FUNCTIONAL ORGANIZATION OF CENTRAL VISUAL NEURONAL SYSTEMS IN FROGS DURING STRYCHNINE ACTIVITY

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Paroxysmal activity induced by strychnine in neurons of the tectum mesencephali in frogs is characterized by the appearance of periodic high-amplitude waves on the curve of total activity, by an increase in sensitivity of individual cells, and by the appearance of a clear tendency for grouping of spike discharges of neurons.

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EXPERIMENTAL METHOD

Experiments were carried out on 120 frogs immobilized by intraperitoneal injection of tubocurarine (1 mg/100 g body weight). Electrical activity of the cells of the tectum mecencephali of the frogs was recorded by the usual method of recording the spike potentials of two or more neurons by means of microelectrodes. The distance between the electrodes varied from 0.25 to 1 mm. The surface electrogram was recorded by unipolar silver electrodes. Potentials were recorded on an EEG-4 electroencephalograph or N-102 loop oscillograph. Spike activity of 294 neurons was studied (81 before application and 213 after application of crystaline strychnine or intraperitoneal injection of 1 ml 0.1% strychnine nitrate solution).

EXPERIMENTAL RESULTS

The electrographic picture of the "epileptic" fit began to appear 10-15 min after application of strychnine to the brain surface or 20-30 min after its intraperitoneal injection. The first "epileptic" waves appeared on the curve of the surface electrogram only when the light was switched off, but later they appeared in response to switching the light on, and only after a period of 20-30 min were observed "spontaneously" in the background electrical activity, this usually being accompanied by synchronization of the spike potentials (Fig. 1).

The results obtained are given in Table 1. They show that in the state of an "epileptic" fit, a distinct tendency is observed for grouping of spike activity, i.e., an increase in the number of neurons with b-type activity. The results given in Table 2 show that a decrease in the number of nonreacting neurons during a state of paroxysmal activity is accompanied by an increase in the number of excitatory responses of both on-and off-effect type. The changes in inhibitory responses were less definite in character. Increased synchronization of neuronal responses during "epileptic" waves observed during background activity was seen

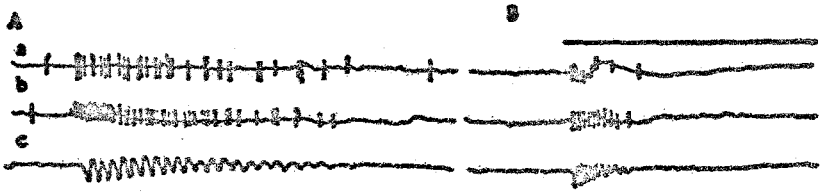

Fig. 1. Synchronization of spike potentials of two neurons (a, b) during waves of "epileptic" activity on curve of total surface electrogram (c) generated (spontaneously) (A) or provoked by photic stimulation (B). The black line above in B denotes action of photic stimulation.

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TABLE 1. Redistribution of Types of Background Spike Activity of Neurons During Action of Strychnine

Type of neuronal activity	Number of neurons	
	before action of strychnine	after action of strychnine
Continuous arrhythmic (a-type)	60 (74)	139 (65.5)
In groups (b-type)	15 (19)	66 (31)
Absence of background activity	6 (7)	8 (3.5)

Note: Here and in Table 2, percentages shown in parentheses.

TABLE 2. Redistribution of Types of Neuronal Responses to Photic Stimulation Before and After Administration of Strychnine

Type of neuronal response	Number of responses	
	before action of strychnine	after action of strychnine
On-excitatory	23 (28.5)	99 (47)
On-inhibitory	8 (10)	19 (9)
Absence of response to switching light on	6 (7)	8 (3.5)
On-excitatory	28 (35)	95 (45)
On-inhibitory	5 (6)	29 (14)
Absence of response to switching light off	46 (59)	85 (41)
Excitation all the time light switched on	25 (73)	70 (90)
Inhibition all the time light switched on	9 (27)	8 (20)

Note: Since both on and off units were counted when calculating the percentage of responses of on units, the sum of the percentages in the first part of the table is not 100.

especially clearly in response to photic stimulation, provoking "epileptic" waves on the curve of the surface electrogram. During prolonged observations on spike activity of the same neurons (for up to 1-1.5 h), the changes in their excitability showed some degree of periodicity (period of waves more commonly 15-30 sec, rarely 2-5 min).

The fact that synchronization of spike potentials took place almost invariably at the time of generation of "epileptic" waves on the surface electrogram evidently demonstrates the important role of electrotonic influences exerted by a focus of paroxysmal activity in the synchronization of cell discharges [1,9]. The results of these experiments indicate that during paroxysmal activity developing as a result of the action of strychnine the delicate pattern of excited and inhibited neurons characteristic of the normal activity of central nervous structures is to some extent obliterated [2, 5, 6, 8, 10-12].

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