PREVENTION OF EXPERIMENTAL ALLERGIC ENCEPHALOMYELITIS IN GUINEA PIGS BY THE USE OF MAGNETOPHORES

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The control of allergic diseases of the nervous system is an urgent problem in modern medicine. It has recently been found that an artificial magnetic field may have a significant effect on immunologic reactions in living organisms [2-4]. Magnetophores – magnetic carriers of a type invented by A. S. Fefer [5], have important advantages as the source of the magnetic field. The magnetic carrier in such a device is an elastic matrix, or magnetophore, made of neutral rubber, on the surface of which the structure of permanent magnetic fields of assigned shape and parameters, including intensity of gradient, magnetic capacity (number of elementary magnetic pole–dipoles), and penetrance, is inscribed. Biological objects are exposed to the effect of the magnetic fields of the magnetophore by direct contact between the device and the body of the biological object. Biological objects can be exposed to the magnetophores without limitation of time or area affected, and the magnetic fields of the magnetophore, reproduced in the internal medium of the biological object, evoke responses or changes in the physicochemical properties of the fluid systems [6].

This paper described an attempt to determine the effect of a magnetic field on the development of experimental allergic encephalomyelitis (EAE).

EXPERIMENTAL METHOD

Experiments were carried out on guinea pigs of both sexes weighing 300-400 g. EAE was induced by subcutaneous injection of 0.01 mg of purified basic heterologous myelin protein in 0.1 ml saline mixed with 0.3 ml Freund's complete adjuvant (Mycobacterium tuberculosis cells, 5 mg/ml), into the footpads of the forelimbs. The time of appearance of paresis and paralysis and of death of the animals, and also the level of hypersensitivity of delayed type (by the skin test method, 8-10 days after induction of EAE), and antibody production against myelin (in the complement fixation test) were determined. Magnetophores with maximal intensity of the magnetic field on the surface of 200-215 Oe and with a gradient of intensity of 950-1000 Oe/cm, were used as the source of the magnetic field. Each magnetophore, with an area of about 1 cm^2, had six pairs of poles with the above-mentioned parameters of the magnetostatic field. The magnetophores were implanted subcutaneously into the animals symmetrically on both sides, in different parts of the trunk, or on a single plate placed on the head. Plates of semifinished "ferroelast" magnetophore with a nonmagnetic matrix were located in the same areas of control animals.

EXPERIMENTAL RESULTS

The results showing the action of the magnetophore matrices applied to different parts of the body, with an exposure of 7 days, to coincide either with the time of injection of the encephalitogenic mixture or with the inductive period of the disease (from the 7th to the 14th day after its injection) are given in Table 1. They show that the incidence of the disease in the control group was 75.9%. In the group of animals to which magnetophores were applied, the disease developed in only 25-33% of cases, and its incidence showed no clear dependence on either the place or time of application of the magnetophores. The mean time of commencement of the disease in the experimental animals was 16 days (13.9 days in the control).

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TABLE 1. Effect of Magnetophores on Frequency of Development of EAE in Guinea Pigs

Application of magnetophores		Experiment			Control		
time	place	number of animals in group	number developing disease	time of commencement of disease, days	number of animals in group	number developing disease	time of commencement of disease, days
from 1st to 6th days	middle of trunk	8	2 (25,0%)	19,5±1,5	9	7 (77,7%)	14,6±1,1
	head	9	3 (33,3%)	16,6±1,9	9	6 (66,6%)	11,6±1,3
	scapular region	33	8 (24,2%)	16,4±1,5	24	20 (83,3%)	14,2±0,4
from 7th to 14th days	scapular region	12	3 (25,0%)	13,3±0,9	12	8 (66,6%)	13,0±0,4
Total		62	16 (25,8%)	16,4±0,6	54	41 (75,9%)	13,9±0,3

TABLE 2. Cutaneous Hypersensitivity of Delayed Type in Guinea Pigs Exposed to Magnetophores

Cutaneous reactivity	Group of animals	Total number of animals	Number with positive reactions	Number of animals developing EAE		Number of animals not developing EAE	
				total	number with positive reactions	total	number with positive reactions
To 1 mg myelin	Experimental	45	30 (66,7%)	11	9 (81,8%)	34	21 (61,8%)
	Control	39	30 (76,9%)	29	23 (79,3%)	10	7 (70,0%)
To 0.1 mg of 10% tuberculin	Experimental	27	26 (96,3%)	8	8 (100%)	19	18 (94,7%)
	Control	31	31 (100%)	23	23 (100%)	8	8 (100%)

Among the 13 guinea pigs in which EAE was induced, but which were not exposed to either magnetophores or the control plates, 77% developed the disease. The same proportion was found in the control group, into which plates without magnetophores were implanted.

In the next series of experiments the possibility of suppressing clinically evident EAE in animals by the action of magnetophores was studied. A study of six guinea pigs with EAE showed that regression of the symptoms did not occur in any of the animals. They all died.

Indices of delayed hypersensitivity and ability to form antigens also were studied in animals exposed to the action of magnetophores and also in control guinea pigs. Investigation of hypersensitivity of the animals to myelin showed that the frequency of positive reactions in the two groups did not differ significantly (Table 2).

Application of magnetophores likewise did not affect the level of sensitization of the animals to tuberculin (a component of Freund's adjuvant).

Determination of antibodies showed that both the frequency of their detection (83 and 81%) and their mean titers ($\log_2$ of mean titers 4.58 ± 0.23 and 4.08 ± 0.17 respectively) did not differ significantly in animals exposed to the action of magnetophores and in control guinea pigs 2-3 weeks after inoculation with encephalitogenic mixture.

The results are evidence that application of magnetophores significantly reduced the incidence of allergic encephalomyelitis in guinea pigs. The action of the magnetic field did not affect indices of the immune reactions that were studied – either cellular or humoral. Consequently, magnetophores act on the effector stage of immunologic injury, preventing the action of immunopathological factors on target tissues in the CNS. In agreement with observations of Bresler [1], who found that a magnetic field changes the structure of the membrane lattice of the cells, it can be tentatively suggested that the use of magnetophores in the period of induction of EAE leads to "stabilization" of cell membranes in the nervous system. As a result of this, immunologic factors capable of inducing the process under ordinary conditions, do not injure modified structures of the nervous system. In cases when injury has already taken place, the magnetic field is ineffective. The fact must also be noted that the effect of magnetophores does not cease when they are removed after an exposure of 7 days.

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