

TO THE COMPARATIVE MORPHOLOGY OF THE INTRAMURAL NERVOUS APPARATUS OF THE HEART IN SOME SMALL-FOODED ANIMALS

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Abstract: The article studies the histological structure of the nerve elements of the subepicardial nerve apparatus in some sexually mature mammals using silvering methods. Comparative data show that the most developed subepicardial nerve plexuses, synaptic and receptor apparatus are in pigs, in second place in terms of the development of the nerve elements of the heart are cattle and horses, and in third place is sheep.

Keywords: subepicardial nerve plexuses, mammals, heart, myocardium, ganglion cells, Dogel type I.

К СРАВНИТЕЛЬНОЙ МОРФОЛОГИИ ИНТРАМУРАЛЬНОГО НЕРВНОГО АППАРАТА СЕРДЦА У НЕКОТОРЫХ МЛЕКОПИТАЮЩИХ ЖИВОТНЫХ

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Резюме: В статье изучены гистологическое строение нервных элементов подэпикардального нервного аппарата у некоторых половозрелых млекопитающих животных при помощи методов серебрения. Сравнительные данные показывают, что наиболее развиты подэпикардальные нервные сплетения, синаптический и рецепторный аппарат у свиньи, на втором месте

по степени развития нервных элементов сердца находится крупный рогатый скот и лошадь, на третьем-овца.

Ключевые слова: подэпикардальных нервных сплетений, млекопитающих животных, сердце, миокард, ганглиозные клетки, I типа Догеля.

Introduction. Due to the increasing prevalence of cardiac rhythm disorders, studying the process of heart rhythm formation is highly relevant [5]. Currently, there is evidence demonstrating the existence of a rhythm generator in the central nervous system alongside a rhythm generator within the heart itself. The intracardiac generator is a vital factor that supports the heart's pumping function when the central nervous system is in a state of deep inhibition [2,4]. The central generator facilitates adaptive cardiac responses under natural conditions. Previous chronic experiments on animals and observations in humans, where a multichannel electrode probe was implanted on the epicardial surface of the sinoatrial node during cardiac surgery for diagnostic purposes and computer mapping of the initial excitation focus was performed, revealed the following [1,3]. Unlike during anesthesia, when the isochronous map shows the initial excitation focus under a single electrode with its location dependent on heart rate, under conditions of full adaptation of the organism to the external environment (with the heart adopting central rhythmogenesis), the initial excitation focus arises in several closely located points.

Study Objective. To investigate the comparative morphology of the intramural nervous apparatus of the heart in certain mammalian animals.

Materials and Methods. The aim of this study is to examine the structure of neural elements in the subepicardial nervous apparatus of sexually mature mammals using silver staining techniques (Bielschowsky-Gross, Campos).

Study Results. The subepicardial nervous apparatus of the posterior wall of the atria in sexually mature pigs, cattle, horses, and sheep consists of large ganglia located at the intersections of fiber bundles along their course and near blood vessels, as well as individual nerve cells. Some nodes are situated in the connective

tissue layers of the superficial myocardial layers. Additionally, individual neurons were observed within nerve trunks. Comparing the sizes of nodes located under the epicardium, pigs have the largest ($1456 \times 416 \text{ }\mu\text{m}$), followed by cattle and horses ($873.6 \times 377.4 \text{ }\mu\text{m}$), and sheep ($728.0 \times 416 \text{ }\mu\text{m}$) in third place. The nodes are equipped with a well-developed stroma and capsule. Ganglion cells are largest in pigs ($86.2 \times 37.8 \text{ }\mu\text{m}$), followed by cattle and horses ($67.4 \times 33.6 \text{ }\mu\text{m}$), and sheep ($50.4 \times 42.3 \text{ }\mu\text{m}$). Alongside these large neurons, medium and small-sized cells are observed in the subepicardial nervous apparatus. The nuclei of nerve cells are light, vesicular, positioned eccentrically or centrally, and contain one or two nucleoli. The neurofibrillary apparatus is predominantly reticular, less frequently fascicular. Chromophilic substance is distributed variably in neurons, ranging from dust-like to fine and coarse granularity. Apopolar arrangement of Nissl substance clumps is observed, with homogeneous staining in some cells. In nodes located under the epicardium in the atria and proximal ventricles, among Dogiel type I cells, individual large hyperargentophilic cells of oval or pear-shaped form with long processes exiting the ganglion and forming receptor structures in the node's stroma near neighboring neurons were identified. Some processes of cells resembling Dogiel type II neurons form synaptic connections with Dogiel type I cells. Alongside cells resembling Dogiel type II neurons, rare pseudounipolar cells are present. The processes of ganglion cells, intertwining with neighboring ones, often form two-neuron aggregates, indicating complex interneural connections within the nodes. Interneural connections were found between Dogiel type I and II cells, as well as among Dogiel type I neurons. In all studied animal species, transitory and terminal synaptic endings were identified. The neurofibrillary framework consisted of a dense network of neurofibrils, continuing from presynaptic nerve fibers. The synapses observed were commonly ring-shaped, button-shaped, pear-shaped, spherical, oval, or bulbous. This diversity in the synaptic apparatus likely reflects adaptive responses to varying functional conditions and autonomic dysfunctions arising from disruptions in physicochemical and biochemical balances during the animal's life. Regarding the receptor apparatus, the greatest variety of sensory

endings was found in the pig heart. Alongside compact non-free sensory endings in the epicardium, subepicardium, and endocardium, both non-free and free diffuse receptors were identified. Diffuse non-free receptors are characterized by multiple dichotomous divisions of terminal branches and significant length. Compact sensory endings, unlike diffuse ones, form extensive receptor fields. In the myocardium of all studied animals, “climbing” type receptors, neuromuscular spindles, and free and non-free bush-like endings were found. In the endocardium and subendocardium of the atria, mainly compact sensory endings were observed. Free diffuse sensory endings were found in cardiac ganglia. In the ventricles, receptors were predominantly diffuse bush-like.

Conclusion. Thus, our comparative data indicate that the subepicardial nerve plexuses, synaptic, and receptor apparatus are most developed in pigs, followed by cattle and horses, with sheep in third place. Sensory nerve endings are distributed across all layers of the posterior atrial wall in the studied animals. Compact receptors in the endocardium and epicardium form receptor fields, while diffuse receptors are characterized by significant length. In the myocardium, “climbing” type receptors, neuromuscular spindles, and free and non-free bush-like sensory endings were identified.

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