

## CHANGES IN EVOKED POTENTIALS OF THE MEDULLARY RETICULAR FORMATION PRODUCED BY CORTICOFUGAL INFLUENCES

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Characteristic forms of evoked potentials of the reticular formation, changes produced by them by conditioning cortical stimulation of increasing strength, and the thresholds of origin of evoked potentials in the reticular formation during stimulation of various cortical areas are described.

The close connection between the cortex and neuronal structures of the reticular formation (RF) is now accepted without reservation, for it is confirmed by numerous morphological and electrophysiological investigations. However, views of different investigators regarding the functional significance of the cortex and of its individual areas in the activity of reticular structures are definitely contradictory.

The opinion has been expressed that corticofugal influences are unconnected with any particular cortical region, but are due to the existence of inhibitory cortical tone [9, 11]. Whereas French [10] asserts that precisely demarcated corticofugal areas exist in the cortex, Zager [5] considers that specific projection zones have a facilitatory effect, while the whole cortex has a diffuse inhibitory effect on the activity of reticular structures. The work of Durinyan and co-workers [1-3, 7, 8] has shown that reticular structures are particularly sensitive to stimulation of somatosensory area II of the cortex. Investigations by Ermol-aeva [4] support this view, but she distinguishes also "silent" areas in the cortex which do not exert corticofugal influences.

Facts characterizing evoked potentials (EPs) of the RF and changes produced in them by corticofugal volleys, together with thresholds of generation of EPs in the RF in response to stimulation of the antero-dorso-lateral surface of the cortex, are described below.

### EXPERIMENTAL METHOD

Acute experiments were carried out on adult cats anesthetized with chloralose (50-70 mg/kg, intraperitoneally). In the course of the experiments the animal and the exposed surface of the cortex were kept at a constant temperature, and the cortex also was irrigated with physiological saline heated to 37°. The sciatic nerve and cortex were stimulated with single square pulses (1-2 V, 0.5 msec for the nerve; 2-16 V, 0.05 msec for the cortex) from an electronic stimulator with high-frequency isolation unit through bipolar electrodes with interelectrode distances of 2.5 and 1 mm, respectively.

EPs from the gigantocellular nucleus of RF were recorded by a unipolar technique with buried steel electrodes which were inserted by means of a stereotaxic apparatus in accordance with the coordinates of a stereotaxic atlas. Potentials were fed into an ac amplifier and recorded by an automatic camera from the screen of a CRO.

The location of the electrode tip, after coagulation of the brain tissue with a dc anode (2 mA, 20 sec) and fixation for 2 weeks in 10% formalin solution, was determined in sections stained by Nissl's method and from photographs of moist sections.

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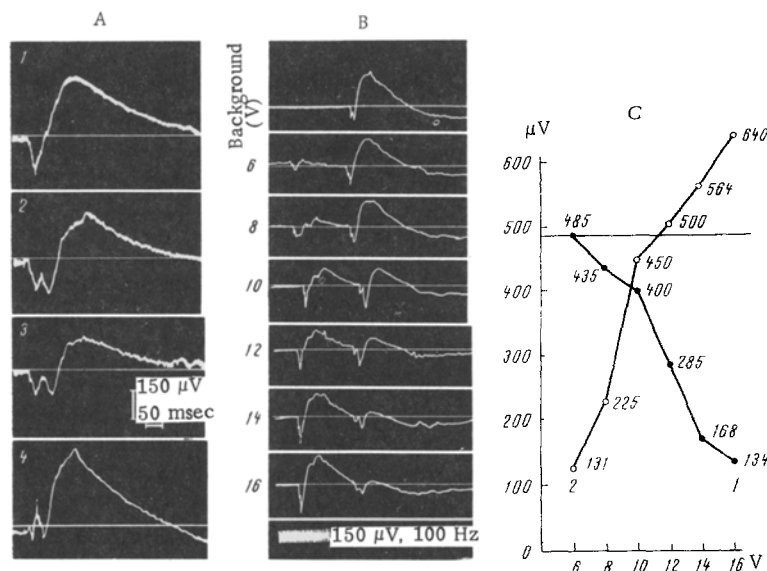


Fig. 1. Evoked potentials of medullary reticular formation to sciatic nerve stimulation. A) 1-4): Types of evoked potentials in reticular formation; B) changes in evoked potentials with an increase in strength of preceding (by 325 msec) cortical stimulus from 6 to 16 V; C) graph showing changes in amplitude of late positive-negative component of evoked potential in reticular formation (1) and development of evoked potential in response to cortical stimulation (2).

## EXPERIMENTAL RESULTS

The experiments showed that electrical responses in the medullary RF to sciatic nerve stimulation are fairly polymorphic, although several types of most characteristic EPs can be distinguished among them (Fig. 1A). EPs shown in Fig. 1 were recorded under similar conditions (anesthesia, intensity of stimulation, location of recording electrode, etc.) in different experiments.

The first type (Fig. 1A, 1) of EP is characterized by a positive-negative complex with the following parameters: amplitude of the positive phase 215  $\mu$ V, duration 63 msec; amplitude of the negative phase 338  $\mu$ V, duration 325 msec. In the responses of type 2 (Fig. 1A, 2), as a rule a small spur is formed during the development of the positive phase, and this is followed by the positive-negative wave. These two types of EP are those recorded most frequently from units of the RF, and their latent periods during sciatic nerve stimulation vary from 16 to 22.5 msec.

