INVESTIGATION OF THE EEG OF RABBITS WITH EXPERIMENTAL ENCEPHALITIS

V. N. Bondarev, E. Ya. Voitinskii, N. A. Piskareva, and T. P. Ryzhova

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In experiments on rabbits during the development of experimental postvaccinal encephalitis diffuse slowing of the background electrical activity of the brain was found, with an increase in the latent periods and duration of the evoked potentials.

The electrical activity of the brain in experimental encephalitis has been studied only sporadically [3, 13].

This paper describes the results of an investigation of the dynamics of electrical activity in different parts of the rabbit brain during the development of experimental encephalitis caused by smallpox vaccine.

EXPERIMENTAL METHOD

Experiments were carried out on 21 rabbits weighing 2.8-3 kg with electrodes implanted into the visual cortex, the lateral geniculate body (GL), the posterior hypothalamic nucleus (NHP), the mesencephalic reticular formation (FR), hippocampus (HIP), medial nucleus of the thalamus (VM), and the globus pallidus (GP). The electrodes were inserted with the aid of a stereotaxic apparatus in accordance with the coordinates of the atlas [12]. The EEG was recorded in 7 monopolar leads on a "Schwarzer" electroencephalograph. In addition, evoked potentials to photic stimulation (50 μsec, 0.3 J) were recorded from the visual cortex.

The rabbits were injected with smallpox neurovaccine (Moscow Institute of Virus Preparations) by the intracerebral route (0.2 ml of a suspension diluted 10^{-3}) and percutaneously (1 ml, dilution 10^{-1}). The titer of the virus for intracerebral injection was 10^{-6} and for percutaneous administration 10^{-7}. The rabbits were sensitized 24 h before percutaneous infection by intramuscular injection of 5 ml normal horse serum.

EXPERIMENTAL RESULTS

The EEG was examined before infection, 24 h after injection of the neurovaccine, and then daily until the animal died.

When the EEG was recorded before infection in a state of relative rest, polymorphic activity was recorded with predominance of θ waves 70-100 μV in amplitude. A regular synchronized rhythm with a frequency of 4-7 Hz was observed periodically in the hypothalamus, hippocampus, and mesencephalic reticular formation. Fast waves were usually ill-defined (Fig. 1). The results of investigations of the evoked potentials in the normal animals were in agreement with those described in the literature [4]. A semiphasic potential, consisting of primary and secondary responses, with a mean latent period of the positive phase of the primary response of 17.8 msec, was recorded in the visual cortex.

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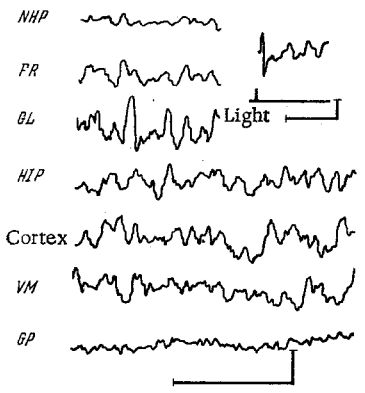

Fig. 1

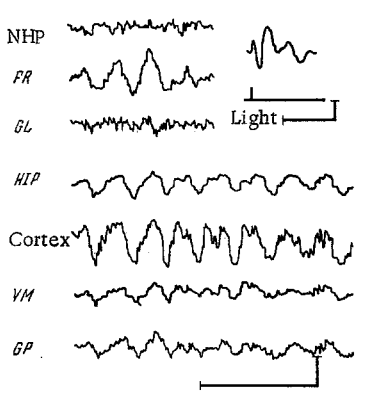

Fig. 2

Fig. 1. Electrical activity of rabbit No. 17 under normal conditions. Calibration: 1 sec, 100 μV. Averaged evoked potential of the visual cortex shown in upper right hand corner. Calibration: 500 msec, 100 μV. Upward deflection denotes negativity. Remainder of legend in text.

Fig. 2. Electrical activity of rabbit No. 17 in the acute period of vaccinal encephalitis. Legend as in Fig. 1.

On the 2nd-3rd day after percutaneous vaccination, the rabbits showed an unstable and ill-defined tachyrhythmia, evidently due to sensitization as Markov [7] has shown. On the 3rd-4th day after vaccination, smallpox vaccine could be isolated from the blood of this group of rabbits.

The clinical manifestations of encephalitis were similar, whether infection was by the intracerebral or the percutaneous route, but in the first case they appeared after 2-3 days, and in the 2nd case after 7-10 days. Wasting, apathy, disturbance of movement coordination, tremor of the limbs, and periodic bouts of restless movement were observed. During the development of encephalitis, pareses and paralyses of the limbs appeared, convlusions occurred, and death ensued. Vaccinia virus was isolated from the brain of the rabbits which died after percutaneous immunization.

Pathological investigation (A. P. Tarasova) revealed a diffuse lesion of the brain substance with perivenous inflammatory infiltration and demyelinization of the nerve fibers around the veins. These lesions evidently result from the action of the virus and also from autosensitization by breakdown products of the brain tissue [8, 9]. These processes possibly lead to disturbances of the cerebral circulation and to cerebral anoxia. In the initial period of encephalitis, the predominant EEG picture was thus one of the comparatively early stages of anoxia [11] – a decrease in the amplitude and desynchronization of the activity in several leads. In some rabbits, in addition, bilaterally synchronized bursts of rhythmic waves lying in the Δ and α range, were recorded.

In the acute period of encephalitis, with development of more marked neurological and visceral manifestations, the electrical activity of the brain resembled the changes described by Gurvich [5] and characterized by an increase in the amplitude of the high, slow waves, mainly in the α range (Fig. 2). The Δ activity quickly spread to all parts of the brain, the EEG pattern became uniform in the various leads, and a decrease in the differentiation of the nervous tissue similar to that observed by Maiorchik in patients with brain tumors [6] evidently took place. A similar picture has been observed in the acute period of vaccinal and para-infectious encephalitis by other investigators [1, 2, 10].

During the development of the terminal state in rabbits with vaccinal encephalitis, the amplitude of the slow waves was reduced, periods of flattening of the curves and standard slow complexes (biphasic waves, 1 sec in duration and about 300 μV in amplitude), similar to those observed by Gurvich [5], appeared.

The evoked activity in response to photic stimulation also underwent considerable changes in the acute period of encephalitis, consisting mainly of lengthening of the latent periods and duration of the primary and secondary responses (Fig. 2) by 30-100%. Evoked potentials continued to be recorded even in the terminal state, and they persisted after extinction of the background activity.

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