

THE ULTRASTRUCTURE OF NEUROCYTES OF THE MOTOR CENTER OF AN INJURED SCIATIC NERVE UNDER THE INFLUENCE OF HIGH-FREQUENCY ELECTROSURGICAL INSTRUMENT

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УЛЬТРАСТРУКТУРА НЕЙРОНОВ ДВИГАТЕЛЬНОГО ЦЕНТРА ТРАВМОВАННОГО СЕДАЛИЩНОГО НЕРВА В УСЛОВИЯХ ВОЗДЕЙСТВИЯ ВЫСОКОЧАСТОТНОГО ЭЛЕКТРОХИРУРГИЧЕСКОГО ИНСТРУМЕНТА

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РЕЗЮМЕ

Разработана новая экспериментальная модель соединения тканей в области травмы периферического нерва методом электрокоагуляции. Был применен электронно-микроскопический метод исследования, который позволил изучить и сравнить картину изменений нейронов двигательного центра травмированного седалищного нерва в условиях стандартной травмы и новой экспериментальной модели. Установлено отсутствие негативного влияния на нейроны двигательного центра седалищного нерва электрокоагуляции.

УЛЬТРАСТРУКТУРА НЕЙРОЦИТІВ РУХОВОГО ЦЕНТРУ ТРАВМОВАНОГО СІДНИЧОГО НЕРВУ ЗА УМОВ ВПЛИВУ ВИСОКОЧАСТОТНОГО ЕЛЕКТРОХІРУРГІЧНОГО ІНСТРУМЕНТУ

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РЕЗЮМЕ

Розроблена нова експериментальна модель з'єднання тканин в ділянці травми периферійного нерва методом електрокоагуляції. Був застосований електронно-мікроскопічний метод дослідження, який дозволив вивчити та порівняти картину змін нейроцитів рухового центру травмованого сідничого нерву за умов стандартної травми та нової експериментальної моделі. Встановлено відсутність негативного впливу на нейрони рухового центру сідничого нерву електрокоагуляції.

Key words: neurocyte, motorium, peripheral nerve, injury, high-frequency electrical surgical instrument.

At the present level is widely used high-frequency electrosurgery in medical practice for the purpose of electrotomy, necrosis and coagulation of tissues. However, there is not a lot of information about the morphological changes of nervous, vascular and connective tissue's elements of the peripheral nerves and their segmental centers under the influence of high-frequency electrosurgical devices (EHVCH — devices) on the nerve trunk, which limits the use of these devices in neurosurgery [1].

The effects of the high-frequency electrosurgical devices explain if there is a high current power, which can arise intense local heat emission that is transferred to the tissue [2, 3]. Coagulation or electrotomy is possible due to the changes in the signal, that comes from the device in the form of vibrations of the appropriate type and frequency.

Take into account the particular importance of perikaryons during the alternative and recovery processes in the nerve fibers [2, 4], there is the important information about the nature of ultrastructural changes in them due to the using of the EHVCH-devices during the surgery on the injured peripheral nerve.

The aim of this study was to establish the neurocytes' ultrastructural changes of the motor center during the degeneration and regeneration of injured sciatic nerve due to the influence of the high-frequency electrosurgical instrument.

MATERIALS AND METHODS

Studying the processes of regeneration of damaged peripheral nerve under the influence of high-frequency electrosurgical instrument was conducted on white rats — males, weight 150–200 g. Experimental animals were divided into 4 groups: the first group were rats with reconstituted standard peripheral nerve injury; the second group had reconstituted standard peripheral nerve injury under the influence of high-frequency electrosurgical instrument; the third group of rats had direct effect of high-frequency electrosurgical instrument on the peripheral nerve; the fourth group were pseudooperated rats (control).

Animals of the II group was reconstituted standard model of peripheral nerve injury in generally accepted way, thereafter there was made a circle connection of injured epineurium in bipolar coagulation conditions with the help of using bipolar instrument EHVCH-device such as tweezers, for preservation of epineurium's hermiticity in the place of connection of the central and peripheral segments of injured nerve. For this purpose was used high-frequency electrosurgical instrument «Ekont-0201» by national producer «Kontakt,» which allows to conduct electrotomy, monopolar and bipolar coagulation of soft tissues with high frequency current.

Animals in the III group was reconstituted the access to the sciatic nerve, and was made its mobilization, thereafter in the middle of its third part was carried out an influence in bipolar coagulation condition with the help of working bipolar instrument EHVCH — device such as tweezers. The procedure was carried out in the follow way: section of peripheral nerve 0.5 cm in length, in its middle third part, was sank between two branches of tweezers, in order to all rat sciatic nerve's structures in the transverse dimensions were affected by high-frequency electrosurgical instrument.

