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MORPHOLOGICAL AND MORPHOMETRIC FEATURES OF NERVE STRUCTURES OF THE GALLBLADDER VESSELS

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Abstract. *The innervation of blood vessels largely determines the functional state of the organ. The aim of the study was to determine the adrenergic innervation of the arteries and veins of the gallbladder in guinea pigs. A fluorescent-histochemical method was applied to total organ preparations. It was found that arteries are most abundantly supplied with adrenergic nerve fibers, which form perivascular adrenergic plexuses around them. Veins contain significantly fewer of these fibers, and perivascular adrenergic plexuses are absent.*

Keywords: *gallbladder, blood vessels, adrenergic innervation.*

МОРФОЛОГИЧЕСКИЕ И МОРФОМЕТРИЧЕСКИЕ ОСОБЕННОСТИ НЕРВНЫХ СТРУКТУР СОСУДОВ ЖЕЛЧНОГО ПУЗЫРЯ

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Резюме. *Иннервация кровеносных сосудов во многом определяет функциональное состояние органа. Целью исследования явилось определение адренергической иннервации артерий и вен желчного пузыря морских свинок. Применен люминесцентно-гистохимический метод на тотальных препаратах органа. Установлено, что наиболее обильно снабжены адренергическими нервными волокнами артерии, которые образуют*

вокруг них периваскулярное адренергическое сплетение. В венах таких волокон содержится значительно меньше, отсутствует периваскулярное адренергическое сплетение.

Ключевые слова: *желчный пузырь, кровеносные сосуды, адренергическая иннервация.*

The morphofunctional state of organs and their blood vessels are interrelated both in normal conditions and in pathology. The intramural nervous apparatus plays a determining role in the regulatory activity of both organs and their vessels[3]. The blood vessels of internal organs are supplied with adrenergic nerve fibers [1, 2, 5]. These nerve fibers ensure the functional adaptation of organ blood supply depending on physiological or pathological conditions. A significant number of scientific studies have been dedicated to the adrenergic innervation of blood vessels in the heart[6, 7] and lungs in both normal and pathological states[4]. However, the study of these organs has been conducted on histological sections, which do not allow for the assessment of the complete innervation of vessels within the organ, nor do they enable the tracking of the spread of adrenergic nerve fibers along the course of arteries and veins. There is also limited information regarding the comparative density of adrenergic nerve fiber distribution in the walls of arteries, veins, and microcirculatory vessels.

Research aim: To identify the morphological and some morphometric indicators of adrenergic nerve structures in the arteries, veins, and microcirculatory vessels of the gallbladder in guinea pigs.

Materials and Methods: The small size of the gallbladder in guinea pigs allows it to be placed entirely on a microscope slide for studying the localization of its vessels at the organ level. The thin-walled gallbladder of guinea pigs, containing transparent bile, serves as a good specimen for preparing a total preparation and studying its vessels down to their smallest branches. A total preparation of the entire gallbladder was studied in 8 adult guinea pigs after treatment with a glyoxylic acid solution according to the method of V.N. Shvalev and N.I. Zhuchkova. The animals were euthanized under anesthesia, following the rules of bioethics. The adrenergic nerve structures glowing with green light were examined under the LUMAM-I2 fluorescent microscope using FS 1-4 and FS 1-6 filters. The comparative density of nerve fiber distribution on the walls of blood vessels was determined using a point method. The obtained digital data were processed using the method of variation statistics.

Research findings: Adrenergic nerve fibers "enter" the gallbladder along the course of the

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cystic artery. They densely intertwine to form a perivascular plexus around the artery, which emits continuous green fluorescence. Some bundles of these fibers are oriented parallel to the vessel's course. Individual fibers branch off from them to the surrounding tissues, where they often dichotomously bifurcate. Where the artery bifurcates, the perivascular plexus also branches out and surrounds the artery's branches (see figure).

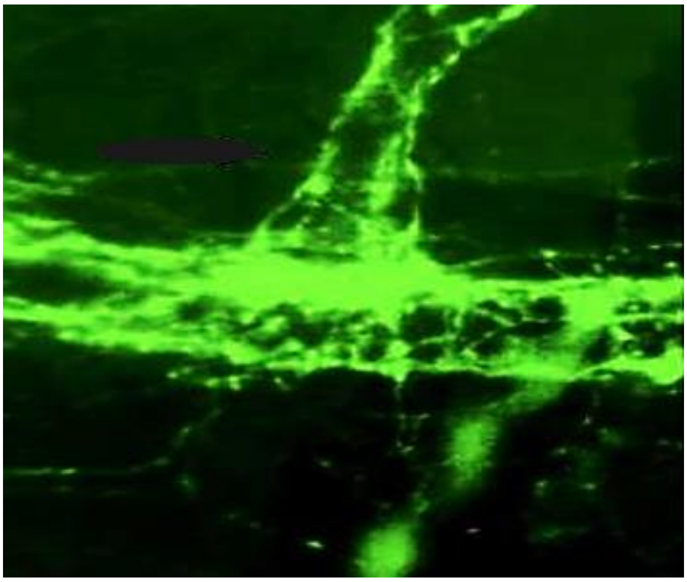

Fig. Perivascular adrenergic plexus of the gallbladder artery in guinea pigs. Method by V.N. Shvalev and N.I. Zhuchkova. Obj.20, approx.10.

As the artery branches, the density of adrenergic fibers decreases, and the perivascular plexus of the vessels becomes less dense. The adrenergic perivascular plexus, resembling a green sheath, accompanies the artery to its smallest branches, down to their branching into capillaries. It is notable that the site of artery branching possesses a higher adrenergic innervation than along the length of the vessel. This section of the artery may have regulatory activity, ensuring the appropriate blood supply to smaller-diameter vessels depending on the organ's functional state. The veins of the gallbladder (not always accompanied by arteries) have a sparse amount of adrenergic nerve fibers. Capillaries do not have a perivascular plexus of adrenergic nerve fibers surrounding them, but a network of adrenergic fibers is always present where the capillary network is found.

The density of adrenergic fibers on arteries is significantly higher compared to veins. In artery preparations, adrenergic nerve fibers occupy an average of 57.1±1.5%, while in veins, they occupy 19.05±1.97%. In the microcirculatory zone, the ratio of the capillary network to the adrenergic nerve fiber network is on average 51 ± 2.9 and 49 ± 2.7, respectively.

Thus, bundles of adrenergic nerve fibers "enter" the gallbladder of guinea pigs along the course of the cystic artery in the form of perivascular adrenergic plexuses and bundles running parallel to it. Individual adrenergic nerve fibers branch off from these bundles to the surrounding tissues. As the artery branches, some fibers of its perivascular plexus transition to its branches, forming perivascular plexuses on them. Therefore, perivascular plexuses are present on all branches of the artery down to their branching into capillaries. Capillaries do not have pericapillary adrenergic plexuses, but a network of adrenergic fibers is present within the capillary network. However, we did not find any consistent patterns of direct contact between these two networks. These data can serve as a certain support in the diagnosis and treatment of functional disorders of bile secretion and in evaluating the results of experimental interventions.

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