For example, whereas after 30 min of ischemia and 23.5 h of reperfusion the area of injury was 38 ± 0.5%, after 1 h of ischemia and 23.5 h of reperfusion it was 47 ± 1.22%, after 4 h of ischemia and 20 h of reperfusion 52 ± 1.5%, and after 24 h of continuous ischemia 53 ± 1%.

The results are thus evidence that a combination of ischemia lasting between 30 min and 4 h with reperfusion leads as a rule to the formation of a zone of injury that is smaller than or, sometimes, equal to the area of that found after ischemia of the same duration unaccompanied by reperfusion.

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COMPENSATORY RECOVERY OF FUNCTIONS IN CATS AFTER SOMATOSENSORY TRACTOTOMY: ROLE OF THE CEREBRAL COMMISSURES

V. A. Fedan, M. M. Galogazha, and N. N. Lyubimov

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There is evidence of the important role of the cerebral commissures in transmission of somatosensory impulses from peripheral receptor to cerebral cortex [1, 8]. Besides classical pathways, primary somatosensory influences have been shown to be conducted through the corpus callosum and interthalamic commissure [2, 3, 6, 7]. It is evident that these commissural pathways can provide the structural basis for compensatory and recovery processes in the CNS when the classical somatosensory pathways are injured.

The object of this investigation was to study the character of compensation of kinesthetic functions in cats when classical commissural projections of the somatosensory system are blocked.

EXPERIMENTAL METHOD

Experiments were carried out on 36 adult cats divided into five groups depending on the character of neurosurgical operations: 1) intact, 2) after division of the right tegmentum mesencephali, 3) after combined division of the right tegmentum mesencephali and left optic tract, 4) after combined division of the left tegmentum mesencephali and left optic tract, 5) after combined division of the right tegmentum mesencephali and cerebral commissures. Divisions of half the tegmentum mesencephali involved the classical somatosensory pathways (spino—cervico—thalamic, posterior funiculus, and spino—reticulo—thalamic tracts). Additional division of the optic tract in the animals of groups 3 and 4 prevented visual control over ipsilateral (group 3) or contralateral (group 4) tegmental part of the body as the result of homonymous tract hemianopia. In the animals of group 5 commissures of the telencephalon, diencephalon, and mesencephalon (corpus callosum, anterior and hippocampal commis-

Laboratory of Neurocybernetics, Brain Institute, Academy of Medical Sciences of the USSR, Moscow.

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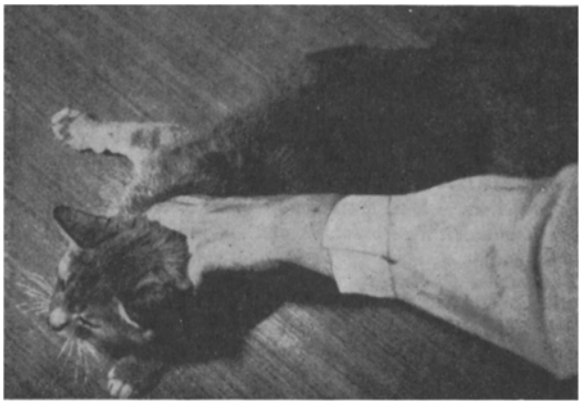

Fig. 1. Asymmetry of forelimbs on pressing shoulder region of cat of group 5 two years after operation.

sures, fornix, septum, interthalamic commissure, intercollicular commissure, and posterior commissure) were divided. The investigation consisted of two parts: neurological and behavioral. The neurological procedure included analysis of motor and sensory disturbances arising after operations on the midbrain, and also the use of additional tests to assess the state of somatosensory sensation in the forelimb. The tests were as follows: With the animal placed on a smooth horizontal platform, asymmetry of position of the forelimbs was studied while the observer pressed the shoulder region with his hand (test 1, Fig. 1); asymmetry of position of the shoulders relative to the sagittal plane also was determined (test 2); the time during which the animal kept the forelimb in an assigned position after passive flexion at the radiocarpal joint at an angle of 90° was measured (test 3). Test 3 was considered to be positive if the limb remained in the same position for more than 3 sec. The neurological investigation was carried out 3 months after operation on animals of groups 2-4 and in the course of 2 years on animals of group 5. Behavioral tests followed the technique in [4]. The cat was taught to strike a white target with the forelimb. Negative reinforcement consisted of electrodermal stimulation of the forelimb (through electrodes secured to the end of the target) by square pulses of current (40-80 V, 50 Hz, 1 msec). Twenty attempts were allowed during the experiment. Behavioral experiments were carried out 2 weeks after the operation and neurological tests after 2 days. The results were analyzed by "Élektronika 100-I" computer, using Fischer's angular transformation [5]. The experiments were concluded with a morphological control.

