УДК 611.892:611.899:22.171

# ТАЖРИБАДАГИ ИТЛАРДА ЎТ ПУФАГИНИ ОЛИБ ТАШЛАГАНДАН СЎНГ ПСЕВДОУНИПОЛЯР НЕЙРОНЛАРНИНГ МОРФОЛОГИК ТУЗИЛИШИ

**Рахмонова Хабиба Нуруллаевна**
Самарқанд Давлат тиббиёт университети ассистенти

**Мухитдинова Сабрина Мунисовна**
Самарқанд Давлат тиббиёт университети талабаси
E-mail: asilarahmonova9@gmail.com
ORSID: https://orcid.org/0009-0006-0813-120X

***Изоҳ.*** *Холецистэктомия энг кенг тарқалган қорин бўшлиғидаги операциялардан бири бўлиб, ҳар йили амалга ошириладиган холецистэктомиялар сони 500 мингдан ошмоқди. Орқа миянинг нерв тугунлари энг муҳим периферик марказлар сифатида қорин бўшлиғи аъзоларининг иннервациясида муҳим роль ўйнайди, морфологик адабиётларда ўт пуфагининг интрамурал нерв аппаратининг орқа мия нерв тугунлари билан микро тузилиши ва иннервация алоқаларига бағишланган илмий ишлар сони камлиги маълум. Холецистэктомиядан сўнг орқа мия нерв тугунларида реактив ўзгаришлар юзага келади, улар перицеллюлар шиш билан; баъзи нейронларда гиперхромия белгилари билан намоён бўлди. Катта, ўрта ва кичик нейронлар популяцияларида, ядро ва ядрочанинг марказий жойлашувига эга бўлган нормохром ҳужайралар сонининг 2-3 баравар камайиши, бир вақтнинг ўзида периферик хроматолиз ва ядро-ядроча аппаратининг дислокацияси ҳодисалари бўлган ҳужайралар сонининг пропорционал ўсиши аниқланди.*

***Калит сўзлар:*** *Ниссл моддаси, холецистэктомия, нейронлар, хроматолиз, орқа мия нерв тугунлари, ядро, ядроча.*

# МОРФОЛОГИЧЕСКАЯ СТРУКТУРА ПСЕВДОУНИПОЛЯРНЫХ НЕЙРОНОВ ПОСЛЕ УДАЛЕНИЯ ЖЕЛЧНОГО ПУЗЫРЯ У ЭКСПЕРИМЕНТАЛЬНЫХ СОБАК

**Рахмонова Хабиба Нуруллаевна**
Ассистент Самаркандского государственного медицинского университета
**Мухитдинова Сабрина Мунисовна**
Студентка Самаркандского государственного медицинского университета

***Аннотация.*** *Холецистэктомия является одной из самых частых абдоминальных операций, и количество холецистэктомий, проводимых ежегодно, превышает 500 тысяч. Спинномозговые узлы, как важнейшие периферические центры, играют значительную роль в иннервации органов брюшной полостью, в морфологической литературе имеются единичные работы, посвященные микростроению и иннервационным связам интрамурального нервного аппарата желчного пузыря со спинномозговыми узлами. После холецистэктомии в чувствительных ганглиях спинномозговых нервов развивались реактивные изменения, которые сопровождались перицеллюлярным отеком, часть нейронов были с признаками гиперхромии, с повышенной сателлитарной реакцией. В популяциях крупных, средних и малых нейронов по сравнению с таковым у интактных животных выявлено уменьшение в 2–3 раза количества нормохромных клеток с центральным положением ядра и ядрышка при одновременном пропорциональном увеличении числа клеток с явлениями периферического хроматолиза и дислокацией ядерно-ядрышкового аппарата.*

***Ключевые слова:*** *вещество Ниссля, холецистэктомия, нейроны, хроматолиз, спинномозговые узлы, ядро, ядрышко.*

## MORPHOLOGICAL STRUCTURE OF PSEUDOUNIPOLAR NEURONS AFTER GALLBLADDER REMOVAL IN EXPERIMENTAL DOGS

**Rakhmonova Khabiba Nurullaevna**
Assistant of Samarkand State Medical University
**Mukhitdinova Sabrina Munisovna**
Student of Samarkand State Medical University