Less commonly (up to 20% of cases) EPs of more complex configuration are recorded in RF, and these can be described as responses of type 3. In EPs of this type the ascending part of the initial positive wave is more clearly defined, for it either almost reaches the isoelectric line (Fig. 1A, 3) or crosses above it and is recorded as a negative phase (Fig. 1A, 4). This is followed by development of the late positive-negative component of the EP. The configuration and latent periods of the EPs may vary with the strength of stimulation applied to the nerve, but in the experiments whose results are given above, no changes were found in the EPs of the reticular formation even after an increase of 20 times in the strength of stimulation.

After application of increasingly strong (from 6 to 16 V) conditioning stimulation to the cortex, the amplitude of EPs generated in the RF in response to this stimulation increased, while the amplitude of EPs generated in response to test stimulation of the sciatic nerve showed a corresponding decrease (Fig. 1B). The decrease in amplitude of the EPs generated in the RF in response to sciatic nerve stimulation, resulting mainly from depression of the later positive-negative component, depending on the strength of conditioning cortical stimulation (and, correspondingly, on the amplitude of the EP produced by this stimulation), is illustrated by the graph in Fig. 1C. This dependence was taken into account in the next experiments, whose object was to examine the thresholds of EP generation in the RF in response to stimuli of different strengths applied to different cortical areas. In these experiments the method of "detailed corticography" developed by K. M. Kullanda [6] was used. The results are shown in Fig. 2. If the strength of the stimulus was 2 V

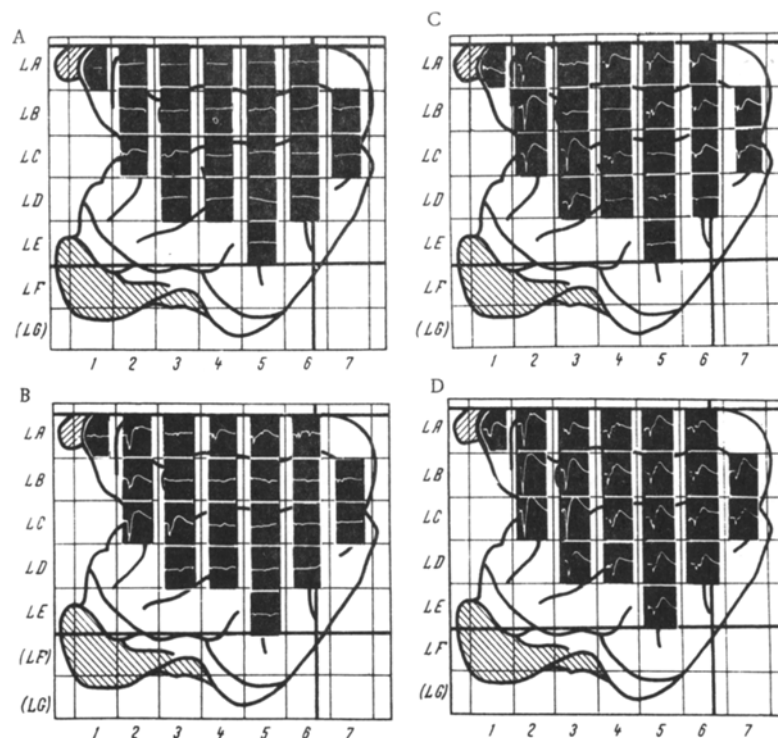


Fig. 2. Topography of cortical areas differing in thresholds of evoked response in reticular formation. Evoked potentials generated in reticular formation during stimulation of cortical surface in region of corresponding squares (LB2, LB3, and so on) are given on schematic maps of the brain. Strength of cortical stimulus: in A, 2 V; in B, 4 V; in C, 8 V; in D, 16 V; duration of pulse 0.05 msec.

(Fig. 2A), for instance, EPs arose in the RF only during stimulation of cortical areas LC2 and LC3. An increase in the strength of the stimulus to 4 V (Fig. 2B) caused an increase in amplitude of the EP during stimulation of LC2, and LC3, and in addition, potentials began to be recorded in response to stimulation of areas LA2, LA4, LA5, LA6, LB2, and LB7. A further increase in the strength of the stimulus to 8 V (Fig. 2C) was followed by the recording of EPs during stimulation both of the areas listed above, and also of cortical areas LB5, LB6, LC6, and LC7. When the strength of the stimulus was 16 V, EPs were generated in the RF in response to stimulation of all areas of the antero-dorso-lateral surface of the cortex (Fig. 2D).

It can thus be concluded from these results that inhibition of evoked potentials to sciatic nerve stimulation in the RF following preceding stimulation of the cerebral cortex is expressed as selective blocking of the development of their late positive-negative component. Under these circumstances, in response to conditioning cortical stimulation, an EP whose amplitude increases with an increase in the strength of the stimulus develops in the RF. Areas of the cortex located at the superior end of the s. coronalis and on the g. suprasylvius ant. have the lowest corticofugal influences. When the method of "detailed corticography" is used, these zones correspond to squares LC2 and LC3. With an increase in strength of the stimulus, EPs and corticofugal influences on them can be reproduced over wide areas of the cortex.

The facts described above show that corticofugal influences may occur from strictly defined areas of the cortex, which differ in the degree of their action on the unit structures of the RF. Corticofugal influences on the medullary RF are reproduced most precisely from the somatosensory and visual projection areas of the cortex.

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