EFFECT OF PARTIAL EXTIRPATION OF THE CEREBRAL CORTEX ON VESTIBULAR NYSTAGMUS IN THE RABBIT

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B. B. Bokhov

Moscow
Scientific Director—Dr. Med. Sci. Yu. G. Grigor'ev)
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The increase in the duration of vestibular nystagmus after decortication has been associated with inhibitory corticofugal influences on the underlying centers [4-5, 9, 12]. That this is not the only form of interaction between the cerebral cortex and the vestibular nuclei is shown by experiments revealing a lowering of the ability of decorticated cats to preserve their adaptation of nystagmus produced in response to a thermal or an adequate stimulus [10].

In the present investigation the duration of the nystagmic reaction was studied after bilateral extirpation of the cortex of the temporo-parietal lobes in rabbits previously accustomed to repeated serial rotations.

EXPERIMENTAL METHOD

The experimental technique was described fully in earlier papers [1, 2]. In the whole experiment the animal received 12 stimuli (rotation and stopping the turntable at 12 different speeds); initially these stimuli were applied consecutively in increasing strength, and then after an interval of 5 min—in diminishing order. The maximal stimulus reached 120°/sec and the minimal 10°/sec; each stimulus differed from its predecessor by 10°.

After six experiments with rotation, decortication was performed, in the course of which symmetrical areas of the temporo-parietal lobes of the cerebral cortex were removed by means of a sharp spoon; the rabbits were anesthesized with urethane. After the end of the experiments a control anatomical examination was made of the brain of the sacrificed animals (Fig. 1).

EXPERIMENTAL RESULTS AND DISCUSSION

The results given below are the mean values for corresponding experiments. Nine experiments were carried out on each of four experimental rabbits, three of them after decortication (836 rotations altogether). Curves 1, 1_1 and 6, 6_1 were plotted from the results of the 1st and 6th experiments respectively, which were separated in the various animals by an interval of 40-120 days. As a result of the shortening of the reaction time to the repeated stimuli the curve of the duration of nystagmus in the 6th experiment fell appreciably during both forms of stimulation (Fig. 2). The decrease in the duration of the nystagmus in the case of application of stimuli of increasing order was sharper than during application of stimuli of diminishing order. This may be attributed primarily to differences in the duration of the original reactions in the initial experiments (curves 1 and 1_1). The strength ratios in the 6th experiment during stimuli of 60-70°/sec were less marked than during application of stimuli of between 70 and 120°/sec.

The first examination of the rabbits undergoing decortication was made on the 4th-5th day after the operation. Curves 7, 7_1 and 9, 9_1 reflect the mean results of the 7th and 9th experiment, carried out with an interval of 1-2 days. By comparison with the results of the 6th experiment after the operation, in an increasing series of stimuli there was an obvious increase in the duration of the nystagmus to stimuli of 70-120°/sec and a decrease in nystagmus to small stimuli. At the same time an increase was observed in the duration of the nystagmus to all the stimuli of the diminishing series, and the most marked increase in the reaction was found in the range of stimuli of 50-120°/sec. However, only two repetitions of the experiment were required to make the curve of duration of increasing stimuli (9)

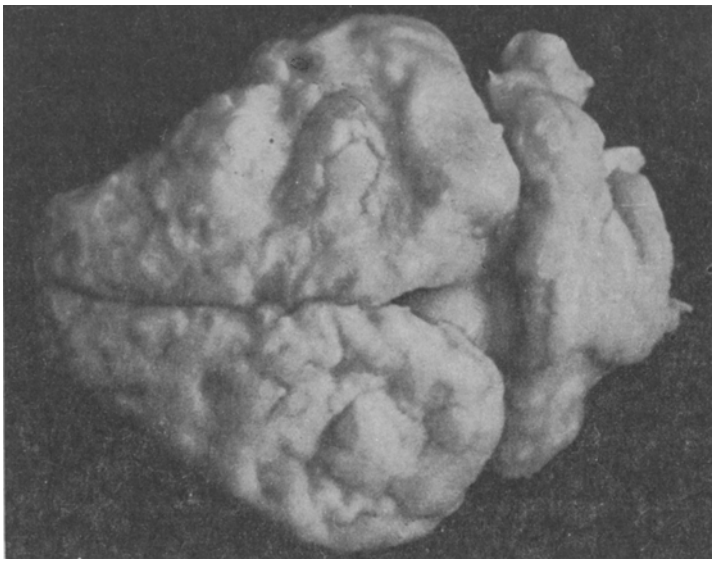

Fig. 1. Brain of a rabbit after partial extirpation of the temporo-parietal lobes. Fixation in formalin.

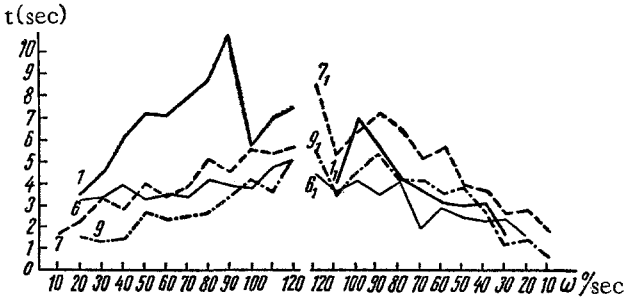

Fig. 2. Curves of duration of nystagmus in response to increasing (on the left) and decreasing (on the right) series of stop stimuli in rabbits before and after partial decortication of the cerebral hemispheres. $1,1_1$ and $6,6_1$ – curves of the 1st and 6th experiments after the operation respectively; $7,7_1$ and $9, 9_1$ – curves of the 7th and 9th experiments after the operation.

fall below the curve obtained in the last experiment before the operation (6), and the curve of duration of stimuli of diminishing intensity (9_1) was displaced to the level of the original curve (1_1).

The curves in Fig. 2 show conclusively that decortication did not abolish the ability of the vestibular analyzer to give a graded nystagmic reaction.

The experiments showed that the partial removal of the temporo-parietal portions of the cerebral cortex in rabbits causes an obvious, but slight, increase in the duration of the postrotational nystagmus to stimuli within the range of 10-120°/sec. In magnitude and stability, this change was clearly less than the disturbances arising after extensive extirpation of the cortex [3-5, 11, 13]. At the same time, it cannot be compared completely with the results of analogous experiments on animals subjected to lobectomy, for the changes in the duration of nystagmus after removal of the frontal or temporal lobes either fail to develop altogether [11] or disappear within the course of 24 h after the operation [4, 7, 13, 14]. Even after hemidecortication of the rabbit asymmetry of the nystagmus is observed for only 3 days after the operation [13].

Hence, although the slight change in nystagmus in the present experiments could be explained by the limited extent and thinness of the layer of cortex removed, the explanation of the stability of these changes by comparison with the results of similar experiments must evidently be sought in the difference between the operative techniques and methods of stimulation. It is tempting in this case to imagine the observed change to be the result of the partial loss of the training acquired by the vestibular analyzer in the preliminary experiments, the stability of which is probably dependent on the function of the cerebral cortex [10].

These experiments confirmed the previous observations of N. F. Tyumyantsev [6], showing that the duration of postrotational nystagmus in decorticated pigeons, like its duration in normal pigeons, depends on the speed of rotation.

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