***Annotation.*** *Cholecystectomy is one of the most frequent abdominal surgeries, and the number of cholecystectomies performed annually exceeds 500 thousand. Spinal nodes, as the most important peripheral centers, play a significant role in innervation of abdominal organs; in morphological literature there are single works devoted to microstructure and innervation connections of the intramural nervous apparatus of the gallbladder with spinal nodes. In the populations of large, medium and small neurons compared to intact animals, a 2-3 times decrease in the number of normochromic cells with a central position of the nucleus and nucleolus was revealed with a simultaneous proportional increase in the number of cells with phenomena of peripheral chromatolysis and dislocation of the nuclear-nucleus apparatus.*

***Keywords:*** *Nissl substance, cholecystectomy, neurons, chromatolysis, spinal nodes, nucleus, nucleolus.*

**Introduction.**

Prevention and treatment of liver and biliary tract diseases remain an urgent problem of modern medicine up to the present time. There is an increasing frequency of cholelithiasis and associated increase in the number of surgical interventions in this area. Cholecystectomy, according to some authors, takes the second place after appendectomy. Despite the use of new treatment technologies, the percentage of its complications in the form of postcholecystectomy syndrome is significantly high. After cholecystectomy 48% of patients complain of pain and dyspepsia. It is known that the control of digestion is carried out through the enteric system, the central nervous system and integrative centres in the sympathetic ganglia. The extent to which the enteric and central nervous system control digestion varies considerably along the digestive tract [10, 13]. The enteric nervous system is recognised as a complex neural network controlling a variety of cell populations including smooth muscle cells, mucosal secretory cells, endocrine cells, microcirculatory bed, immune and inflammatory cells. This network is organised in several plexuses, each of which provides quite autonomous control of gastrointestinal functions [8,10,13]. Classical [1,2] as well as 21st century studies have been devoted to the study of the morphology of digestive neurons. Immunohistochemical determination of the presence or absence of neuronal substance (i.e. chemical coding of intestinal neurons) has become an effective and readily applicable tool for distinguishing intestinal neuron types in the guinea pig and later in other species. These cells were first described by Stach in 2000 in pigs and guinea pigs as type IV neurons. No chemicals specific to these three types of efferent neurons of the ENS have been found. What they have in common is the content of cholinacetyltransferase, and this too is not found in all types of spiny neurons. Morphological and chemical heterogeneity of ENS neurons may be related to the presence of their regional features, which has been established by a number of researchers. All available methodological approaches, both "classical" and "modern", can contribute to this [6]. Thus, the wide use of immunohistochemistry to study innervation of the organs of the biliary system [7,11,12] does not detract from the effectiveness of traditional neurohistological methods, since up to now the classification of ENS neurons is based on their morphological features. In this regard, such studies can be continued to study different parts of the digestive tract, in particular, the biliary system [10] in the comparative aspect of its components.

Without knowledge of anatomo-functional features of the peripheral nervous system it is impossible to successfully present morphological substantiation of the postcholecystectomy condition. Spinal ganglia as an object of study are of interest due to the fact that they include sensitive neurons that receive information from different parts of the animal’s body [13]. Each spinal nerve has two roots - dorsal and ventral.

On the dorsal root is the intervertebral spinal node (ganglion), which contains sensitive neurons. There is a branch from the spinal nerve that innervates the spinal cord sheaths. It is believed that spinal ganglia neurons respond faster and more clearly than spinal cord neurons and are characterised by great functional plasticity [8].

The state of Nissl substance (chromatophilic substance, tigroid, basophilic substance) is of great importance in the assessment of neuronal activity. It is known that the variety of morphological manifestations of Nissl substance and the degree of its basophilia corresponds to a certain functional state of the neuron. Nissl substance, its design and quantity are considered to be the most characteristic for neurons [5]. Chromatophilic substance is quite labile during changes in the functional state of neurons. At the same time, the functional interpretation of tigroid structural changes is diverse [13].

Despite the variety of studies of cholecystectomy effect on metabolic, dystrophic processes occurring in the digestive system, there are no comprehensive studies on compensatory and adaptive reactions in the peripheral nervous system in domestic animals [2, 4, 7, 9]. The study of the degree and dynamics of pathological and morphofunctional changes in neurons is important, firstly, to explain many clinical symptoms, and secondly, to assess reparative and compensatory-adaptive capabilities of nervous tissue [3]. Due to the lability of Nissl substance in physiological conditions and especially in pathological changes, it is the best indicator for assessing the state of a neuron [6].

