases, these were located in the brain. That of *A. flavicollis* contained numerous cysts, that of *M. arvalis* one only (60×60 μm). Serological trials with a basic solution of 1 : 5 disclosed toxoplasma antibody in 5 *A. flavicollis* (6.4%), in 8 *Microtus arvalis* (5.8%), in 2 *Clethrionomys glareolus* (1.8%) and in one *A. sylvaticus* (3.8%). Antibodies were present in 16 of the 634 small mammals examined (2.5%) (Table 1).

Table 1. The incidence of *Toxoplasma gondii* in small mammals

Species	No. of examined animals	Direct pro of	Serologically positive
Mus musculus	40	—	—
Apodemus flavicollis	78	1	5 (6.4 %)
A. sylvaticus	26	—	1 (3.8 %)
A. agrarius	8	—	—
Clethrionomys glareolus	124	—	2 (1.6 %)
Microtus arvalis	138	1	8 (5.8 %)
M. agrestis	14	—	—
M. nivalis	16	—	—
Pitymys subterraneus	38	—	—
P. tatricus	12	—	—
Arvicola terrestris	23	—	—
Sorex araneus	98	—	—
S. minutus	6	—	—
Neomys fodiens	12	—	—
Crocidura leucodon	1	—	—
Total	634	2	16 (2.5 %)

As regards the localities, toxoplasma organisms were found in the brain of *A. flavicollis* from the High Tatra Mts. and in *M. arvalis* from Central Slovakia. A comparison of the incidence of toxoplasma antibody in the localities under consideration showed that it was lowest in the small mammals from SW-Slovakia.

Of the game animals we examined 13 boars *(Sus scrofa)*, 41 hares *(Lepus europaeus)*, 10 roe deer *(Capreolus capreolus)*, 16 red deer *(Cervus elaphus)*, 4 fallow deer *(Dama dama)*, 4 moufflons *(Ovis musimon)* and 3 foxes *(Vulpes vulpes)*. The incidence of infection was high in the boar, toxoplasma organisms were isolated from 4 animals (30%), and in the hare (9 animals, 22%). It was lower in the red deer (one animal, 6%). Although toxoplasma organisms could not be isolated from either the fallow deer or the moufflon, toxoplasma antibodies were present in one fallow deer and in one

moufflon. They were present also in the three foxes, but could be isolated from one fox only (Table 2). Of the 91 animals examined, toxoplasma organisms were isolated from 17 (18.7%), toxoplasma antibody, however, was present in 29 (31.9%) of these animals. The rate of infestation of game animals was almost uniform in all localities (Table 3).

Table 2. Isolation of *Toxoplasma* organism from the organs of game animals

Species	Organ	No. of examined animals	Toxoplasma positive	CFT positive in titers of 1 : 5 and above
Sus scrofa	Muscle	13	4	5
Lepus europaeus	Muscle	41	9	13
Capreolus capreolus	Muscle	10	2	3
Cervus elaphus	Muscle	16	1	3
Dama dama	Muscle	4	—	1
Ovis musimon	Muscle	4	—	1
Vulpes vulpes	Muscle	3	1	3
Total		91	17	29

Table 3. Incidence of toxoplasmosis in wild animals from Slovakia

Locality	Small mammals		Game animals	
	direct proof	serologically positive	direct proof	serologically positive
W-Slovakia	—	4	8	11
SW-Slovakia	—	2	4	9
Central Slovakia	1	5	5	7
High Tatra Mts.	1	5	not examined	2
Total	2	16	17	29

DISCUSSION

Our studies on wild animals were preceded by studies on domestic animals, which had been found to be important reservoirs of toxoplasmosis, although acute signs of infection were infrequent (Čatár et al. 1969). A high rate of infestation was observed in swine (31%), domestic rabbit (82%), goat (31%) and sheep (15%). This supports our assumption that toxoplasmosis is well—established in these parts of the country and, frequently, attacks also larger wild animals. A typical sign of infection with toxoplasma organisms is their "polyhost" character, conditioned by the presence of a certain range of hosts in each geographical area, which enables the circulation of the toxoplasma organisms in nature.

The little importance of ectoparasitic arthropods as vectors transmitting toxoplasmosis has been confirmed in earlier investigations and, hence, this infection cannot be classified as a transmissive disease (Jíra et al. 1967). The remaining routes of infection are generally known. These are: alimentary, percutaneous (through the damaged skin), diaplacentary and inhalatory routes. The organisms may enter also through the mucosa

or may be introduced by sexual contact. It appears that, apart from the alimentary route, the diaplacentary route is of great importance particularly in the reservoir animals. In view of the ubiquity of *T. gondii*, and its cosmopolitan pattern of distribution, infection in the field occurs independently of man. We believe that toxoplasma organisms circulate in the individual biocenoses as a component of the organisms inhabiting these biocenosis, and are primarily independent of either man or domestic animals.

CONCLUSIONS

The results of our investigations performed in four selected localities indicate that the incidence of toxoplasma organisms is not very high in the small mammals examined. On the other hand, however, the incidence of infection in game animals was surprizingly high in all four localities; this may be explained by the migratory habits of these animals. It indicates also that these animals act as reservoirs of toxoplasmosis. Assuming that the transmissive cycle of toxoplasmosis proceeds along the feral-domestic route, i.e., from wild to domestic animals and vice versa, the incidence of infection should be considerably high in domestic animals in these localities (cattle, swine, sheep, goat).

The results of our investigation of toxoplasmosis as a disease with a natural focus confirmed that this infection is a true anthropozoonosis with all the signs typical of a natural focus disease in the sense of Pavlovsky's theory. In view of the pantropic character of the parasite *T. gondii* it is possible to suggest that, in Slovakia, the infection has a dynamic natural focus and a typical range of hosts enabling the circulation of the causal organisms and, for these reasons, it will be difficult to control.

ИЗУЧЕНИЕ ТОКСОПЛАЗМОЗА И ЕГО ПРИРОДНОЙ ОЧАГОВОСТИ В СЛОВАКИИ

Г. Чатар

Резюме. Наличие природных очагов токсоплазмоза изучалось посредством диких животных из 4 географически разных местностей Словакии. Имея в виду пантропический характер паразита *Toxoplasma gondii*, автор считает, что территория Словакии является динамическим природным очагом токсоплазмоза с типичным кругом хозяев, поддерживающих циркуляцию *Toxoplasma* организмов в природе.

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