DETERMINANT-FORMATION OF COMPLEXES OF HYPERACTIVE FOCI IN THE RABBIT CEREBRAL CORTEX

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It has been shown [1, 2] that a hyperactive focus of excitation in the cerebral cortex potentiates and synchronizes activity of other, weaker foci, and combines them into a single complex, the character of whose activity it determines. Such a focus of excitation thus plays the role of a determinant focus [1]. Blocking of the determinant focus leads to disintegration of the complex and to autonomization of the dependent foci. Blocking any other focus of the complex has no such effect. To discover how universal is the determinant principle in the activity of the CNS it was decided to carry out similar investigations on different species of animals. Determinant relationships have already been studied and established in the cortex of cats [2, 3] and rats [4].

The present investigation was conducted on rabbits. The cortex of these animals has a more complex structure than in rats, and it is clearly subdivided into areas [5-7]; the neurons are characterized as a rule by widespread receptive fields (polyvalent neurons [8]).

EXPERIMENTAL METHOD

Experiments were carried out on 15 rabbits anesthetized with pentobarbital (25-30 mg/kg, intraperitoneally). The skull was trephined, the dura was excised above the cerebral hemisphere, and the edges of the wound were retracted sideways. Scattered foci of epileptic activity were created by application of a piece of filter paper (1-2 mm^2) soaked in a 0.1-0.5% solution of strychnine nitrate, to different parts of the sensomotor, visual, and auditory areas of the cortex. A more powerful focus of seizure activity was formed by application of a 1-3% solution of strychnine to the parietal and temporal areas of the ipsilateral hemisphere. The foci were inactivated by local application of filter paper soaked in a 6% solution of pentobarbital or by extirpation. Seizure potentials were derived from the cortex by a monopolar method and recorded on the 4-ÉEG-3 ink-writing electroencephalograph.

EXPERIMENTAL RESULTS

Strychnine spikes of different amplitudes (Fig. 1A, zones 2 and 3) appeared 2-3 min after application of a 0.1% strychnine solution to different parts of the sensomotor and visual areas of the rabbits' cortex. Each focus generated strychnine discharges asynchronously and independently of one another. The creation of a new and powerful focus of seizure activity in the parietal cortex by application of 3% strychnine solution led to an increase in the amplitude and frequency of the strychnine discharges in the foci in zones 2 and 3 and to their synchronization with discharges in the hyperactive focus in zone 1 (Fig. 1B, C). Synchronous discharges appeared initially in the focus in zone 2, located nearer to the powerful focus, and later in a more distant focus. A complex of free foci was thus formed, in which the focus in zone 1 (Fig. 1C) played the determinant role. Under these conditions the complex continued to function for 24-52 min, after which synchronization of activity of the foci was disturbed and the complex disintegrated. During the formation of a single epileptic complex the separate dependent foci did not necessarily obey completely the activity of the determinant focus and they continued to generate asynchronous spike activity. In rabbits it was found that the dependent focus could escape from the influence of the determinant focus of activity. The amplitude and frequency in such a focus at this period were greater than in the other dependent foci included in the complex. Seizure potentials were conducted into areas of the neocortex untreated with strychnine. This happened most frequently in the sensomotor cortex. Under these circumstances they were not always synchronous with activity of the epileptic complex.

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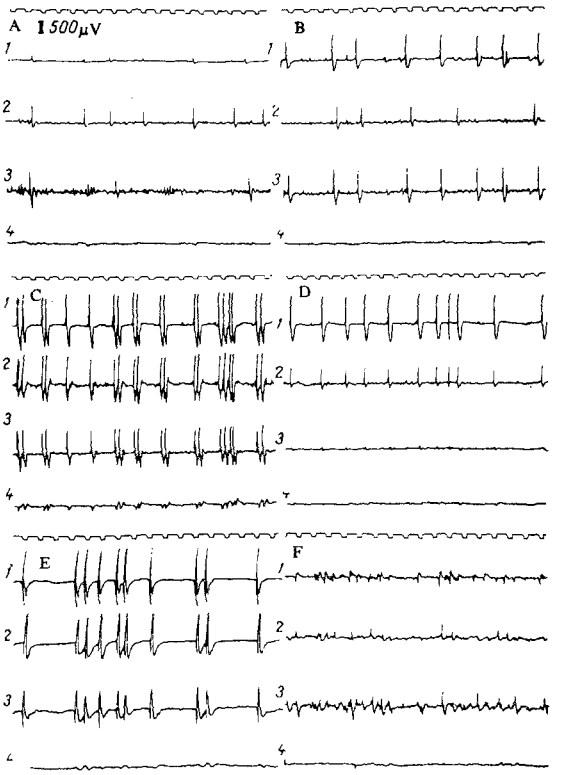

