CHANGES IN NUCLEI OF THE BRAINSTEM RETICULAR FORMATION FOLLOWING DEAFFERENTATION

S. A. Babayan

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Morphological changes in the nuclei of the brainstem reticular formation were studied in cats after induction of degeneration by injury to a peripheral nerve and spinal deafferentation. In both groups of animals degenerative changes were found principally in the same nuclei of the reticular formation and at the same times after deafferentation.

Studies of the results of trauma to a peripheral nerve [5] have shown that degenerative changes extend to various levels of the nervous system, including its central portions. Results indicating the selective injury to hypothalamic nuclei in such cases have been obtained [1-3]. It has also been shown [4] that when the degeneration becomes generalized it leads to changes in many of the systems of the body and, in particular, to disturbances in the myocardium. Such changes in the heart muscle have been found after deafferentation of the heart [6].

An important aspect of this problem is the study of the state of nuclei of the brainstem reticular formation connected anatomically and functionally with the hypothalamic region and containing regulatory centers for the cardiovascular system.

EXPERIMENTAL METHOD

Male cats were used. The animals of group 1 received an injection of 0.1 ml 2% formalin solution into the sciatic nerve, which was divided distally to the site of injection. Spinal deafferentation was performed on the animals of group 2, the upper five thoracic spinal ganglia being removed on both sides*. The animals of group 1 were killed 7, 21, 45, and 90 days, and those of group 2, 2 weeks and 1 month after the operation.

Series of frontal sections through the medulla, pons, and midbrain of intact (control) and experimental cats were investigated. The sections, 8 μ in thickness, were stained with cresyl violet by Nissl's method; every 10th section was studied.

EXPERIMENTAL RESULTS

Seven days after division of the sciatic nerve the microscopic picture of the sections examined was still normal. On the 21st (Fig. 1), 45th, and 90th days (Fig. 2) histopathological changes were found in the lateral reticular nucleus, the nuclei of the raphe, and the central nuclei of the pons. Disintegration and lysis of the chromatophilic material (central and peripheral chromatolysis, cell ghosts) were found in the neurons of these nuclei, and other changes included vacuole formation in the cytoplasm, an eccentric location of the nucleus or its expulsion from the cells, proliferation of glial cells, surrounding of nerve cells by glial cells, and a glial reaction at the site of dying cells. After this operation histopathological changes were thus found in the nuclei of the reticular formation of the medulla and pons; no significant abnormalities were observed in the nuclei of the mesencephalic reticular formation.

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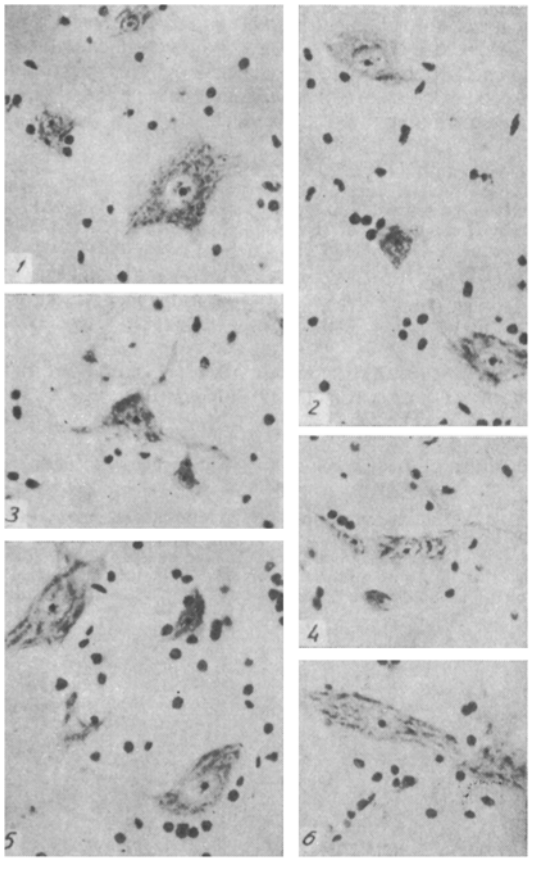

