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EFFECT OF CEREBROSPINAL FLUID FROM DONORS WITH COMPENSATED UNILATERAL MOTOR DISORDERS ON RECOVERY OF RECIPIENTS WITH MOTOR DEFICIT AFTER ANALOGOUS TRAUMA

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KEY WORDS: pathology of the central nervous system, postural asymmetry, motor pathology, compensation of motor pathology

As was shown peviously the cerebrospinal fluid (CSF) of animals 3-4 weeks after unilateral extirpation of the motor neocortex acquires the property of abolishing asymmetrical function of spinal centers in recipients in the acute post-traumatic period after a similar operation. This takes place only if the sides of the trauma are identical in recipients and donors [5]. These results were obtained on spinal animals, in which the character of action of the donor's CSF at the behavioral level remained unexplained. The aim of the present investigation was to study the action of the CSF of animals with compensated motor disturbances after unilateral extirpation of the motor neocortex on the rate of recovery of the recipients with the motor deficit as a result of undergoing identical trauma.

EXPERIMENTAL METHOD

Noninbred male albinorats weighing 160-200 g were used. There were two series of experiments, each comprising 3 groups of animals with 12 rats in each group. An operation of unilateral extirpation of the cortical area of representation of the hind limb was performed on all the experimental animals [2, 3]. In the animals of series I the operation was performed on the left, and in those of series II, on the right hemisphere.

On the second day after the operation, under superficial ether anesthesia, a solution of the freeze-dried CSF of donor animals, with functionally compensated deficit after a similar operation on the cortex, in a dose of 0.15 mg/20 μl physiological saline, was injected into the cisterna magna of animals of the 1st and 2nd groups of both series. This dose was determined as the most effective in the behavioral test used by preliminary experiments on small groups of animals. CSF was taken from the donors 21 days after unilateral extirpation of the cortical area of representation of the hind limb, for at that time muscle tone in the hind limbs has become symmetrical and CSF and brain extracts of such animals have the property of correcting postural asymmetry of the hind limbs of spinal animals undergoing identical trauma [2, 4, 5]. The sides of injury were the same in the donors and recipients of the first group, but opposite in the donors and recipients of the second group. Animals of the third group served as controls, and they were subjected only to puncture of the dura mater, under similar conditions, in the region of the cisterna magna without injection of the solution of freeze-dried CSF.

The degree of recovery of motor function of the affected limb was assessed by the number of times the rat slipped with their right and left hind limbs when held on a revolving wooden rod [6]. The number of limps of the affected limb per minute was calculated and expressed as a percentage, taking the value of this parameter on the first day (24 h) after the operation as 100%. The numerical results were subjected to statistical analysis by standard methods [1].

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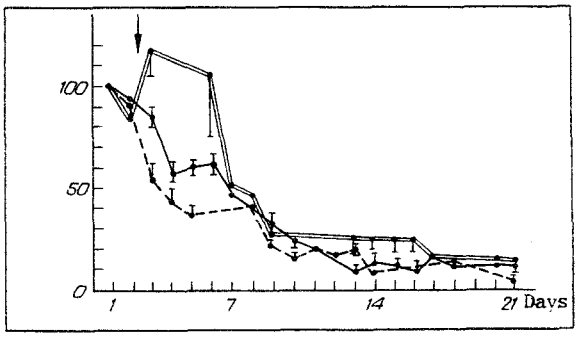

Fig. 1

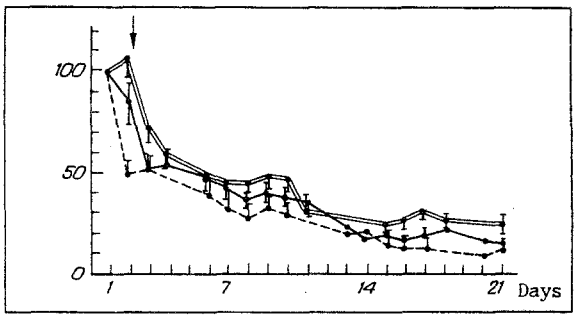

Fig. 2

Fig. 1. Dynamics (in percent, ordinate) of reduction of number of slips by the right hind limb. Number of slips on first day after operation taken as 100%. Broken line (animals of group 1) denotes injection of CSF from donors with homotopic lesion; double line (animals of group 2) injection of CSF from donors with heterotopic lesion; continuous line (animals of group 3) – without injection of donor's CSF.

Fig. 2. Dynamics (in percent, ordinate) of reduction of number of slips by left hind limb. Legend as to Fig. 1.

