

# CONSEQUENCES OF SIMULTANEOUS SECTION OF THE ANTERIOR AND POSTERIOR HALVES OF THE SPINAL CORD IN DOGS

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The work of E. A. Asratyan [1] and his collaborators, as well as that of L. S. Gambaryan [2] from the laboratory of E. Sh. Airapetyants, has shown that segmental lesions of the posterior columns of the spinal cord, and also total removal of the posterior columns over several segments [3], do not prevent the formation of new or the manifestation of previously established conditioned electro-defensive reflexes.

Continuing along this line of investigation, the present work was undertaken with the aim of using the conditioned reflex method for the study of the disturbance and dynamics of recovery of motor, sensory, and vegetative functions in dogs subjected to simultaneous section of the anterior and posterior halves of the spinal cord at the level T5-T12.

Such operative intervention had not, as far as could be established, been previously performed. There are descriptions of experiments in the literature in which hemisection of one and then the other side was carried out either simultaneously or sequentially. Thus, Osava [5], using dogs, performed hemisection followed several weeks later by a second hemisection on the contralateral side of the cord 2-3 segments lower than the first. After 8 days almost complete recovery of impaired functions was observed. Osava noted complete recovery even after a third operation. In 1924 Danitch [6], using rabbits, and E. A. Asratyan in 1937, and S. N. Ivanova [4] rather later, using dogs, obtained similar results. However, as these authors point out, recovery of function proceeded appreciably more slowly after a second operation.

## EXPERIMENTAL

9 adult dogs and 2 pups were subjected to operation. In 4 dogs conditioned electro-defensive motor reflexes were first established only after operation. In 5 dogs these were established prior to operation. In all dogs the anterior half of the cord was sectioned at the level T-5, and the posterior half at T-12.

## RESULTS

Simultaneous section of the anterior and posterior halves of the spinal cord in dogs led to exceptionally profound and fairly prolonged disturbances of the motor, sensory and vegetative functions of the organism.

During 7-10 days after operation the dogs were lying with rigidly extended limbs. Pricking, pinching the skin below the operative site, powerful compression of the legs and tail elicited no reaction. The state of profound spinal shock persisted for 7-10 days; after this period there was extremely slow and gradual recovery of reflex flexion of limbs to mechanical and electrical stimuli, and also even slower and more gradual recovery of cutaneous sensibility of the affected parts of the body. At this stage of functional recovery the dogs began to stand on the front legs. During the attempts to rise on the front legs the extension of the hind legs was enhanced.

In 2 dogs extension of hind limbs in response to calling or stimulation of skin receptors on the head (the Asratyan-Durmishyan phenomenon) was observed from the 15th day. On the 25th - 30th day the dogs moved about with the help of the front legs, dragging along the rigid extended hind legs. These positive changes were later followed by recovery of the impaired functions of standing (40th-60th day), walking and running (90th-120th day).

Disturbances of a vegetative nature accompanying simultaneous bilateral section of the spinal cord at different levels became apparent first of all in considerable vasodilatation over the affected parts of the body (especially the distal parts of the hind limbs), which led to a rise in their temperature of 4-6°. All the dogs showed very pronounced disturbances of defecation and micturition over 15-25 days. All the motor, sensory and vegetative disturbances disappeared in the course of 3 months, and the dogs could then stand and walk fairly freely.

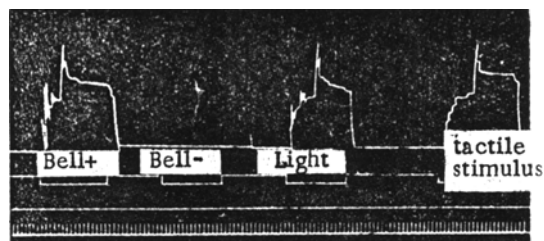


Fig. 1. Conditioned electro-defensive motor reflexes in the dog Belka established after operation. Records from above downwards; tracing of motor response of hind limb; conditioned stimulus marker; unconditioned stimulus marker; time marker (1 second). Plus sign signifies a positive stimulus, minus sign - negative stimulus.

In the case of pups sensory and motor disturbances were less pronounced and, other conditions being equal, recovery of impaired functions proceeded more rapidly.

After the recovery of impaired functions a study was made of the conditioned electro-defensive motor reflexes, established in the hind limbs to acoustic, optic, and cutaneous mechanical stimuli, in 7 dogs. After the establishment of positive conditioned reflexes differentiation was developed. The process of extinction of the positive conditioned reflex was then studied.

As can be seen from Fig. 1, good conditioned electro-defensive motor reflexes, both to positive and negative stimuli, were established in the dog Belka after bilateral section of the anterior and posterior halves of the spinal cord. In the case of dog Sevuk, moreover, there was recovery of conditioned reflexes developed prior to operation (Fig. 2). When conditioned electro-defensive reflexes were developed in the affected limbs, their supporting and locomotor functions were still to some extent impaired.

Thus the new variant of organic lesion of the central nervous system (simultaneous section of the anterior and posterior halves of the cord at different levels of the thoracic region) was accompanied by profound motor, sensory and vegetative disturbances; however, these functions underwent recovery, though very slow and gradual, and furthermore, it was possible not only to restore but also to develop anew positive and negative conditioned electro-defensive motor reflexes in these animals. (Fig. 3).

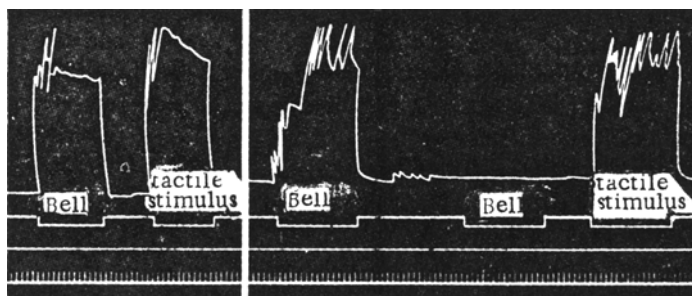


Fig. 2. Conditioned electro-defensive reflexes in the dog Sevuk. a) Before operation; b) After operation. Records as in Fig. 1.

Histological examination of the spinal cord of 2 dogs (Belka and Kashtanka) revealed that the operative procedure employed did in fact damage the anterior and posterior halves of the cord. The bridge remaining between the sites of section proved sufficient for the recovery of functions impaired by operation. It is possible to subscribe to E. A. Asratyan's view that that intracentral pathways, spared in a certain area proved to be able to take over, under the influence of cortical mechanisms, functions which had dropped out as the result of operative intervention.

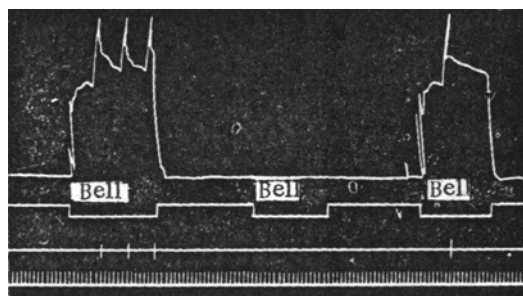


Fig. 3. Conditioned electro-defensive motor reflexes established after operation in the pup Bobik.

Records as in Fig. 1.

#### LITERATURE CITED

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\* In Russian.

\*\* Translated into Russian.