EFFECT OF STIMULATION OF THE RETICULAR NUCLEUS OF THE THALAMUS ON NEURONAL ACTIVITY OF ASSOCIATIVE AND NONSPECIFIC THALAMIC STRUCTURES

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The reactions of neurons of the centromedian, mediodorsal, and posterior lateral nuclei of the thalamus to electrostimulation of its reticular nucleus were studied in experiments on anesthetized cats. A high reactivity of neurons of the centromedian (53.7%) and mediodorsal (48.3%) nuclei in comparison with the posterior lateral (10%) was established. "Silent" neurons reacted by an excitatory type of reaction having a phasic chamber. Primary and secondary inhibitory reactions were noted among the spontaneously active neurons. The latent period of the excitatory reactions of the neurons of the centromedian nucleus varied from 5 to 33.6 msec (14.83 ± 1.77 msec) and of the mediodorsal nucleus from 3.5 to 44.8 msec (18.03 ± 2.5 msec). A high degree of convergence of reticular and somatovisceral signals on neurons of the centromedian nucleus (52.83%) and mediodorsal nucleus (53.5%) was found. An inhibitory type of interaction of central and peripheral influences was established.

KEY WORDS: thalamus, centromedian, mediodorsal and posterior lateral nuclei, convergence, and interaction.

It is known that the rostral parts of the reticular nucleus of the thalamus, being a functionally important formation, participate in regulating the sensory flow of impulses passing through various relay nuclei of the thalamus [5, 6, 10]. In this connection it is important to investigate its influences on associative and nonspecific structures of the thalamus, in particular, the centromedian, mediodorsal, and posterior lateral nuclei. In earlier published works we presented the results of studying the reactions of neurons of these structures to stimulation of peripheral nerves [2, 4]. A high degree of convergence of somatic and visceral signals on thalamic neurons and their interaction according to the mutual blocking type was found.

This article presents experimental data on the types of reactions, degree of convergence, and character of interaction of reticular and somatovisceral impulses on neurons of the thalamic structures indicated above. In the literature there is practically no information about the functional interrelations of the investigated thalamic nuclei and neuronal mechanisms of their mutual influences.

METHODS

The experiments were conducted on cats (2.3-3.0 kg) anesthetized with a mixture of chloralose and Nembutal (respectively, 50 and 10 mg/kg intraperitoneally) and immobilized with d-tubocurarine. The scheme of setting up the experiments is shown in Fig. 1. The method of simultaneous recording of the impulse activity of neurons and focal potential by means of glass microelectrodes filled with a 4% solution of procion red. The potentials were photographed from the screen of an S8-11 dual-beam storage oscillograph in a frame tape-transport regime.

Stimulation of the rostral parts of the reticular nucleus (F = 13, L = 2.5-3, H = -0.5 + 3) was carried out by bipolar electrodes with an interelectrode space of 0.5 mm.

and diameter of 90-110 μm. Rectangular current impulses with a voltage of 10-20 V, duration 0.1-0.3 msec, and frequency of 0.5-3/sec were used.

The peripheral nerves were stimulated by bipolar silver electrodes. Supraliminal stimuli with a duration of 0.3 msec and frequency 0.5-1 sec were used.

The electrodes were inserted into the central structures according to the stereotaxic atlas of Jasper and Ajmone-Marsan [11]. To refine the localization of the tips of the recording and stimulating electrodes, electrocoagulation and electrophoretic introduction of the procion dye with a subsequent histological check was carried out.

RESULTS OF INVESTIGATION

Reaction of Neurons to Stimulation of the Reticular Nucleus. The results of the investigation showed a rather high reactivity of neurons of the centromedian (53.7%) and mediodorsal (48.3%) nuclei in comparison with the posterior lateral nucleus, where it was only 10% (Fig. 1A). Owing to the insignificant number of reacting units (3), the given nucleus was eliminated from further analysis.

A comparison of the types of reactions of neurons of the centromedian and mediodorsal nuclei did not reveal significant differences. In both structures excitation was the most typical reaction of the "silent" neurons, which was expressed in the occurrence of single impulses and discharge (Fig. 2A). A response in the form of a discharge was more characteristic for the mediodorsal nucleus. The neuronal discharge consisted of two to six peak potentials with a repetition rate of 180-360/sec (262 ± 29.5/sec) for the centromedian and 200-500/sec (308.7 ± 31.3/sec) for the mediodorsal nucleus.

Spontaneously active neurons also reacted similarly. In some cases stimulation of the reticular nucleus caused a reaction in the form of initial phasic inhibition with subsequent recovery of the initial spontaneous impulses (Fig. 2B, 1). In other cases a complex sequence of the response consisting of several phases was observed: Initial excitation was replaced by a long period of inhibition of activity, often accompanied by late excitation (Fig. 2B, 2). Both types of responses were found almost on a par. The average duration of postactivation inhibition in the centromedian nucleus was 472 ± 87.78 msec and of primary inhibition 521 ± 91.01 msec. These values were somewhat exceeded on investigating the time parameters of these types of inhibition recorded in neurons of the mediodorsal nucleus: respectively, 783 ± 45.8 and 532.2 ± 96.9 msec.

The values of the latent periods varied in a rather wide range. A histogram of their distribution is shown in Fig. 1B. It is seen that the peak in the distribution of the