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MORPHOLOGICAL CHANGES IN NEURONS OF THE HIND LIMB REFLEX ARC DURING LONG TERM IMMOBILIZATION

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16. Abstract

Twelve adult rabbits were immobilized for 9 to 31 days, followed by histological study of the nerve processes of lumbar vertebra VII and sacral vertebra I, the sciatic nerve and the motor endings of the thigh muscles. In the spinal ganglia, dystrophic changes of increasing severity with immobilization time were found, including pericellular edema, vacuolized neuroplasm, pycnotic changes, cytolysis and destruction. Chromatophilic matter decreased and was partly bleached, and amitotic division occurred. A portion of the sciatic nerve fibers were argentophilic, and some fragmentary decomposition occurred. Considerable dystrophic changes occurred in the motor nerve endings.

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MORPHOLOGICAL CHANGES IN NAURONS OF THE HIND LIMB REFLEX ARC DURING LONG TERM IMMOBILIZATION

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The experiment was conducted on 12 full grown rabbits. Complete /383* immobilization of the hind limbs was achieved by application of a plaster cast up to the 12th rib, which immobilized the entire trunk and hind limbs in the customary position of the rabbit. Immobilization of the limbs lasted 9, 15, 21, 25 and 31 days. The animals then were killed with an air embolism.

In order to determine the condition of components of the reflex arc of the hind limbs, the spinal ganglia, posterior root and sensory and associative cells of lumbar vertebra VII and sacral vertebra I were studied. The nerve centers of the arc under study, the motor cells of the anterior horns, the anterior root, the sciatic nerve and the motor endings of the thigh muscles are located in them. Histological study was carried out, by means of hematoxylin-eosin staining according to Nissl and silvering according to Bil'shovskiy-Gross.

Study of the preparations permitted tracing the spread of dystrophic changes in the spinal reflex arc.

Spinal Ganglia

On day 9 of immobilization, all the cells were involved in a dystrophic process of the hydropic change type, but a small portion of the cells were distinguished by the beginning of pycnotic changes.

*Numbers in the margin indicate pagination in the foreign text.

Chromatophilic matter in the cells decreases and partially bleaches. Hydropic degeneration increases on day 15 of immobilization. Counting of the changed cells in serial sections of the ganglia showed that there were 40% cells with pericellular edema, 10.7% with vacuolized neuroplasm, 6.5% in the pycnotic change stage and 8% in the destruction stage. Later during immobilization (day 21), counting of the changed cells showed that 34% of the cells were involved with pericellular edema, 8% with vacuolization and regional cytolysis and 1% in the destruction stage. Chromatophilic matter with the appearance of dust was partially bleached. The reactivity of the sensory cells is marked by cases of the capacity for amitotic division: 2.1% of all cells were in the cytotomy stage. On day 25 of immobilization, the same changes were observed, but the dystrophic process became chronic and occurred sluggishly. The count showed that there were 18.5% cells with pericellular edema and 4% with regional cytolysis. Amitotic division was found in 1.3% of all nerve cells. On day 31 of immobilization, the dystrophic process involved all ganglial cells.

Spinal Cord

Long term immobilization of the limbs caused dystrophic changes in the cells of the spinal cord. The cells of the associative and sensory nuclei display the greatest susceptibility. In early periods of immobilization, day 9, the chromatophilic matter is reduced in these cells, and all round activation of the glial components is evident. The motor cells were unchanged. On days 15 and 21, part of the cells of the associative and sensory nuclei had indistinct outlines, with irregular decrease in chromatophilic matter, with cuts and partial bleaching of it. A reduction in nucleoli was observed. Activation of

the glial components was evident. A decrease in chromatophilic matter and a decrease in nucleoli was evident in the motor cells. On days 25 and 31 of immobilization, sluggish dystrophic processes occurred. Activation of the glial components was insignificant, bleaching was slight, the contours of most associative and sensory cells were blurred, and there was lysis of single cells. In the motor cells, there was dissolving and partial decrease of the chromatophilic matter.

In the sciatic nerves, a portion of the fibers is argentophilic and eruptive. In late periods of immobilization, the number of fibers in the fragmentary disintegration stage increases, but the majority of the fibers is unchanged.

The motor nerve endings in the muscle fibers, on day 9 of immobilization, display an increased argentophilic nature, swelling, blurring of the terminals, and swelling and necrosis of the auxiliary cells. On days 21, 25 and 31 of immobilization, a portion of the motor endings disintegrates completely, and the remainder stay in the dystrophic change stage.

Conclusions

1. Long term immobilization causes loss of weight and dystrophy /384 of the muscles and bones. The older the animal, the more strongly expressed is the dystrophic process. Dystrophy develops actively in the first two weeks, with a severe reaction of the glial components, and it then acquires a chronic nature and sluggish course.

2. Over the length of the spinal reflex arc, the dystrophic changes spread irregularly. We observed the most profound and general dystrophy

in the sensory and associative nuclei of the corresponding segments of the spine and, finally, in the motor nerve endings. In all cases without exception, the motor cell nuclei of the spine and a large portion of the sciatic nerve fibers proved to comparatively resistant.

3. Despite the resistance of the spinal motor cells and their processes, which form the sciatic nerve, massive dystrophic changes of the sensory cells of the spinal ganglia and the cells of the associative and sensory nuclei of the spine can reproduce in the direction of excitation in the spinal reflex arc and cause functional disorders of the hind limbs.

4. The set of insults to sensitivity of part of the reflex arc we have found explains why long term immobilization of the limbs in military or everyday trauma results in temporary hypesthesia and adynamia.