EFFECT OF STIMULATION OF THE HYPOTHALAMIC REGION ON REFLEX FLUCTUATIONS OF SKIN POTENTIALS OF FROGS

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Most authors, in considering the problem of Sechenov-type inhibition, are of the opinion that there is no need to postulate the existence of special inhibitory structures in the brain, in order to explain development of central inhibition. The basic task of research workers is to elucidate the intimate mechanisms of development of inhibition in the spinal cord, in relation to stimulation of the brain. Developing the view expressed by Academician L. A. Orbeli [2, 3], on the adaptive-trophic function of the sympathetic nervous system, A. V. Tonkikh [7, 8] elucidated experimentally the phenomenon discovered by I. M. Sechenov [4] in 1862, as being an effect emerging from the diencephalic vegetative centers, and mediated through the sympathetic system.

In the classical form of Sechenov's experiment this action of the sympathetic system is manifested by the alteration in the course of the motor reflex, and practically all those who have studied this phenomenon have done so on the basis of the motor reactions [1, 5, 6, 8, 9].

The object of the present research was to investigate the nature of the action of the diencephalon on vegetative reflexes, using Sechenov's method of stimulating the hypothalamic region. In addition, we hoped, by comparing these findings with the known effects of visual processes on motor reflexes, to gain some insight into the action of vegetative centers on both groups of reflex reactions. As an indicator of vegetative reactions we selected the reflex changes in skin potentials (emf) occurring when it is subjected to chemical (acid) stimulation. These effects were correlated in some of the experiments with the motor reactions taking place on the application of acid.

EXPERIMENTAL METHODS

Our experiments were performed on frogs. We measured the changes in skin potential by a compensatory method. A potentiometer and a mirror galvanometer were connected in circuit with the parts studied. The magnitude of the skin potentials and of their fluctuations were measured in millivolts. The skin potentials were taken off from the hind legs of the frogs, which were immersed up to the knee in physiological saline (0.65% NaCl). One nonpolarizing agar-agar electrode was placed in the vessel containing saline, and the other was connected through a cotton pad soaked in saline to the exposed, but undamaged, dorsal muscles of the frog. In this way we could lead the current off from the inner and outer surfaces of the skin. Chemical irritation of the skin was performed by placing a piece of filter paper of area 0.25 sq. cm , wetted with 1% sulfuric acid, on the skin of the thigh.

One of the objectives of our experiments was to elucidate the effect of stimulating the diencephalon of the frog on the nature of vegetative reflexes.

The experiments were performed in the following way. The movements of the animal were slightly restricted by giving appropriate doses of curare, the skull was opened, and the brain was transected at the level of the anterior boundary of the mesencephalon, as was done by I. M. Sechenov in his experiments. After an interval of an hour, the frog was switched into the potentiometer circuit. Having established a more or less definite background level of reflex variations in the skin potential (stimulation of the skin was applied for 30-second periods, at 5-minute intervals), we placed a sodium chloride crystal on the mesencephalon, leaving it there for 1 minute, during the last 15 seconds of which we also applied skin stimulation. This permitted of the registration of alterations in reflex changes in skin potentials, proceeding against a background of stimulation of the mesencephalon, We used 100 frogs in our experiments.

EXPERIMENTAL RESULTS

In most cases we found heightening of reflex fluctuations in skin potentials during periods of stimulation of the mesencephalon (Table 1).

The enhancement of excitability of the reflex apparatus of the spinal cord, manifested as increase in reflex skin potential oscillations, was particularly well marked in those cases where the reflexes were of low strength. At times, they disappeared altogether during an experiment, and only reappeared after preliminary stimulation of the mesencephalon. An effect of this sort was recorded by taking a photographic tracing of the movements of the galvanometer mirror (see Figure).

Apart from these effects, we observed cases in which stimulation of the mesencephalon led to a lowered excitability of the reflex apparatus, manifested by diminution in amplitude of the reflex changes in skin potential, and by a shortening of the latent period. In a number of the experiments reflex variations in skin potential disappeared completely during stimulation of the mesencephalon, as is evident from Table 2.

TABLE 1

Time		Reflex potential changes, mv
hours	minutes	
12	00	10
12	05	5
		Stimulation of the mesencephalon
12	10	15
12	15	8
12	20	5
		Stimulation of the mesencephalon
12	25	6
12	30	3
12	35	2
		Stimulation of the mesencephalon
12	40	4,5
12	45	4
12	50	4
		Stimulation of the mesencephalon
13	00	5
13	05	5
13	10	2

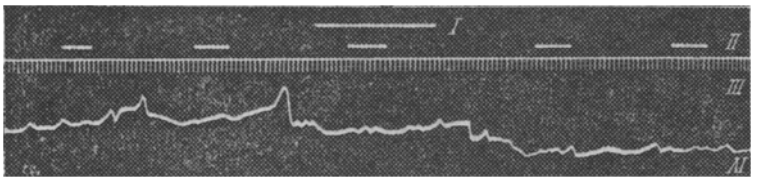
Thus our results are evidence of the adaptive-trophic action of central sympathetic nerve elements of the mesencephalon on vegetative reflexes.

TABLE 2

Time		Reflex potential changes, mv
hours	minutes	
11	30	5
		Stimulation of the mesencephalon
11	35	0
11	40	4
		Stimulation of the mesencephalon
11	45	0
11	50	5
		Stimulation of the mesencephalon
11	55	0
12	00	3

We compared our results on the effect of the mesencephalon on vegetative reflexes with the known effects of visual centers on motor reflexes. The experiments were designed to permit of the simultaneous observation of

motor and autonomic system reactions. The latent period found for the motor reflex was much shorter than that of the vegetative reflex, in response to one and the same stimulus. We found, further, that in accordance with A. V. Tonkikh's findings, the latent period of the motor reaction was lengthened during stimulation of the mesencephalon, whereas we often observed shortening of the reflex reaction time for the vegetative reaction, with strengthening of the reflex itself. In some cases, the changes in both types of reaction were in the same direction during stimulation of the mesencephalon. Together with lengthening of the latent period of the motor reaction we found a lengthening of the latent period of the vegetative reaction, up to its total abolition.



Increase in reflex skin potential variations observed during stimulation of the mesencephalon with a crystal of salt.
I) Signal indicating time and duration of stimulation of the mesencephalon with a salt crystal; II) signal showing time and duration of stimulation of the skin with sulfuric acid; III) time marker; IV) photorecording of movements of the light spot of the galvanometer.

We were also able to establish that the upper boundary of emergence of sympathetic fibers responsible for skin-potential variations, and effecting communication between the spinal cord and the higher levels of the central nervous system, are at the level of the 2nd segment of the spinal cord.

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