It is a noteworthy fact that practically complete inhibition of EP of PFC was observed during ES of the negative points, whereas the increase in LP of TNS avoidance did not amount to more than 20%. This is in agreement with the conclusion [6] that stress analgesia may have a powerful, but only a short action. Finally, it must be noted that below-threshold ES only of negative points, but not of positive points in the hypothalamus reduced LP of TNS aboidance and increased the amplitude of EP of PFC in response to nociceptive EDS. This is evidence that only emotional stress of negative sign increases sensitivity to pain. This is of definite biological importance, for it acts together with the defensive reactions of the animal during avoidance of harmful factors. Strong emotional excitation, on the other hand, depresses sensitivity to pain, and this also supports the animal's defensive reactions aimed either at achieving a useful adaptive result in the case of positive emotions, or defensive reactions aimed at combating factors directly threatening the animal's life in the case of negative emotions.

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EFFECT OF STIMULATION OF THE PALEOCEREBELLAR CORTEX ON A MULTIFOCAL CORTICAL EPILEPTIC COMPLEX

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To depress epileptic activity (EA) many workers have used stimulation of the cerebellar cortex [4, 9, 11, 12, 14, 16]. However, the results of these investigations are inconsistent or even contradictory: Besides an inhibitory effect, potentiation of EA also has been found [15, 16]. Yet the solution to this problem is of great practical as well as theoretical importance, for it is a matter of identifying brain structures whose stimulation can cause inhibition of EA through activation of physiological "antisystems" [2].

The aim of this investigation was to study the effect of electrical stimulation of the paleocerebellar cortex on a multifocal cortical epileptic complex (EC), separately and in combination with administration of benzodiazepines (BD) which, as we know, also inhibit EA [1-3, 5, 10, 14].

EXPERIMENTAL METHOD

Acute experiments were carried out on 40 cats. A multifocal EC was created by application of penicillin to different zones (a piece of filter paper 2 mm^2 in area was soaked with

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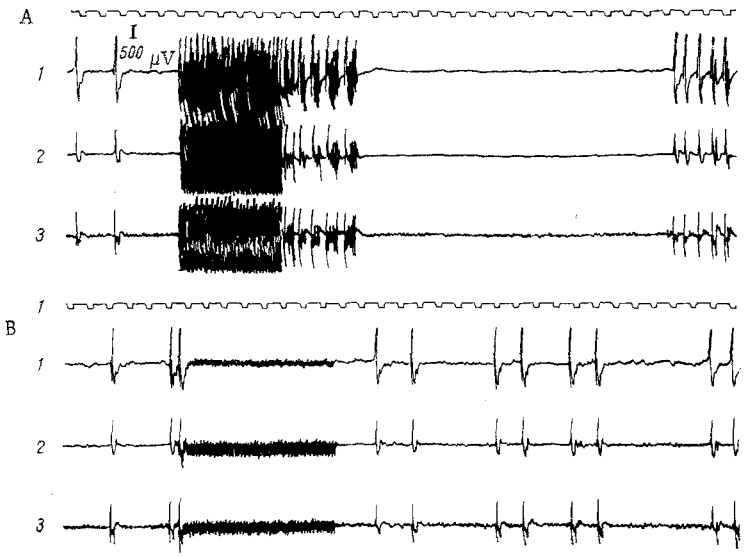

Fig. 1. Effect of electrical stimulation of paleocerebellar cortex on a cortical multifocal EC. A) Before injection of phenazepam; B) 20 min after injection of phenazepam (1 mg/kg). 1) Coronal gyrus, 2) anterior sigmoid gyrus, 3) posterior sigmoid gyrus. Calibration: 500 μV, time marker 1 sec, marker of stimulation — continuous line.

penicillin solution). The leading (determinant) focus was formed by application of a 5% solution, and the dependent foci by application of a 0.5% solution of the sodium salt of penicillin. Biopotentials were derived by a monopolar technique (the reference electrode was fixed in the nasal bones) and recorded on a 4-EEG-3 electroencephalograph. The paleocerebellar cortex (lobules IX, X) was stimulated electrically (square pulses) by an ESU-1 generator. The parameters of stimulation were: frequency 10-12 and 100 Hz, stimulus duration 0.5-1 msec, voltage 3-12 V, duration of continuous stimulation 7-15 sec. The interval between repeated periods of stimulation was 2 min. BD (diazepam, phenazepam) were injected intraperitoneally (0.5-1 mg/kg body weight).