Different types of neurons have a different structure of Nissl's substance. In particular, motor cells of the brain and spinal cord are characterised by its arrangement in the form of clumps forming bands parallel to the body or nucleus (stachychromic type), in neurons of sympathetic ganglia the substance often has a network-like structure (achrichromic type), in Purkinje cells of the cerebellum with a reticulate-globular structure (archichochromic type), small grains scattered throughout the cytoplasm (griochromic type) are characteristic of neurons of sensitive ganglia [6].

As evidenced by the results of studies by T.D. Dehkanov et al. [8] of thoracic spinal ganglia of dogs, the nodes were more often ellipsoidal in shape, their dimensions were 5.84±0.15 mm longitudinally and 2.64±0.12 mm transversely. It should be noted that the size of ganglia did not depend on sex and body weight of dogs. The central part of the ganglia of dogs localises from 480 to 576 neurons of different sizes and having a nucleus in the plane of the longitudinal slice. According to morphometric indices there were neurons (small) with diameter up to 35 μm (52,6 %), medium - 35-50 μm (17,2 %) and large - more than 50 μm (29,6 %). A large number of studies are devoted to the reaction of brain and spinal cord neurons under various extreme effects, such as hypokinesia, drug use, immune reactions, noise exposure, and other factors [1, 9, 10].

The issue of so-called hyperchromic (dark) neurons of the brain and spinal cord is one of the debatable issues in neuromorphology and is constantly discussed [8, 11]. The data obtained at present suggest that hyperchromia reflects one of the phases of the functional state of a neuron. In one case, the state of hyperchromia may be reversible, while in other cases, especially under constant action of a damaging factor, it leads to shriveling of neurons and cell death.

There is no information in the literature about the reaction of neurons of spinal ganglia of dogs during cholecystectomy in the corresponding parts of the vertebral column. Regarding the reaction of spinal ganglia neurons, we can emphasise the studies conducted by T. Dehkanov [8]. After gallbladder removal, various structural changes were traced in the sensitive neurons of various nodes of spinal nerves. In populations of large and medium-sized neurons, various variants of peripheral chromatolysis, more often in combination with nucleus displacement, were most characteristic, while a significant part of neurons retained normal structure.

Cells with significant structural transformations, such as changes in the shape of the nucleus, were detected. Small neurons were more characterised by transformations concerning the state of the nucleus-nucleus apparatus; in addition to the displacement of these structural components, in some cells it was possible to observe such changes as the presence of chromatophilic substance near the nucleus sheath.

Purpose of work was to trace the dynamics of changes in the structure of spinal ganglia neurons after gallbladder removal at different terms in dogs.

Morphometric characteristics of neurons were studied in the sensitive ganglia of spinal nerves in the thoracic region of seven dogs in segments VII and IX (Th7, Th), three mongrel dogs served as controls. The experiments were performed in compliance with the guidelines for the use of animals published by the International Society for Neuroscience (Guidelines for the Use of Animals in Neuroscience Research. Membership Directory of the Society, 1992). Biopsy specimens were fixed in 10% neutral buffered formalin at t+4 oC at pH 6.9-7.0.

**Research materials and methods.** To study the cellular architectonics of spinal neurons we used the Nissl method based on "regressive" sharp staining of slices with subsequent differentiation in 700 alcohol [4].

Quantitative studies were performed on neurons with a nucleus and a clearly contoured nucleus in the slice plane. In one animal, at least 100-150 neurons were studied with their subdivision into large, medium and small neurons, focusing on the dimensional characteristics of the cell body. Three groups were distinguished in the studied neuron populations: normochromic, hyperchromic and hypochromic cells. In the group of normochromic neurons the following was taken into account: central position of the nuclear nucleus apparatus and with its topography; in the group of hyperchromic neurons - localisation of Nissl substance, localisation of the nuclear nucleus apparatus, size of tigroid granules, presence of central, total or peripheral chromatolysis, concentration of Nissl substance near the karyolemma, degree of nucleus ectopia; in hypochromic neurons - presence of peripheral chromatolysis, central, pole chromatolysis taking into account the localisation of the nuclear nucleus apparatus. Histosections were evaluated using the Bioscan system, including a For Avikon Tex microscope, a Kwality 500 megapixel colour video camera, a computer and a computer application program under the Windows operating system.

