HISTOTOPOGRAPHIC STRUCTURE OF THE SYMPATHETIC TRUNK AND NERVES

Qodirova Marhabo Miyassarovna, Assistant
Department of Propedeutics of Children's Diseases
Samarkand State Medical University

Abstract: This article investigates the neurohistological structure of the sympathetic trunk and nerve fibers in humans. To study the histological structure of nerve tissue, the Bielschowsky-Gros staining method was employed. The results showed that the interganglionic branches of the sympathetic trunk possess distinctly expressed epineurium, perineurium, and endoneurium. The epineurium consists of an outer denser layer and an inner looser layer. The ganglion capsule is directly connected to the epi- and perineurium, whereas the endoneurium continues into the ganglion stroma.

Keywords: Humans, sympathetic trunk, nerve ganglia, nerve fibers, perineurium, endoneurium, Bielschowsky-Gros method.

ГИСТОТОПОГРАФИЧЕСКОЕ СТРОЕНИЕ СИМПАТИЧЕСКОГО СТВОЛА И НЕРВОВ

Кодирова Мархабо Миясаровна, ассистент
Кафедра пропедевтики детских болезней
Самаркандский государственный медицинский университет

Резюме: В данной статье изучена нейрогистологическая структура симпатического ствола и нервных волокон у человека. Для изучения гистологической структуры нервной ткани использовался метод окрашивания Бильшовского-Грос среди нейрогистологических методов. Согласно полученным результатам, межузловые ветви симпатического ствола обладают четко выраженными эпиневрием, периневрием и эндоневрием. Эпиневрий состоит из наружного — более плотного и внутреннего — рыхлого слоев.

Капсула узлов непосредственно связана с эпи- и периневрием, тогда как эндоневрий продолжается в строму узлов.

Ключевые слова: человек, симпатический ствол, нервные узлы, нервные волокна, периневрий, эндоневрий, метод Бильшовского-Грос

Introduction. According to modern concepts, the autonomic nervous system is regarded as a complex of central and peripheral cellular structures that regulate the functional level of the organism's internal activity necessary for adequate responses of all systems [1,2]. Currently, thoracic sympathectomy is widely used in the treatment of upper limb hyperhidrosis, obliterating thromboangiitis and atherosclerosis of the upper limb arteries, and Raynaud's disease [4,5]. The literature contains no data on the macro-microscopic anatomy of the sheaths of sympathetic nerve trunks and visceral nerves [6,3]. Meanwhile, connective tissue occupies nearly half of these functionally important trunks and, together with nervous tissue, serves as a target for various pathological processes in the autonomic nervous system [7,8].

Objective of the study. To study the histotopographic structure of the human sympathetic trunk and nerves.

Materials and methods. The use of macromicroscopic methods for removing and processing the epi-, peri-, and endoneurium of the interganglionic branches and capsules of the sympathetic trunk ganglia and splanchnic nerves, as well as the examination of total histotopograms of transverse and longitudinal sections of these trunks stained with van Gieson and hematoxylin and eosin, revealed new significant findings. Fourteen thoracic sections of the human sympathetic trunks and splanchnic nerves were studied. Analysis of the specimens and summarization of all the data obtained made it possible to develop a basic diagram of the structure of the sympathetic trunk sheaths and splanchnic nerves.

Study results. It was established that the interganglionic branches of the sympathetic trunk have a distinct epineurium, perineurium, and endoneurium. The epineurium is divided into an outer, denser epineurium and an inner, loose epineurium. The outer epineurium of the interganglionic branches directly passes into the outer portion of the sympathetic ganglion capsule, which has varying thicknesses. The perineurium consists of outer and inner layers, between which a perineural space can be traced. Both layers of the perineurium fuse together upon approaching the ganglion, forming the ganglion capsule itself. The perineural sheaths then close, forming sharp pockets around the bundles of the interganglionic branches. From the inner perineurium, trabeculae extend into the bundles, forming the endoneurium. Similar layers extend into the ganglion from the inner layer of the capsule, surrounding small bundles of nerve fibers within the ganglion. Between the internodal branches of the sympathetic ganglia, circumferential nerve bundles are observed, which adjoin the sympathetic ganglia externally and provide connections between adjacent internodal branches. The large splanchnic nerves contain from 3 to 7 roots, which has allowed us to distinguish two forms of variability in their structure: pauciradicular and multiradicular. The number of bundles in a nerve increases as it approaches the diaphragm, while their size decreases; exchange of groups of nerve fibers is possible between bundles. Connective tissue sheaths are represented by the epineurium, perineurium, and endoneurium. The bulk of the connective tissue stroma of the splanchnic nerves is made up of the external and internal epineurium, which contains a large number of vessels and proper nerve trunks. The external epineurium is a continuation of the outer layer of the ganglion capsule; its thickness decreases as the nerve approaches the diaphragm. The perineurium is a multilayered membrane consisting of two layers—an outer layer and an inner layer—that form the perineural sheath, which contains the perineural space. The perineural rootlet sheaths in the region of the sympathetic ganglia begin bluntly and, forming a pointed pocket, surround each rootlet of the splanchnic nerve. In the region of the internodal branches, the perineural rootlet sheaths communicate with the perineural sheaths of the internodal branch bundles.

Conclusion. The above demonstrates that there are unique relationships between the capsule and stroma of the sympathetic ganglia, on the one hand, and the epi-, peri-, and endoneurium of the internodal branches and splanchnic nerves, on the other. The capsule of the ganglia is directly connected to the epi- and perineurium, while the endoneurium is continuous with the stroma of the ganglia. The perineural sheaths of the internodal branches and splanchnic nerves close upon approaching the capsule of the ganglia, forming obtuse pockets. A similar pattern of perineural sheath closure was described by one of us in the region of the proximal spinal nerves. Circumferential nerve bundles may lie between adjacent internodal branches in the outer part of the capsule of the sympathetic ganglia. This not only facilitates nerve connections along the sympathetic trunk, bypassing the ganglia, but also facilitates circulation of perineural fluid throughout the entire trunk.

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