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RESTORATION OF MOTOR FUNCTION AFTER PARTIAL DECORTICATION AND DURING EXPOSURE TO TWICE THE GRAVITATIONAL LOAD

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The search for specific treatment of disturbed functions after brain injury remains an urgent problem even today. Methods of transplantation of brain tissues and cerebrospinal fluid therapy, which involve the obtaining of material from donors [2, 3], are evidently the most promising approaches. This paper describes an attempt to activate the injured victim's own powers in order to optimize the course of recovery.

EXPERIMENTAL METHOD

Experiments were carried out on noninbred male albino rats weighing 180-200 g. The zone of representation of the limbs in the motor cortex of the left hemisphere was removed from all the rats by suction [6] under hexobarbital anesthesia, in a dose of 70 mg/kg, intraperitoneally; the mean values for the limits of the extirpated zone were from 4 mm rostrally to 4 mm caudally to the bregma, and from 0.5 to 4 mm laterally to the sagittal suture. There were two series of experiments: I) with exposure to twice the gravitational load daily for 10 days from the 2nd day after the operation, and for 20 min each day, II) with exposure for 40 min daily for 30 days starting on the 1st day after the operation. There were two series of control experiments, which corresponded to the experimental series but without exposure to the increased gravitational load. The double gravitational load was created by spinning the animals (they preferred to move facing the direction of spinning) in the horizontal plane in the clockwise direction when viewed from above. The animals either went willingly into the cabin (measuring 6 × 8 × 15 cm) of the "roundabout," or they did not resist being placed inside it. The direction of the force of gravity was dorsoventral, and during spinning the rats sat in a normal, restful position. The supporting function was tested by measuring the distance between the first and fifth digits of the hind limbs while the rat held itself in the vertical erect position for 10 successive measurements [4]. The mean value for the day and for the series and the confidence interval at the $p = 0.95$ level were calculated. After the end of the experiments the animals' brain was removed for morphological examination.

EXPERIMENTAL RESULTS

The experiments showed that post-traumatic pathology, identified by testing as a decrease in the distance between the digits of the limb whose cortical projection area was damaged was reduced in rats of the experimental series compared with the controls. In the case of daily exposure for 20 min this decrease was small and was visible only during the first days after the operation (Fig. 1). Exposure for 40 min led to a greater difference between the data of the experimental and control series (Fig. 1). In series II the differences remained to a greater or lesser degree almost 2 weeks after the operation,

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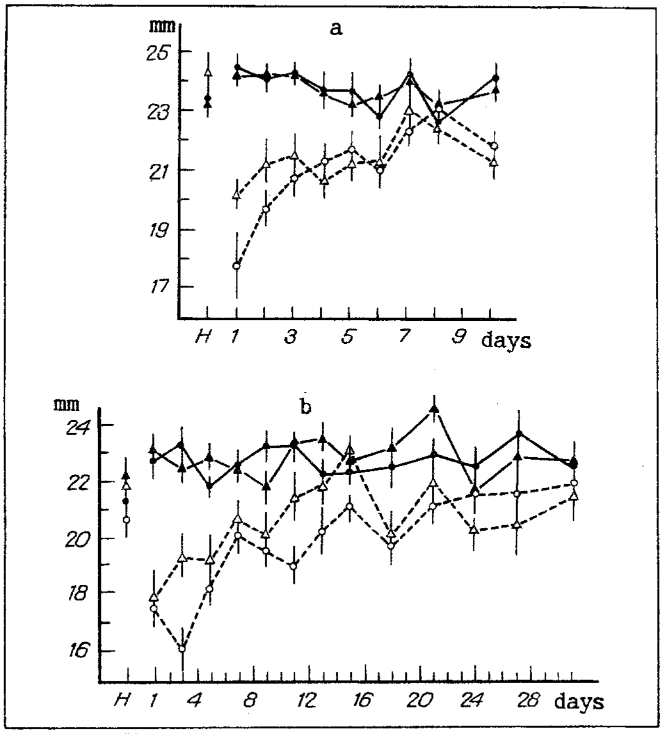

Fig. 1. Distance between digits of hind limbs under normal conditions and after partial decortication. a) Exposure to increased gravitation for 20 min daily, b) for 40 min daily. Ordinate, distance (in mm). Triangles — experimental series, circles — control. Broken lines — data for limb contralateral to cortical injury, continuous lines — data for ipsilateral limb, with undamaged cortical projections. Confidence interval shown for p = 0.95.

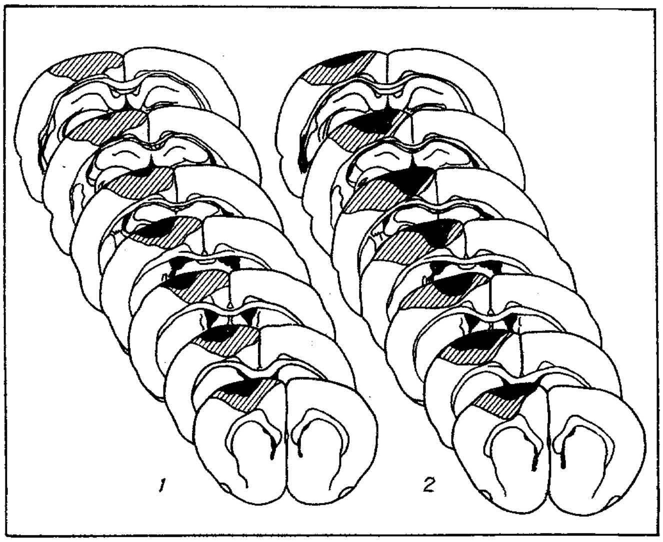

Fig. 2. Diagram shows size of region of extirpation in serial frontal brain sections. Black region — minimal, obliquely shaded — maximal removal. a, b) Series I and control, c, d) control and series II.

i.e., at a time when the pathology was distinctly present as shown by the test used. The greatest differences were found on the first days after the operation, at the same time as the maximal differences between the rats of series I and their control. Examination of the brain revealed the absence of any significant differences in the state and dimensions of the experimental trauma. Averaged values of the tissue defect in all series of rats are given in Fig. 2 on diagrams of frontal sections.

It has long been argued on account of which structures and brain formations the motor function is restored after injury to the cerebral cortex. Previously [5] it was suggested that after similar experimental trauma to the motor cortex, the late stages of recovery (about 6 months) were characterized by the involvement of cortico-bulbo-spinal pathways which, in particular, control the formation of posture, in the compensatory process. Assuming that increased gravitation acts primarily on processes of postural regulation, we suggested that the motor structures of the brain stem (evidently the vestibular nuclei) may be activated by an increased gravitational load, and that early involvement of these structures would have a positive influence on the course of recovery from the motor disturbances. As regards the type of this activation, it most probably resembles in its character the predominantly static load arising through an increase in body weight [1] rather than increased action mainly on the vestibular system, suggested on the basis of the therapeutic effect of rapid rotation of the revolving chair type for neurological patients [7]. This suggestion seems possible on the basis of the fact that the effect increased significantly with an increase in the duration of exposure to increased gravitation from 20 to 40 min, whereas the homogeneity of the spatial distribution of the force of gravity remained essentially unchanged and was the same for rats of series I and II.

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