covering the areas of the autograft denuded of endothelium. The collagen fibers were greatly deformed and junctions between collagen and elastic fibers were disturbed (Fig. 3).

The total protein concentration was 4.3 ± 0.8 mg/ml in the aortic arch, 3.7 ± 0.62 mg/ml in the thoracic aorta, 4.3 ± 0.82 mg/ml above the graft, 4.5 ± 0.9 mg/ml in the graft, and 4.9 ± 0.9 mg/ml below the graft. There was a sharp increase in the number of macromolecular protein fractions in the zone of the autograft.

It can be concluded from analysis of the results that denervation and devascularization cause contraction of endotheliocytes and the formation of interendothelial "ports" during the hours immediately after the operation. This process facilitates rapid imbibition of blood by the vessel wall. Absence of transport of blood in the vessel wall leads to death of cells in all layers of the aorta and to desquamation of the endothelium. The fibrous structures of the aorta are most resistant to hypoxia and denervation. On the 10th day after denervation and devascularization irreversible changes take place in the collagen-elastic framework of the aorta, and these must adversely affect the strength and durability of vascular autografts.

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COMMISSURAL MECHANISMS OF RESTORATION OF VISUAL FUNCTION

V. N. Rybitskii, L. Rakić,
V. A. Fedan, M. Galogaža,
and V. A. Shepelev

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Recent investigations have demonstrated the great importance of forebrain commissures in the conduction of sensory impulses to the cerebral cortex [1, 2, 5, 6, 8]. Recent research by the present writers [4, 5] has shown that commissural projections of the visual and somatosensory systems are functionally highly effective. The callosal projections of these systems show features of topical organization [3, 4], evidence of the complexity of interhemispheric integration of sensory signals. It will be evident that the commissural systems of the forebrain, with their complex organization, their considerable size, and their functional effectiveness, are an important factor in the compensation of sensory functions in lesions of the principal afferent pathways.

The object of the present investigation was accordingly to study the dynamics of compensatory-repair processes in the CNS of cats after unilateral division of the optic tract, and with the commissures of the telencephalon, diencephalon, and mesencephalon either intact or completely divided.

EXPERIMENTAL METHOD

Experiments were carried out on 15 adult cats divided into three groups: 1) control animals, 2) cats with division of the left optic tract, 3) animals with division of the left optic tract and of commissures of the telencephalon, diencephalon, and mesencephalon. The fields of vision were measured monthly in all animals (in the cats of groups 2 and 3, 1 month

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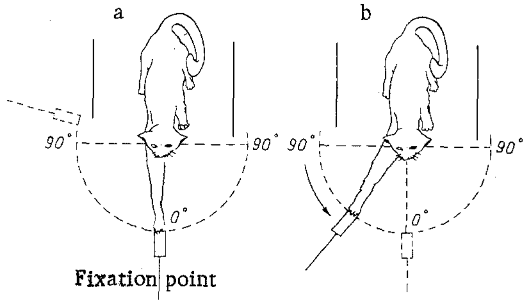

Fig. 1. Scheme of two stages of perimetric investigation: a) cat placed on platform, lateral visual fields limited by vertical blinds, testing target outside visual field, left eye covered; testing target applied to establish direct orientation of gaze of fixation point; b) after orientation of gaze on fixation point testing target applied from the right; at moment of discovery of testing target (cat strikes it with its paw) angle between fixation point and testing target is measured automatically.

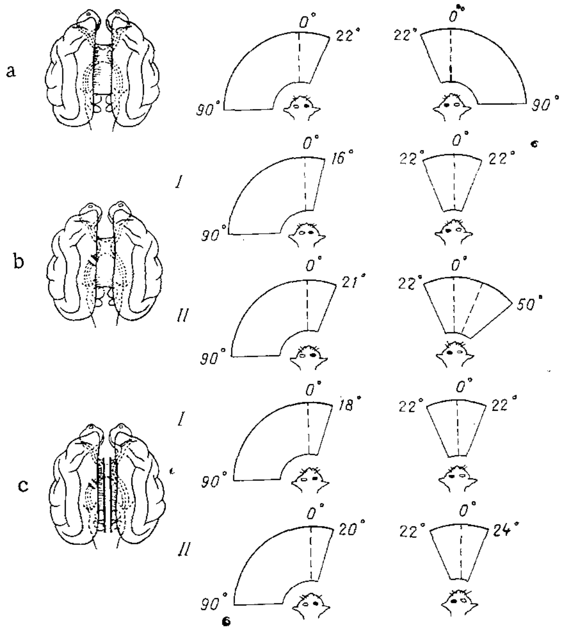

Fig. 2. Horizontal visual fields of intact cats (a), cats with division of left optic tract (b), and with combined division of left optic tract and cerebral commissures (c), 1 month (I) and 1 year (II) after operations.