The material for the study were segmental centers of the sciatic nerve namely the anterior horn of the lumbosacral of the spinal cord after 3 weeks surgery. There was used the electron microscope method of the investigation.

RESULTS AND DISCUSSION

During the electron microscope study of the motoneuronic pool of the sciatic nerve in the spinal cord, under the direct influence of electrosurgical instrument on the nerve trunk area, within 3 weeks after surgery, there was found a significant heterogeneity of the pathologic picture. There are significant distinct retrograde changes in many spinal cord's perikaryons at this period of time, which are clearly visible against the background of virtually unchanged. For the degree of electron density of the cytoplasm, the motoneuronic pool of the sciatic nerve in the spinal cord of this group of animals consists of three types of cells — the «dark», «light» and «transitional», but the «dark» cells prevail with signs of retrograde changes among them.

It was revealed, that there are observed mainly the signs of the irritation and degeneration. in the altered nerve cells of the anterior horn of the lumbosacral spinal cord. The neuropile of the anterior horns of the spinal cord has signs of the edema, which manifests by significant sections of enlightenment, and covers neurons' perikaryons, involves nerve fibers, gliocytes and vessels.

There is a polymorphism of the ultrastructural pattern among the gliocytes too. There are numeral gliocytes with manifestation of reactive changes against the background of the neuroglia's cells with relatively normal structures.

The results of the electron microscopy showed, that in the II group of animals, within 3 weeks after surgery, there was also detected the ultramicroscopic picture's polymorphism, during the study of the motoneuronic pool of the sciatic nerve in the lumbosacral anterior horn of the spinal cord, in the standard trauma conditions and the electrosurgical instrument's influence. There are significant perikaryons' retrograde changes of the spinal cord at this period of time, against the background of the virtually unchanged ones, but in comparison with the III group of animals, the number of neurons is moderate, which underwent an irritation and degeneration,

For the degree of electron density of the cytoplasm, the motoneuronic pool of the sciatic nerve in the spinal cord of this group of animals also consists of three types of cells — the «dark», «light» and «transitional», but the «dark» and «light» cells with signs of retrograde changes prevail among them.

Morphologically degenerative altered neurons of this group of animals are not different from degenerative altered dark neurons in the I and III groups of animals. The irritation has different degrees of severity in the neurons' bodies in this groups.

The neuropile of the anterior horns of the spinal cord, which covers neurons' perikaryons of the II group of animals, has also signs of edema, which manifested by the presence of less amount of the enlightenment parts, which are located chaotically among the normally constructed plots, in comparison with the previous III group of animals.

Neuroglia's cells of the anterior horns of the spinal cord in the II group of animals, also form clusters or lie separately. Heterogeneity of the morphological picture exists also among the gliocytes. There is a moderate amount of the gliocytes with the reactive changes manifestation against the background of the neuroglia's cells with relatively normal structure. However, many glial's cells of this group of animals have signs of increased activity.

The moderate amount of the anterior horns nerve fibers of the spinal cord also have the signs of reactive changes in the form of irritation. There was also revealed the heterogeneity pathologic picture during the electron microscope study of the motoneuronic pool of the sciatic nerve in the spinal cord under the standard nerve trunk injury, within 3 weeks after surgery.

The animals of this group predominantly have neurons with signs of the metabolic processes activation, that occur in the cells of all three types — «light», «dark» and «intermediate.» Sometimes there are dark cells with signs of degradation against their background. The results of the electron microscopy showed, that there are three types of cells, because of the degree of electron density of the cytoplasm, — the «dark» «light» and «transitional» with no signs of degradation, in the IV (control) group of animals, within 3 weeks after surgery, during the study of the motoneuronic pool of the sciatic nerve in the lumbosacral anterior horn of the spinal cord.

The neuropile of the anterior horns of the spinal cord, which covers neurons' perikaryons of the IV group of animals does not have enlightenment plots and consists of the chaotically arranged glial's cells and the nerve cells' processes. Neuroglia's cells of the anterior horns of the spinal cord in the IV group of animals predominantly lie separately or next to the neurons' bodies and have normal structure.

CONCLUSIONS

The analysis of the changes in the motor segmental center's neurocytes of the sciatic nerve showed, that in any groups we could not observe the death of the perikaryons, which is an indication of their stability to the EHVCH-device, but the degeneration proces of the motor neurons are bright marked in the group of animals with reproduced directly impact of the EHVCH-device on the sciatic nerve, which may indicate the accelerated rate of the degeneration in this group of animals, unlike others.

The deep breach of the particular perikaryons' ultrastructure of the motor neurons, in all groups of animals, except the control one, can be due to the damaging effect of the metabolic's products, which come from the peripheral process with retrograde transport aksonnym, therefor the revealed changes can be regarded as a manifestation of the typical non-specific reaction its perikarion on the injury its peripheral process, which

is not connected with adverse effects of the EHVCH-device.

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