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CHANGES IN CONDITIONED REFLEX ACTIVITY DURING GROWTH OF EXPERIMENTAL TUMORS, DEPENDING ON THE TYPE OF NERVOUS SYSTEM

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The dependence of the growth of tumors on the functional state of the central nervous system may now be considered as having been proven. Insufficient study has, however, been devoted to the course of the neoplastic process in animals possessing typologically different kinds of higher nervous activity, or to the effect of the neoplastic process on the conditioned reflex activity of such animals. Only a few isolated papers have been devoted to work on these problems, on white mice [4, 6] and white rats [3, 5].

The object of the present research was to study the effects of the transplantable tumor M-1 on the conditioned reflex activities of animals, taking into account the typological features of their nervous systems.

EXPERIMENTAL METHODS

The experiments were performed on white rats, the conditioned reflex activity of which had first been studied by means of L. I. Kotliarevskii's motor-alimentary method [1, 2].

A system of conditioned reflexes was elaborated in each animal, as follows: a positive conditioned reflex to red light, a positive conditioned reflex to the sound of a bell, and a negative conditioned reflex to the sound of a buzzer (differentiation to the positive conditioned reflex to the sound of a bell). Having established a dynamic stereotype in the rats, we proceeded to experiments involving change in stereotype (altered sequence of application of stimuli), extinction, and recovery of positive and negative conditioned reflexes, with the object of achieving a more precise picture of the typological characteristics of the higher nervous activity of the animals.

In determining the type of nervous system we took into account the speed of formation of positive conditioned reflexes, and their stability, the rate of establishment of differentiation , and its reinforcement, the results of modification of the dynamic stereotype, and the results of tests involving fasting for 24 hours.

An analysis of the results so obtained permitted us to segregate the experimental group of animals into their various types of higher nervous activity: strong inert, strong excitable, and weak.

To the strong inert type belonged those rats which developed a positive conditioned reflex after 10-18 associations, in which the strength of the conditioned reflex effort exerted in displacing the barrier to the feeding chamber was sufficiently great, and in which establishment of discriminatory inhibition and remodelling of the stereotype took place quickly. In most of the experiments considerable strengthening of the conditioned reflex activity took place after fasting the animals for 24 hours.

The strong excitable type of rats included those for which establishment of the conditioned reflex proceeded faster than in the preceding group, after 8-11 associations; the strength of the conditioned reflex was often greater, and discriminatory inhibition was established more slowly than in the first group, and lacked stability, and remodelling of the stereotype required a greater number of associations. Conditioned reflex activity was greatly enhanced after a 24-hour fast.

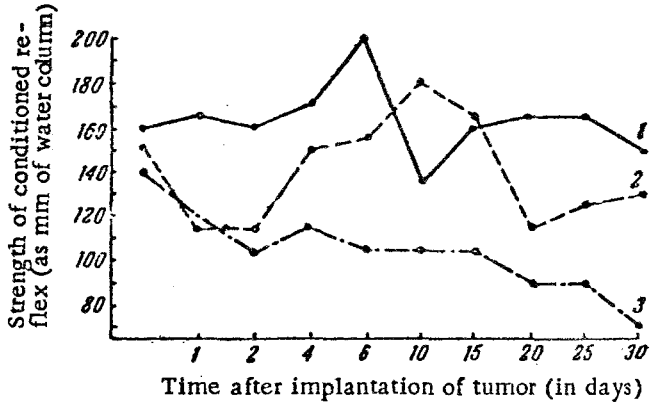
Finally, the third type of nervous system was represented by those rats in which it was difficult to establish positive or discriminatory conditioned reflexes, and in which the strength of the motor reflexes was much lower than in the first or second group. Fasting either weakened or did not affect their reflex activity.

As indicators of changes in the functional state of the nervous system we took changes in the duration of the latent period (time from application of the conditioned stimulus to appearance of the motor reflex), changes in the strength of the motor reflex (force used to displace the barrier to the feeding chamber, expressed as divisions on a scale), and the release of conditioned reflexes.

EXPERIMENTAL RESULTS

Our experiments showed that growth of the malignant tumor M-1 caused changes in the cortical and subcortical activity of the rats; these changes were more pronounced in rats of the strong types (inert and excitable).

We observed a shortening of the latent period of the reflexes in rats of the strong inert type, over a period of 8-15 days, followed by a prolongation of the latent period after growth of the tumor had begun. The strength of the motor reflex rose during the first 10 days. Discriminatory inhibition remained unchanged throughout the experiment in 4 out of 6 cases, release of reflexes being observed in 2 experiments on the 5th-9th day after implantation of the tumor. We observed the phenomenon of irradiation of inhibition in the rats of this type – application of discriminatory stimuli was followed by abolition of positive reflexes. This effect was observed on the 6th, 7th, 8th, 20th, and 24th day after implantation, in a group of 5 rats; the implant did not take in one rat. The implant began to grow on the 7th day in all five rats. The weight of the tumor amounted on the average to 58 g after 25 days.



Changes in the total magnitude of positive conditioned reflexes in rats with M-1 tumor.
1) Strong inert type; 2) strong excitable type; 3) weak type.

The latent period was shortened in a group of 5 rats of the strong excitable type, over the whole duration of the experiments. The strength of the motor reflex fell during the first 2-3 days, and then rose, to fall again at about the 20th day. Release of the differentiating reflex was observed on the 2nd-12th day after implantation of the tumor. Tumor growth began on the 6th day in 4 rats, and on the 8th-10th day in 2 rats. The average weight of the tumors was 69 g after 25 days.

Rats of the weak type did not show any such regular changes in higher nervous activity. Prolongation of the latent period was seen in 3 out of 4 rats during the first days after implantation. In one case prolongation of the latent period was observed only during the first 10 days, and was then followed by its shortening. The strength of the motor reflex varied irregularly. In 2 rats we observed abolition of positive reflexes, while discriminatory inhibition persisted over the whole period of observation. The implants began to grow on the 4th day in 2 rats, and on the 5th and 6th days in the other two. The average weight of the tumors was 82 g after 25 days.

The implants began to grow on the 5th-7th day in a group of 16 rats in which conditioned reflexes had not been formed, and the average weight of the tumors was 59 g on the 25th day.

Our results provide evidence of the significance of typological characteristics of nervous activity of rats for the development of M-1 tumor transplants. The nature of the changes in the strength of conditioned reflexes during the growth of the tumors is shown by the curves of the Figure.

In rats of the weak type, with a preponderance of inhibitory processes, the growth of the tumors began earlier, and they attained a higher weight, than in the animals of the other groups.

Conversely, in rats of the strong inert type of nervous system the positive reflexes persisted over the whole period of observation, and their strength increased. Similar changes were seen in rats of the strong excitable type of nervous system, with the difference that strengthening of the positive reflexes appeared later, and was of short duration.

It thus appears that the nature of the disturbances in nervous activity of rats during growth of the tumor is determined by the typological characteristics of the nervous system. Excitatory processes prevail in rats of the strong type of nervous system, as opposed to inhibitory processes in animals of the weak type. The prevalence of excitation in the nervous system of tumorous rats may be regarded as a factor retarding the growth of the neoplasm.

SUMMARY

Investigation conducted on rats showed that the development of malignant tumor M-1 caused changes in the cortical and subcortical nervous activity. These changes show the significance of the specific features of different types of higher nervous activity. Excitation was increased in rats of the strong type, while inhibitory processes prevailed in rats of the weak type. The tumor developed more rapidly and was of larger size in rats of the weak type of nervous system.

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