EXPERIMENTAL RESULTS

After division of half of the tegmentum mesencephali on the side contralateral to the operation the animals showed a typical symptom-complex of somatosensory disturbances (groups 2-5). The nature of this symptom-complex was that after the tegmental operation the cats' ability to control the part of the body opposite to the side of division was disturbed. This was manifested as symptoms of dysmetria, ataxia, and muscular atony, observed on the side opposite to the mesencephalic section. Additional tests for the contralateral forelimb were positive in all animals undergoing the operation (Fig. 2). However, the symptoms described above were unstable in animals of groups 2-4 and disappeared in the course of 2-3 months. No appreciable signs of recovery were observed in the animals of group 5, not only during 3 months of observation, but also after 2 years. Blocking of visual control of the part of the body ipsilateral or contralateral to the mesencephalic section had no significant effect on the rate of rehabilitation. The time course of the symptoms obtained by the additional tests (Fig. 2) had no significant differences in the animals of groups 2-4.

The behavioral experiments showed that the rate of conditioned reflex formation in animals of groups 2-4 involving the forelimb contralateral to the side of mesencephalic section was five times slower than in intact animals (Fig. 3). In the animals of group 5 no conditioned reflex whatever could be formed with that particular limb. Learning curves for animals of groups 3 and 4 did not differ significantly ($P > 0.05$) from those of the animals of group 2, evidence of the absence of any significant effect of visual control on the rate of conditioned reflex formation.

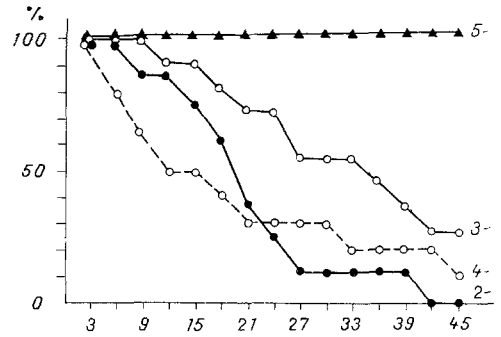

Fig. 2

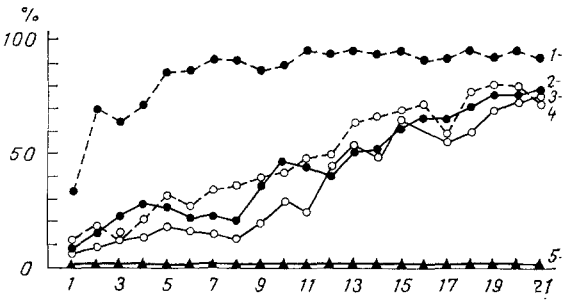

Fig. 3

Fig. 2. Time course of symptoms of disturbance of somatosensory functions revealed by test 3 in animals of groups 2-5. Abscissa, days of investigation; ordinate, percentage of animals with positive test 3.

Fig. 3. Time course of conditioned reflex formation in animals of groups 1-5. Animals of groups 2-5 trained on contralateral forelimb (relative to side of mesencephalic section). Abscissa, days of experiments; ordinate, average percentage of correct responses to 100 presentations of conditioned stimulus.

Cerebral commissures play an important role in the mechanisms of compensatory and rehabilitative changes in the CNS after blocking of the principal (classical) somatosensory pathways (groups 2-4). Interruption of commissures of the telencephalon, diencephalon, and mesencephalon prevents compensation of somatosensory functions, which is manifested as stability of the neurological symptoms and impossibility of conditioned reflex formation (group 5).

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