Fig. 1. Formation of complex of hyperactive foci in rabbit cerebral cortex. A) Creation of scattered foci of excitation by application of 0.1% strychnine solution in zones 2 and 3, B) initial stage of formation of determinant focus in zone after application of 3% strychnine solution, C) 18 min later, D) 1.5 h later, E) creation of a new complex of hyperactive foci under the influence of a determinant focus in zone 1, F) effect of blocking of determinant focus in zone 1 (by application of 6% pentobarbital solution) on complex of hyperactive foci. 1) Parietal cortex, 2) sensomotor, 3) occipital, 4) temporal zone of cortex. Calibration 500 μV, time marker 1 sec.

Blocking of the dominant (stronger) focus (Fig. 1F, 1) of the epileptic complex by application of 6% pentobarbital solution caused gradual disintegration of the complex. Initially high-amplitude synchronized epileptic discharges continued to be recorded in the dependent foci, after which the discharges became independent of one another and their amplitude fell. If activity in one of the dependent foci of the complex was abolished by 6% pentobarbital solution, the complex remained intact and the rest of the foci continued to discharge under the conditions imposed by the powerful focus.

Consequently, a powerful focus of epileptic activity created in the cerebral cortex of a rabbit potentiates the level of activity in other, relatively weaker foci, to correspond with the character of its own activity: it unites them into a single complex, and plays a determinant role.

The experiments showed that the similarity which exists in principle in the time course of this process is a feature when foci are created in different areas of the rabbit cortex. Meanwhile in rabbits, compared with rats [4], certain distinguishing features were found both in the formation of individual foci and in their combination into a complex. For instance, the latent period of formation of scattered epileptic foci in rats is longer than in rabbits. These observations are in agreement with the view [9, 11] that the more highly developed the cerebral cortex, the more easily epileptic foci are produced. The investigations described above showed that the total length of life of individual foci and of the complex in rabbits is longer than in rats. Complexes in the cerebral cortex of cats are even longer in duration [2, 3].

One of the distinguishing features of the formation of epileptic complexes in the rabbit neocortex under the influence of a determinant focus is the fact that dependent foci became independent of the activity of the de-

terminant focus more often than in experiments on cats [2, 3]. This may be due to the fact that cortico-cortical connections in rabbits are less well developed than in cats [6, 7, 12, 13], and inhibitory mechanisms suppressing independent secondary epileptogenesis are less perfectly developed [14].

On the whole it can be concluded from the results of these investigations that species differences in the morphological and functional organization of the cerebral cortex are responsible only for some particular features of the realization of the determinant principle but do not modify it substantially. This fact, together with the observation that determinant relationships exist in different parts of the CNS [1], is evidence that the determinant principle is universal in character and is one of the essential principles governing activity of the CNS. As has been shown [1], it is a basic principle of intrasystemic relations.

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EFFECT OF THYMECTOMY AND THYMUS POLYPEPTIDE FACTOR ON INSTRUMENTAL REFLEX FORMATION TO FOOD IN RATS

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The writers showed previously [1, 3, 4] that low-molecular-weight polypeptides isolated by extraction with acetic acid from the thymus (thymarin) and from the cerebral cortex of calves (cortexin) are not only antigenically related [4], but also possess a common property of restoring the T-cell population in adult thymectomized mice by stimulating differentiation of T-cell precursors into mature T lymphocytes [3], normalizing immunologic reactivity to thymus-dependent antigen in the thymectomized animals [3] and stimulating it in normal animals [1]. It was decided to study whether this function of the thymus is limited to its effect on immunogenesis or, since it possesses common antigenic components with cells of the cerebral cortex [4], it can also influence processes of higher nervous activity.

The object of this investigation was to study the effect of thymectomy and of the thymus polypeptide factor thymarin on the effectiveness of instrumental reflex formation to food in adult rats.

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