Fig. 1

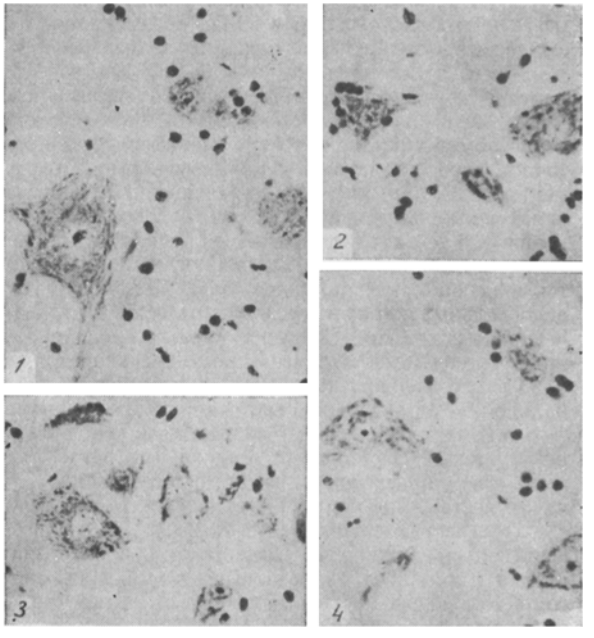

Fig. 2

Fig. 1. Changes in nerve cells of nuclei of brainstem reticular formation 21 days after division of sciatic nerve: 1) gigantocellular nucleus; 2) central nucleus of pons (posterior part); 3) central nucleus of pons (anterior part); 4) lateral reticular nucleus; 5) gigantocellular nucleus; 6) paramedian ventral nucleus. Nissl, 600 ×.

Fig. 2. Changes in nerve cells of nuclei of brainstem reticular formation 90 days after division of sciatic nerve: 1) gigantocellular nucleus; 2) paramedian ventral nucleus; 3) nucleus of raphe; 4) lateral reticular nucleus. Nissl, 600×.

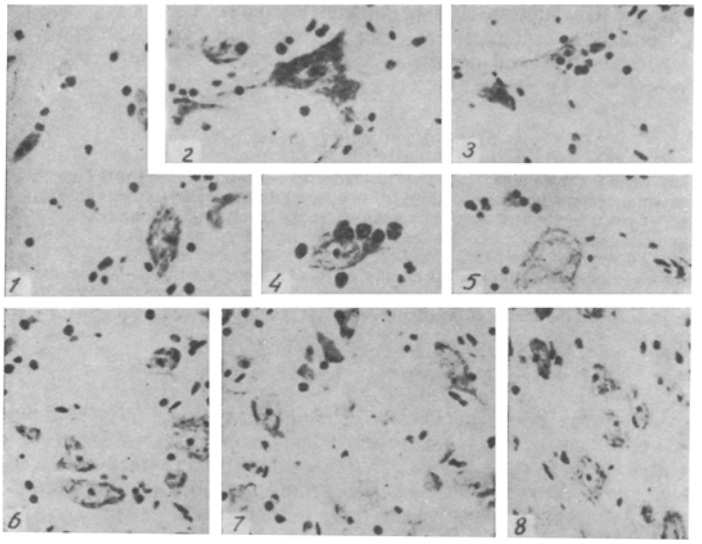

Fig. 3. Changes in nerve cells of nuclei of brainstem reticular formation 1 month after spinal deafferentation of the heart: 1) gigantocellular nucleus; 2) lateral reticular nucleus; 3) central nucleus of pons (posterior part); 4) paramedian ventral nucleus; 5) central nucleus of pons (anterior part); 6) paramedian dorsal nucleus; 7) nucleus of raphe; 8) dorsal nucleus of vagus. Nissl, 600×.

Two weeks after spinal deafferentation the microscopic picture of the sections studied was the same as in the control. After 1 month (Fig. 3) histopathological changes were found in the lateral reticular nucleus (peripheral chromatolysis), the gigantocellular nucleus (chromatolysis in the large cells, surrounding of small cells by glial cells), the paramedian reticular nuclei (palely stained cells with pulverized Nissl's substance, nerve cells surrounded by glial cells), the central nuclei of the pons (chromatolysis, vacuolation of the cytoplasm, cell ghosts, penetration of nerve cells by glial elements), the nuclei of the raphe (palely stained cells), and also the dorsal nuclei of the vagus (pulverization and disintegration of the Nissl's substance in the nerve cells). No histopathological changes were found in the mesencephalic reticular nuclei of the animals of this group.

Comparison of the results shows that after both spinal deafferentation and trauma to the peripheral nerve degenerative changes were found in basically the same nuclei of the reticular formation (lateral reticular nucleus, paramedian reticular nuclei, gigantocellular nucleus, nuclei of the raphe, central nuclei of the pons) and at the same times after trauma.

These observations suggest common mechanisms of development of the disturbances observed. An important role in their genesis is evidently played by pathogenic afferent stimuli connected with injury to the corresponding fibers. Cells of the lateral and posterior horns of the spinal cord are known to be connected by fibers with the reticular formation, which itself receives collaterals from various sensory afferent pathways [7].

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