**Results of the study.** After cholecystectomy in the sensitive ganglia of spinal nerves of dogs reactive changes developed, which were accompanied by pericellular oedema, some neurons had signs of hyperchromia, with increased satellite reaction. In a number of cases satellite cells were concentrated at one of the cell poles. The number of shadow cells increased, many of them with signs of apoptosis (Fig. 1a).

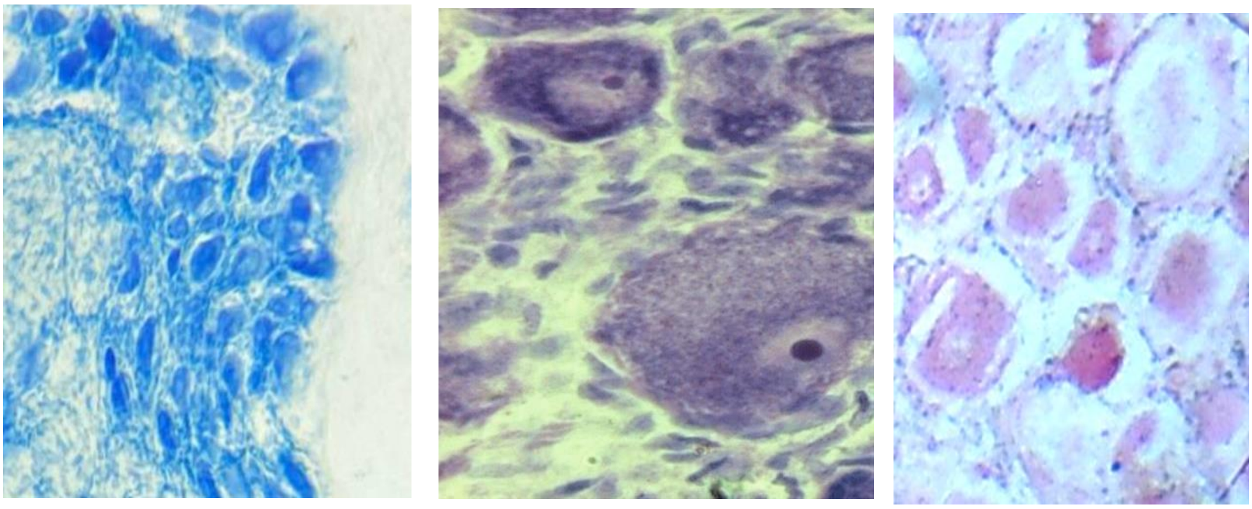

Fig. 1 . Appearance of shadow cells, deformation of contours, signs of apoptosis (a); total chromatolysis, displacement of the nucleus to the pole of the neuron, hypertrophy of the nucleus, increased satellite reaction, pericellular oedema (b); detachment of capsules from neurons. Nissl staining (a, b) Brasher staining (b). Microphoto. Bioscan. Magnified: a, c - 240; b - 500.

Some peculiarities of the nuclei reaction in those neurons subjected to total chromatolysis were revealed, namely, there is a sharply expressed hypertrophy and some displacement to the karyolemma (Fig. 1b). Detachment of capsules from perikaryons is registered, in some cases this distance reaches 13-19 µm (Fig. 1c). Although it is known that contact, with neuroglia cells plays an important role in the regulation of the process of dendritic structure formation and neuron functioning. In populations of large, medium and small neurons compared to intact animals, a 2-3 times decrease in the number of normochromic cells with a central position of the nucleus and nucleolus was detected with a simultaneous proportional increase in the number of cells with phenomena of peripheral chromatolysis and dislocation of the nuclear nucleus apparatus.

To assess the state of Nissl substance (tigroid) in neurons of spinal ganglia, we used the scheme developed by V.V.Malashko (5); according to the scheme, we distinguished three levels (Fig. 2).

The first level includes the characteristic of Nissl substance, namely, diffuse and clumpy components. The two types of components are present in small, medium and large neurons.

The second level was assessed by the predominance of the diffuse component or the clumpy component. Small, medium and large Nissl substance structures were defined by size. In the cytoplasm of neurons, tigroid is concentrated in the form of networks that form focal or total conglomerates.