after the operation). An active defensive reflex was formed beforehand in all the animals (1 week before perimetry) [6]. The cats were trained to strike a white target, located in either the center or periphery of the field of vision, with their forelimb. A latent period of response of 1-2 sec was achieved. Perimetry was carried out after successful reinforcement of the conditioned-reflex act. The cats were placed on the platform of the instrument and one eye was covered with a bandage (Fig. 1). The conditioning target was presented two to four times in the center and direct orientation of fixation obtained, after which the conditioning target was removed and the testing target applied, and moved from the periphery around the circle by means of a special device. The angle between the testing target and fixation point was measured automatically. The time when the cat noted the testing target (and responded by striking it with the forelimb) was marked on the graduated scale of the apparatus. During the first day of the experiment 10 measurements were made of each horizontal field of vision of both eyes. The investigation continued for 1 year. The results of the measurements were averaged for each group. The significance of differences between the results of the measurements was assessed by Student's test. At the end of the experiments the accuracy of the brain section was verified morphologically.

EXPERIMENTAL RESULTS

The results are shown diagramatically in Fig. 2. The nasal and temporal visual field of the control animals of group 1 did not vary significantly and measured 22.2 ± 3.1 and 87.6 ± 7.3° (M ± σ) respectively. During the year of the investigation (every month) no statistically significant differences were found in the size of the visual fields of cats of this group. After division of the left optic tract there was a sharp decrease in size of the right visual field in animals of groups 2 and 3 (Fig. 2b, I, c, I). The temporal visual field of the animals of group 2, 1 month after the operation, measured 22.5 ± 4.85°, compared with 22.1 ± 3.3° in the cats of group 3. The nasal visual fields of the animals of groups 2 and 3, 1 month after the operation, measured 16.1 ± 5.2 and 18.3 ± 4.2°, respectively. In the animals of group 2 gradual widening of the temporal and nasal visual fields began 2-3 months after the operation: They measured 38.2 ± 3.6 and 19.6 ± 2.3° after 6 months and 50.6 ± 3.9 and 21.8 ± 2.7° after 1 year (Fig. 2b, II).

The right nasal visual field of the animals of group 2 was thus completely restored 1 year after the operation. On the other hand, the temporal visual field was restored by only 58% 1 year after the operation. The visual field of the animals of group 3 showed no statistically significant changes during 1 year after the operation (Fig. 2c).

These results show that considerable compensation of the visual defects takes place in cats during 1 year after unilateral division of the optic tract. The nasal visual field of such animals is restored almost to normal in the course of this period and the temporal field by 58%. Comparison of the results of perimetry on animals of group 2 with those of group 3 with combined division of the optic tract and cerebral commissures leads to the conclusion that these compensatory-restorative processes have a commissural mechanism. The virtually complete absence of signs of compensation of the visual defects in the animals of group 3 in the course of 1 year of investigation indicates that it is the forebrain commissures which play the main role in this process. Comparison of the results of this investigation with those of the writers' previous study of the commissural mechanism of compensation in the somatosensory system [4] reveals considerable variation in the duration of rehabilitation processes in the visual system. Whereas not more than 2 months is necessary for sufficiently complete rehabilitation of animals with division of the classical somatosensory pathways, the same processes in the visual system require a time five or six times longer. Considering that in both cases compensation of sensory functions is based on a commissural mechanism, it can be concluded that principles of organization of commissural connections of the visual and somatosensory systems are different.

The results thus demonstrate that considerable compensation of tract hemianopia is possible in cats. The basic mechanism of such compensation is functional mobilization of the commissural system of the brain.

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