ELECTROENCEPHALOGRAM REFLECTION OF ETHOLOGICAL REACTIVITY OF LABORATORY RATS

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Introduction

It is very difficult to evaluate the role of individual peculiarities of reaction of laboratory animals on physical and chemical indexes in experiments especially in establishing of dozedepending physiological or pathological influences.

To avoid occasional elements in experiments and mistaken interpretation of obtained results it is necessary to take into account emotional reactivity of tested animals which is studied by means of "open field" test.

Material and methods

The aim of our investigations was to establish the conformity of characteristics in bioelectrical activity of the brain of white rats under functional loading (photostimulation) with the peculiarities of their emotionally oriented behaviour. 15 white rats (males) were tested (their mass was 200-250 gr). Ethiological reactivity was evaluated by means of the "open field" test. We used cage (60x60cm) with the height of 40 cm in side and the floor was painted in black and white colours (25 black and white squires), with openings in corners. For 10 minutes the movement of animals along the margins and in the center was constantly registered, looking into holes (hole reflex), standing on back pads, the quantity of fecal excrements (reflex of defecation) and quantity of washing. Record of EEG was done under the conditions of sound isolation and darkness by means of elrctroencephalograph (EEG-84-2-05) by needle-shaped electrodes which were fixed in subcutaneous in frontal and occipital zones. Before fixing of electrodes rats were injected thiopental sodium (40 mg/kg) of living mass intraperitoneum. EEG was registered 30 minutes after injection. Results of records were analyzed by means of half-quantity methods, revealing swing components. To determine the functional situation in the brain of rats photostimulation with various frequencies of light flashes was used (1, 2, 5 and 10 per second). Every test lasted for 2 minutes.

Results and discussion

All animals during test period displayed various behavior. To reveal animals with different reactivity of the nervous system we have chosen movement activity of rats along the margins. We have revealed three groups of animals, which differed statistically as to the level of index (table).

It should be noted that the main reason for the movement was fear. That is increased level of locomotion of rats, belonging to the first group, was the result of the slip reflex. As may be seen from the table data concerning vegetative reaction of defecation, standing on back pads confirm the fact that nervous system of rats in this group is more emotional and irritable.

Defecation is closely connected with emotional reactivity, that's why we selected to the second group steady animals with a low level of defecation but with a high level of locomotion which is a result not only of strange situation but also oriented reflex of investigation. It is considered that the cause for the investigation is the movement along the centre of the field. This cause was not revealed with the animals of the third group. Besides emotional reactivity of these rats was rather high. Thus, on the basis of obtained results we may distinguish three types of nervous system: irritable (26,6%), steady (26,6%) and inhibitory (46,8%).

During the second stage of investigations there were recorded EEG in animals. Immediately after relaxation (30 min after injection of thiopental sodium) the swing rhythm of biopotentials was characterized by slow vibrating with frequency as much as 6-10 Hz, which follows the desynchronized activity of more low amplitude. Under such conditions rats are able to perceive light irritants, which is the result of activation of more frequent swings and partial depression of slow waves. During prolonged irritation by photoflashes (more than 1 minute) α and θ-rhythm were partially renewed and the adjustment of cortex to outer irritations was quite evident.

Taking into account individual nervous and psychological peculiarities of selected animals during reactions on light irritants we analyzed three experimental groups of rats.

I group (irritable type).

Photoflashes with frequency 1 second caused desynchronization of rhythm and decrease of swing by two times; some shifts of swing were registered, which coincided in time with light flashes. Shimmer of light with swing 2 and 5 seconds caused analogous reactions of disorganization and increase of potential swings up to 12 Hz and with the frequency 10

flashes per second increase up to 20 Hz. 50 seconds later we observed the renewal of swings that is adaptation to the irritant. When we switched off the stimulator, 2 minutes later we observed the following: in front area of the cortex and θ-rhythm were as much as 20%, and in back area – 80% as a part of total phon.

Table Statistic characteristics of ethological reactivity of rats according to the test "open field" (M±m, n= 4-15)

Group of animal	Indexes					
	Movements along the margins (sec.)	Movements along the centre (sec.)	Standing on pads (amount)	Looking into holes (amount)	Washing (amount)	Reaction of defecation (%)
0 group, n=15	81,8 ± 25,1	30,7 ± 1,8	7,9 ± 2,6	6,5 ± 2,2	18,3 ± 6,7	46,6
I group, n=4	226,3 ± 35,8 P_{0-I}<0,05 P_{I-II}<0,01 P_{I-III}<0,001	10.8 ± 5,3 P_{0-I}>0,05 P_{I-II}>0,05 -	18,3±5,6 P_{0-I}<0,05 P_{I-II}<0,05 P_{I-III}<0,01	17,2 ± 4,7 P_{0-I}<0,05 P_{I-II}<0,01 P_{I-III}<0,001	46,0 ± 16,6 P_{0-I}>0.05 P_{I-II}>0,05 P_{I-III}<0,001	64,0
II group, n=4	49,5 ± 9,5 P_{0-II}>0,05 P_{II-III}>0,05	0,75 ± 0,74 P_{0-II}>0,05 -	3,5 ± 1,5 P_{0-II}>0,0 5 P_{II-III}>0,05	2,7 ± 0,8 P_{0-II}>0,05 P_{II-III}<0,01	22,2 ± 7,7 P_{0-II}>0,05 P_{II-III}<0,01	10,7
III group, n=7	22,9 ± 4,9 P_{0-III}>0,05	0,0 -	1,7 ± 0,6 P_{0-III}>0,05	2,7 ± 1,1 P_{0-III}>0,05	0,14 ± 0,13 P_{0-III}>0,05	17,8

II group (steady type).

Photostimulation with 1 swing per second didn't cause any changes. During stimulation of two plashes per second vibrating of potentials desynchronized, their frequency rose, but the amplitude regime was the same. Photosamples with the frequency 5 and 10 flashes per second caused more definite desynchronization of swings. Adaptation to the light irritant was observed 30 seconds later. After turning off the stimulator substantial differences between animals of the second and the first groups were not observed.

III group (inhibitory type)

Photostimulation with the frequency of 1 and 2 flashes per second didn't cause any changes in frequency and amplitude characteristics and under the frequency 5 and 10 flashes per second some changes were observed. Only 15 seconds later partial desynchronization and swing frequency up to 15-20 Hz took place and slow waves were 10-15% from total phon. Complete synchronization of swing (95%) was observed after switching off of the irritator.

Thus, on the basis of complete investigations it was revealed that photostimulation of rats with the irritable type of nervous system causes activation of frequent rhythms of biopotentials swings in brain, quicker reaction on light flashes of low frequency and rather long period of adaptation to the irritant .Animals of the II and III groups displayed less desynchronization and reaction on light flashes is revealed under more frequent rhythm of irritations and after more prolonged period of time. Besides adaptation of brain of the animals

in II and III groups comes earlier than in the first group. Thus it may be stated that the analysis of main components of functional EEG makes it possible to reveal emotional reactivity of white rats and may be the basis of division of animals according to the type of nervous activity.

Conclusions

1. Formation of groups of laboratory animals according to their age, living mass is not suitable for all experiments for it was revealed that the majority (46.6%) has got inhibitory type of nervous system.
2. Correlation between results of the “open field" test and typological peculiarities of bioelectrical activity of the brain of white rats was established.
3. Electroencephalogram investigations permit to differentiate objectively animals with different reactivity of nervous system, not using other methods.

References

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