The third level considers the distribution of the tigroid throughout the perikaryon of the neuron. The topography of the tigroid can be in several directions: from the periphery to the centre of the cell, from the centre to the periphery of the cytoplasm, gradient-polar, eccentric localisation and densely, adjacent to the plasmolemma of the neuron. In populations of large and medium-sized neurons, different variants of peripheral chromatolysis are most characteristic, more often in combination with nucleus displacement. For small neurons, characteristic rearrangements concerned the state of the nuclear nucleus apparatus; along with displacement of these structural components, such changes as the concentration of Nissl substance near the nuclear envelope were observed in some neurons.

**Conclusion.** In neurons of spinal ganglia after cholecystectomy in dogs, a trend of structural transformations was observed, namely, a decrease in the number of neurons with normal structure and an increase in the number of neurons with combined changes. Structural rearrangements were characterised by pericellular oedema, hyperchromia, increased satellite response, total chromatolysis, appearance of shade cells and neurons at the stage of apoptosis.

## REFERENCES:

1. Abramovitz, Y. N. Complications of surgery for discogenic disease of the spine / Y. N. Abramovitz // Neurosug. Clin. of North. Am. – 1993. – Vol. 4, № 1. – P. 167–176.
2. Artyukhina, N. I. Neuroglial changes in the cerebral cortex of animals under the influence of white noise / N. I. Artyukhina, K. K. Gecht, I. P. Levshina // Archives of Anatomy, Histology and Embryology. - 1981. - T. 81, № 9. - C. 27-33.

3. Biryuchkov, M. Yu. Features of surgery of herniated intervertebral discs / M. Yu. Biryuchkov // Vopr. neurohir. - 2005. - № 4. - C. 22-23.
4. Bogolepov, N. N. Changes in the ultrastructure of nerve cells during compression of the cortex of the large hemispheres of the brain by supratentorial tumours / N. N. Bogolepov, Z. P. Krushinskaya // Zh. neuropathol. and psychiatr. - 1976. - T. 76, № 4. - C. 501-511.
5. Churilina, S. E. Effect of vibration on the ultrastructure of nerve cells of the rat spinal ganglia / S. E. Churilina // Structure, function and reactivity of cells: a collection of scientific articles - Moscow, 1973. - Issue. 5. - C. 101-103.
6. Dehkanov T.D., Oripov F.S. at all., Features of the structural organisation of the ampulla of the phaternal papilla of animals with different feeding patterns / Scientific Journal №2(57) March 2021 Moscow. Pages 94-96.
7. Gorelikov, P. L. Functional changes of chromatophilic substance and RNA content in the cytoplasm of sympathetic neurons in case of synaptic transmission disorder / P. L. Gorelikov // Archives of Anatomy, Histology and Embryology. - 1981. - T. 81, № 7. - C. 58-64.
8. Netukova, N. I. Changes in the ultrastructure of the rat bulbar nuclei cells under the influence of kainic acid / N. I. Netukova, S. V. Kulchitsky, J. A. Pesotskaya // Morphology. - 2003. - T. 123. - № 2. - C. 30-32.
9. Rakhmanov Z.M., Dehkanov T.D. Morphology of structural components of the mucous membrane of the ampulla of the Fater papilla // Problems of Biology and Medicine, 2016.
10. Rakhmonov Z.M., Oripov F.S., Dekhkanov T.D. Gross and Microscopic Anatomy of the Vater Papilla (Hepatopancreatice Ampule) in Animals with and without Gall Bladder/ American Journal of Medicine and Medical Sciences, 2020. 10 (1). C. 55-58.
11. Rakhmonova H.N., Rakhmonov Z. M. at all. Morpho-Functional Changes in Neurons of Spinal Nodes after Experimental Cholecystectomy in Mongrel Dogs, American Journal of Medicine and Medical Sciences p-ISSN: 2165-901X e-ISSN: 2165-9036 2023; 13(12): 1904-1907
12. Safonova, G. D. General characteristics of spinal ganglia of dogs / G. D. Safonova, A. P. Kovalenko, E. A. Khomicheva // Morphology. - 2006. - 129, № 2. - C. 84-85.
13. Safonova, G. D. Structural changes of the neurons of the sensitive nodes of the spinal nerves at the lengthening of the tibia of adult dogs / G. D. Safonova // Morphology. - 2011. - T. 139, № 3. - C. 35-40.
14. Sood, P. P. Immunocytochemical localization of angiotensinogen in the Nissl bodies / P. P. Sood, M. Richoux, R. Wegmann// Cell. and Mol. Biol. – 1988. – Vol. 34, N 5. – P. 461–463.