NEUROHISTOLOGICAL CHANGES IN THE VAGUS NERVE UNDER THE INFLUENCE OF COLCHICINE IN AN EXPERIMENT

Mamataliev Abdumalik Rasulovich, PhD, Associate Professor,
Samarkand State Medical University,
Samarkand, Uzbekistan

Abstract: In the experiment, colchicine was used to study axonal transport and nerve trophism upon application to nerve fibers. The study was conducted on Wistar rats. Three days after application, uneven thickening of cylindrical myelinated nerve fibers and swelling of neurofibrils were observed. The overall morphological changes in nerve fibers can be attributed to the effect of colchicine on neurofibrillary structures. These structures are involved in forming the overall cellular structure of nerve fibers and maintaining the tone of the plasma membrane. This, in turn, has a certain significance for the mechanism of slow axonal transport in neurons.

Keywords: experiment, colchicine, rat, vagus nerve, application, nerve cell, morphology, nerve fibers, neurogenic myopathy.

НЕЙРОГИСТОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ БЛУЖДАЮЩЕГО НЕРВА ПОД ВЛИЯНИЕМ КОЛХИЦИНА В ЭКСПЕРИМЕНТЕ

Маматалиев Абдумалик Расулович PhD, доцент,
Самаркандский государственный медицинский университет,
Самарканд, Узбекистан

Аннотация: В эксперименте колхицин применялся для изучения аксонального транспорта и трофики нерва при аппликации на нервные волокна. Исследование проводилось на крысах Вистар. Спустя 3 дня после аппликации выявлено неравномерное утолщение цилиндрических миелиновых нервных волокон и набухание нейрофибрилл. Общие морфологические изменения в нервных волокнах могут быть объяснены воздействием колхицина на нейрофибриллярные структуры. Эти структуры участвуют в формировании общей клеточной структуры нервных волокон и

поддержании тонуса плазматической мембраны. Это, в свою очередь, имеет определённое значение для механизма медленного аксонального транспорта в нейронах.
Ключевые слова: эксперимент, колхицин, крыса, блуждающий нерв, применение, нервная клетка, морфология, нервные волокна, нейрогенная миопатия.

ТАЖРИБАДА КОЛХИЦИН ТАЪСИРИ ОСТИДА АДАШГАН НЕРВНИНГ НЕЙРОГИСТОЛОГИК ЎЗГАРИШЛАРИ

Маматалиев Абдумалик Расулович PhD, доцент,

Самарқанд давлат тиббиёт университети,

Самарқанд, Ўзбекистон

Аннотация: Тажрибада колхицин препаратининг нерв толалари ўтказувчанлига аппликациясида аксонал транспорт ва нерв трофикасини ўрганиш мақсадида қўлланилади.Тадқиқот Вистар каламушларида ўтказилди. Аппликациядан сўнг 3 кундан бошлаб, цилиндрсимон миенли нерв толалари нотўғри шаклда қалинлашуви ва нейрофибрилларнинг шишиши аниқланди. Нерв толаларидаги умумий морфологик ўзгаришлар колхициннинг нейрофибрилляр тузилмаларга таъсири билан тушунтирилиши мумкин. Бу тузилмалар нерв толаларидаги ҳужайра умумий тузулишини ташкил этишда ва плазматик мембрана тонусни сақлашда иштирок этади. Бу эса нейронларда секин аксонал транспорт механизмида муайян аҳамиятга эга.
Калит сўзлар: тажриба, колхицин, каламуш, адашган нерв, аппликация, нерв ҳужайраси, морфология, нерв толалари, нейроген миопатия.

