CHARACTERISTICS OF VISUAL ADAPTATION IN EPILEPSY PATIENTS

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Adaptation may be defined as the process by which the organism becomes equilibrated with its environment. The functional mobility method developed by P. G. Snyakin [3, 4] and his colleagues is of interest in studying adaptation; this method makes it possible to evaluate the quantitative aspect of the human adaptive reaction under readily attainable conditions. Specifically, with this method as a basis it has been established that the number of rod elements of the visual analyzer participating in perception increases as the illumination decreases [4]. This relationship between the state of the retinal photoreceptor apparatus and the illumination conditions promotes very accurate visual analysis and may serve as a striking example of equilibration of the organism with its environment. As the observations of N. V. Galuzo [2] and other authors have shown, this relationship is markedly disrupted in certain patients. However, the conclusions reached by these researchers are based primarily on disruptions which reduce to the retina's exhibiting dark adaptation in light and vice versa.

This article describes an investigation of the ability of the visual system of epilepsy patients to vary the number of active rods in accordance with the intensity of a light stimulus (rather than in accordance with the two opposed situations of light and darkness), i.e., it provides a more precise evaluation of this adaptive property.

The practical goal of this work was the development of a diagnostic test (on the basis of the "correspondence" criterion) which could be used for establishing a difference in the adaptive properties of the visual system in healthy individuals and epilepsy patients.

EXPERIMENTAL METHOD

We examined 23 epilepsy patients ranging in age from 16-39 years.

As a control group we investigated 10 healthy persons ranging in age from 23-27 years.

The investigation was conducted in a darkened room. A method developed in the Sense-Organ Laboratory of the Institute of Normal and Pathological Physiology, Academy of Medical Sciences, USSR [3] was used to determine the number of rods participating in perception (in other words, their mobilization level). This method is based on the fact that the boundaries of retinal photosensitivity reflect the level of rod mobilization. The boundaries were recorded along the horizontal meridian of the retina with the aid of a projection perimeter and expressed in degrees (the retina of the right eye was examined in each case).

After dark adaptation of the retina (for 40-45 min), which caused the boundaries of photosensitivity to reach their maximal extent, we subjected it to a series of illuminations by switching on one by one, incandescent lamps of different wattages. The illuminations, each of which lasted 30 sec, followed one another at the varying time intervals (2-10 min) necessary for restoration of the initial background corresponding to complete dark adaptation of the retina. In other words, during the course of the investigation the retina was exposed to five light stimuli of increasing intensity, which was measured at 3, 11.5, 42, 115, and 220 lx at the level of the work table. Each of the illuminations employed caused a constriction of the boundaries of retinal photosensitivity; the extent of this constriction

TABLE 1. Correlation Coefficient in Healthy Persons

Subject's surname	Correlation coefficient
K-va	1.0; 0.8
P-t	1.0; 1.0
Kh-va	0.6
E-va	0.6; 0.8
A-er	0.8
N-na	0.6
V-va	0.6
Kh-v	0.8; 0.8
K-k	1.0
S-va	0.8

was measured in degrees and served as an index of the reaction by which the mobilization of the rod elements is reduced in response to photostimulation.

EXPERIMENTAL RESULTS

The chain of light stimuli, applied in order of increasing intensity, stimulated answering drops in rod mobilization, which also usually occurred in order of increasing magnitude. There was thus a definite quantitative relationship between the stimulus system and the system of answering retinal reactions. However, in almost every application of this series of stimuli we were able to note one or two reactions which disrupted the general increasing sequence. A complete correspondence of this type consequently almost never developed in our investigations. In this connection we found it necessary to introduce a correlation coefficient, the ratio $J = K/C$, where K is the total number of stimuli applied (5 in our investigations) and C is the number of stimuli causing reactions adhering to the aforementioned sequential increase.

This correlation coefficient was proposed in the Sense-Organ Laboratory of the Institute of Normal and Pathological Physiology, Academy of Medical Sciences, USSR, for determining the precision with which the visual system reacts to exposure to adequate stimuli of varying intensity [1, 3]. In essence, it reflects the adaptation of the visual system to these stimuli and, on this basis, may be employed for quantitative evaluation of the adaptation of the organism to its environment.

TABLE 2. Correlation Coefficient in Epilepsy Patients

First group		Second group	
Patient's surname	Correlation coefficient	Patient's surname	Correlation coefficient
A-ev	0,8	B-in	0,6; 0,8; 0,8
Ya-va	0,6; 1,0	E-ov	0,4; 0,6
G-va	0,6	N-ov	0,4; 0,4
V-ev	0,8	H-ov	0,6
K-va	0,6; 0,8	P-va	0,6; 0,6
M-ov	0,8; 0,8	H-ha	0,6
N-ov	0,8	T-ov	0,6; 1,0; 0,6
Zh-va	1,0; 0,4; 0,4	B-ev	0,8
		G-ii	0,6; 0,4
		H-ev	0,4; 0,6
		K-uk	0,6
		G-ov	0,8
		K-ov	0,8
		M-ov	0,8; 0,6
		K-aya	0,6; 0,8; 0,2

The correlation coefficient was determined once or three times for each subject. For the healthy individuals (control group) it ranged from 0.6 to 1.0 (Table 1). The nonuniformity of the coefficient is apparently explained by a varying level of adaptive properties in different persons. It may also fluctuate in an individual as a function of the examination time. Thus, for the subject E-va this index was 0.6 on August 5, 1961, and had increased to 0.8 on August 14. The arithmetic mean of all the values obtained for the control group was 0.8 (with a mean square deviation of 0.16).

The correlation coefficient varied over a wide range in the epilepsy patients, from 0.2 to 1.0. The mean arithmetic coefficient was 0.65, with a mean square deviation of 0.18.

The mean correlation coefficient was thus higher in the healthy individuals (0.8) than in the epilepsy patients (0.65). As statistical processing showed, the difference between these mean values was reliable. In comparing individual subjects, the epilepsy patient occasionally exhibited a higher correlation coefficient than the healthy person. In these cases functional variations in the state of the central nervous system in the healthy individual apparently had a greater influence on the correlation coefficient than did the patient's epileptic focus.

On the basis of the material presented above we may conclude that the adaptive capacity of the visual system, as determined from the correlation coefficient, is, on the average, markedly reduced in epilepsy patients.

The patients were divided into two groups in accordance with the frequency of the seizures and the length of time for which they had had the disease (Table 2).

The 1st group included eight persons with comparatively infrequent seizures (no more than 3 per year) who had had the disease for a short time (from several weeks to five years). The 2nd group (15 individuals) comprised patients who had had the disease for more than 10 years, as well as those who had incurred the illness recently but had frequent seizures.

The correlation coefficient averaged 0.72 for the patients in the 1st group and 0.61 for the patients in the 2nd group (the difference between these values was statistically reliable). The highest correlation coefficient 0.8) was thus noted in the healthy persons and the lowest (0.61) in the epilepsy patients of the 2nd group, who had a long-standing illness or frequent seizures.

The correlation criterion may consequently be utilized both to indicate damage to the central nervous system in epilepsy and, to some extent, to establish its severity.

SUMMARY

The degree of the quantitative ratio between the light stimuli of various intensities, and responses of the retina in respect to "demobilization" of rod elements, served as an index of the adaptive function of the visual system in healthy persons and in epileptics (the so-called "ratio-index").

Investigations demonstrated that the degree of the mentioned ratio averaged higher in healthy subjects than in epileptics. In turn, in the patients with rare attacks and short duration of the attacks it was much higher than in the cases with more frequent attacks, or with a longer history of the disease.

LITERATURE CITED

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