EXPERIMENTAL RESULTS

The results of the experiments of series I are given in Fig. 1: recipient rats of groups 1, 2, and 3, with left-sided extirpation of the motor neocortex. The action of the donor's CSF was exhibited on the day after injection and persisted for 4 days (3rd-7th days after the operation). In the animals of group 1 there was a significant reduction in the number of limps by the affected limb compared with the control (group 3) by 33% (88% in the control and 55% after injection). Later, the parameters of recovery did not differ significantly from the control. In the animals of group 2 there was a significant increase in the percentage of limps by 31% compared with the background, and by 54% compared with the control group. In the animals of group 2 a second phase of manifestation of the action of the donor's CSF also was observed, on the 13th-16th days after the operation, and it was characterized by a significantly higher (on average by 15%) figure for the percentage of the number of limps compared with the control. It can accordingly be concluded that if the sides of the brain trauma coincided in the donors and recipients, the donor's CSF led to more rapid recovery of motor functions after trauma to the cortex.

The results of the experiments of series II are given in Fig. 2: the recipient rats of groups 1, 2, and 3 underwent right-sided extirpation of the motor neocortex. The degree of difference in recovery of the recipient animals from the motor deficit compared with the control was much less marked than in series I. The therapeutic effect of injection of the donor's CSF into the recipients of group I was not significant. Meanwhile, in the recipients of gropu 2, restoration of motor function of the affected limb, although inferior to the control, was not so inferior as in the animals of series I. Two phases of action of the donor's CSF were observed in this group: on the second and on the 16th-18th days after the operation. The use Wilcoxon's paired test suggests that the percentage of limps of the affected limb throughout the period of observation was significantly higher in this group than in the control. Thus only a tendency persists in the action of the donor's CSF on the rate of recovery of motor function in the recipients as observed in the experiments of series I.

One possible explanation of differences in the results of the experiments of series I and II may be nonequivalence of the motor deficit following right- and left-sided trauma to the neocortex. The test of gripping a metal rod with the hind limbs showed that animals with left-sided extirpation of the motor neocortex can achieve more effective recovery of the disturbed motor functions than animals with right-sided brain trauma [3]. We also know from clinical experience that the prognosis regarding restoration of function of the paralyzed limb is more favorable for patients with left-hemispheric brain damage than in patients with right-hemispheric trauma [1]. Our own experimental data also support this view: comparison of the results of the control experiments (animals of the 3rd groups in series I and II) show that in animals with a damaged right hemisphere (Fig. 3) a sharper decrease in the number of slips takes place during the first three days after the operation by the damaged limb than in animals undergoing left-sided trauma. However, from the 10th to the 13th day this parameter

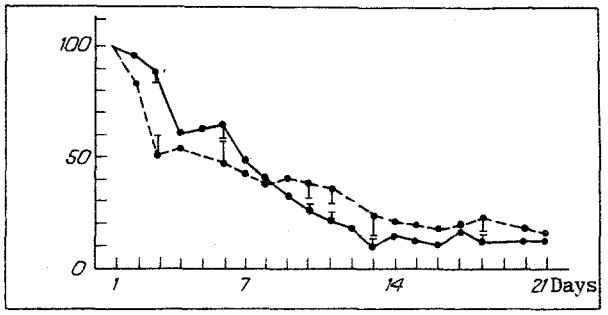

Fig. 3. Dynamics (in percent, ordinate) of reduction in number of slips by hind limb after removal of left (continuous line) and right neocortex (broken line).

is reversed, and later its value in animals of series II remains on average 15% higher than in animals with left-sided brain damage.

On the whole this investigation suggests that transfusion of CSF from compensated donors may be a method of accelerating the restoration of motor function after unilateral brain trauma, but provided that the side of the lesion and, as far as possible its location, in the brain are identical in donors and recipients.

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UNILATERAL PERIPHERAL INFLUENCES ON THE MOTOR SYSTEM AS ACTIVATORS OF POSTURAL ASYMMETRY FACTORS IN ANIMALS WITH AN INTACT NERVOUS SYSTEM

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In the initial stages of the study of induction of postural asymmetry (PA), as a result of the appearance of substances in the nervous system modifying the working of the motor centers of the spinal cord asymmetrically, it has been considered that these phenomena are the result of asymmetrical processes in the nervous system, caused solely by unilateral influences on the motor structures of the brain [1-3]. Later it was shown that PA can be induced by a change in the peripheral afferentation to the spinal cord [4]. The aim of this investigation was to test the hypothesis of the possible induction of asymmetrical processes in the intact nervous system, leading to PA, as a result of a systemic response of the recipient.

EXPERIMENTAL METHOD

Noninbred male albino rats weighing 180-200 g were used. The animals were anesthetized with ether, the skin divided in the right or left thigh, and the thigh muscles divided with a sharp razor at the middle level, down to the femur, after which the skin was sutured and

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