Introduction. The analysis of mechanisms of nervous regulation of internal organ activity has been and remains at the center of attention in domestic and world neurophysiology for decades [1,2]. This regulation is based on local and central nervous mechanisms. The former are realized in the neuronal networks of the metasympathetic nervous system and are based on a system of local reflex arcs closing within the internal organ [3,4,5]. Local reflexes provide only the basic functional functions of the internal organ and, under certain conditions, allow it to function without connection to the central nervous system. The latter are located at different levels of the central nervous system and control the activity of the internal organ, bringing it into line with the needs and conditions of the internal and external environment [6]. Application of colchicine to nerve conductors is used for the experimental study of axonal transport and nervous trophics. The study of these issues is of great importance in researching the pathogenesis of neurogenic myopathies and, in particular, cardiogenic myopathies. In the literature, morphological changes in nerve conductors are evaluated ambiguously: some find no significant changes in ultrastructure; many authors note a decrease in the number of neurofilaments, indicate swelling of nerve processes, asymmetric violation of their shape [7]. In culture with the addition of colchicine to the medium, unevenness of the contours of processes, varicosities, detachment of processes from the substrate, and pulling toward the cell body are observed. Given the selective action of colchicine in small and medium doses on microtubules, the complex of morphological changes in nerve conductors requires deciphering, which was the purpose of this study.

Study Objective. To investigate in experiment the changes in conductivity and trophics of neuron axons as a result of colchicine application to the vagus nerve.

Materials and methods. The experiment was performed on 30 male Wistar rats weighing 150–200 g. All operations and manipulations with animals were carried out under general anesthesia, following the humane principles of the European Community Guidelines (86/609/EEC) and the Helsinki Declaration, as well as in accordance with the “Rules for conducting work using experimental animals.” Under nembutal anesthesia, 100 μg of colchicine in a filler was applied to the cervical part of the right vagus nerve. As a control, 7 rats with filler application without colchicine and 5 intact rats were examined. At 2, 3, 4, 5, 7, and 10 days, a segment of the right vagus nerve at the application site was excised. Material from experimental and intact rats was examined light-optically (silver impregnation according to Bielschowsky-Gros). The next stage was the study of histological preparations using a light microscope MT 5300L with a digital camera at magnifications from ×100 to ×400 in accordance with recommendations for morphometric studies.

Results. Light-optically, starting from day 3 after application, uneven thickening of axial cylinders and swelling of neurofibrils were detected. On semithin sections stained with toluidine blue, changes in the configuration of the transverse section of myelinated processes were studied. Processes with a diameter of less than 4 μm have a shape close to round in both control and experimental material. Processes with a diameter of 4 μm and more in intact rats are polymorphic; outlines close to a circle make up an average of 33%. By day 3 after application, the configuration of sections becomes more isomorphic (up to 71% round sections). By day 5, the number of round sections sharply decreases (to 15%); the configuration of processes is characterized by sharp foldability, invaginations inward of the process of part of the plasma membrane together with the myelin sheath are observed. Such figures look like “process within process” and are not found in intact nerves. By day 10, the ratio of sections of different configurations approaches normal, but double myelin contours of individual processes continue to be encountered. At the submicroscopic level, vesicular swellings of axial cylinders were revealed: expanded segments are filled with neurofilaments and fragments of microtubules without a definite orientation. Part of the axial cylinders is poor in neurofibrils and appears lightened. On oblique sections, the adhesion of microtubules to the axonal plasma membrane is visible. The detected two-phase change in the shape of the transverse section of axial cylinders with a diameter of 4 μm and more apparently depends on the tone of the plasma membrane on the state of cytoskeletal structures, which is observed in tissue culture, as well as under conditions of experimental and congenital pathology of nerve trunks. The monomorphism of small and polymorphism of large axial cylinders is apparently associated with a different ratio of microtubules and neurofilaments in them and emphasizes a more stable cytoskeletal structure of small-caliber processes resistant to the action of colchicine.

Conclusion. With the application of 100 μg of colchicine to the right vagus nerve of rats, deformation of processes, two-phase change in the configuration of the transverse section of axial cylinders, disaggregation of microtubules, and disorientation of neurofilaments are observed. The complex of morphological changes can be explained by the action of colchicine on neurofibrillary structures involved in the organization of the cytoskeleton of processes and in maintaining the tone of the plasma membrane, which has a certain significance in the mechanism of slow axonal transport.

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