EXPERIMENTAL RESULTS

In 20 experiments the effect of electrical stimulation of the paleocerebellum was studied on an EC created in the cerebral cortex.

The results of one experiment are illustrated in Fig. 1A. The determinant focus was created by application of 5% penicillin solution (zone 1) and the dependent foci by application of a 0.5% solution (zones 2 and 3). The vermis of the cerebellum was stimulated after determination of the steady-state level of EA in all foci of the EC. During low-frequency stimulation (12 Hz) an increase in the frequency of EA took place in the determinant and dependent foci compared with the original level. Instead of sporadic spikes arising once per second, rhythmic seizure potentials with a frequency of 3-4 Hz were generated. Immediately after the end of stimulation inhibition of EA began in all foci, and continued for 16 sec. EA in the determinant and dependent foci was then restored and the spike frequency increased to 1-2 sec (the "rebound" phenomenon). This picture of transformation of activity of the cortical EC was preserved during repeated stimulations of these same areas of the cerebellum.

In another series of experiments on 10 cats the action of high-frequency stimulation of the paleocerebellar cortex (100 Hz) on the cortical EC was studied. An increase in the frequency of stimulation caused no particular changes in the type of cortical response described above.

In the next series of (10) experiments the principles governing development of the effects of electrical stimulation of the paleocerebellar cortex were studied after administration of BD, which have anticonvulsant properties.

Activity of an EC in the cerebral cortex 20 min after intraperitoneal injection of BD (1 mg/kg) is shown in Fig. 1B. Stimulation of the cortex of the cerebellar vermis in these animals immediately depressed the seizure potentials of EC. After the end of stimulation, sporadic spikes were restored. Phases of activation of seizure potentials against the background of stimulation and after inhibition were abolished by BD.

Different results to stimulation of the paleocerebellar cortex were thus obtained under different conditions. Each cycle of stimulation was accompanied by the formation of complex responses consisting of a phase of more rapid seizure potentials in the determinant and dependent foci of the cortical EC against the background of stimulation, but by inhibition after discontinuation of stimulation, followed by postinhibitory quickening. Consequently, paleocerebellar stimulation has a dual action on the cerebral cortex: facilitatory and inhibitory. This effect evidently reflects the special features of functioning of the cerebellar cortical neuron net discovered previously by other workers [13, 18], activation of which evokes the standard type of response in the form of excitation—inhibition—disinhibition, which characterizes its intrinsic ability to generate different patterns of efferent neuronal discharge.

On the basis of these findings BD were used to abolish activating volleys from the paleocerebellum. The results obtained in these experiments suggest that BD potentiate inhibition from the cerebellum on the cortical EC. This phenomenon may be based on the following particular features of the action of BD on the brain. First, BD depresses activity of the reticular formation [6]. Besides this, BD potentiates cortical postsynaptic inhibition [17], reduces the sensitivity of the cerebral cortex itself to these activating nonspecific influences, and so depresses their epileptogenic effect. Predominance of the inhibitory effect of paleocerebellar stimulation may also depend on intensification of the spike discharge of the Purkinje cells of the cerebellar cortex after administration of BD [7].

The results are in agreement with those of other investigations and they suggest that structures of the paleocerebellum participate in the regulation of general electrogenesis and may consequently, under certain conditions, bring about an antiepileptic effect.

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