ANATOMICAL AND TOPOGRAPHICAL RELATIONSHIPS OF THE INTERCOSTAL MUSCLES AND THEIR ORGAN BLOOD VASCULAR BED

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Abstract. This article investigates the intraorganic blood vascular bed of human intercostal muscles based on studies conducted on 34 adult human cadavers. The capillary network of the intercostal muscles, characterized by the small size of its meshes, frequent anastomoses between adjacent capillaries, and the close proximity of each capillary to several muscle fibers, indicates the intensity of metabolic processes in these muscles. Different regions of the human intercostal muscles possess characteristic structural features of the terminal vascular bed concerning the mutual arrangement of vascular components.

Keywords: human cadavers, formalin, intercostal muscles, vascular bed, artery, arterioles, capillaries.

АНАТОМО-ТОПОГРАФИЧЕСКИЕ ВЗАИМООТНОШЕНИЯ МЕЖРЁБЕРНЫХ МЫШЦ И ИХ ОРГАННОГО КРОВЕНОСНОГО РУСЛА

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Аннотация. В данной статье изучено интраорганное кровеносное русло межреберных мышц человека исследовалось на 34 трупах взрослых людей. Капиллярная сеть межреберных мышц с небольшой величиной ее ячеек, частыми соустьями между соседними капиллярами, близостью каждого капилляра к нескольким мышечным волокнам свидетельствует об интенсивности обменных процессов в этих мышцах. Различные участки

межреберных мышц человека имеют характерные особенности строения терминального кровеносного русла, касающиеся взаимного расположения сосудистых компонентов.

Ключевые слова: трупы человека, формалин, межреберных мышцы, кровеносное русло, артерия, артериолы ,капилляры.

Introduction. At the present stage of healthcare development, given the demographic characteristics of the country, the strategic priority is the preservation of health in the working-age population. The introduction of magnetic resonance imaging (MRI) — a non-invasive, highly informative method of radiation diagnostics — into clinical practice has significantly expanded the possibilities for comprehensive examination of the skeletal musculature in patients with muscular pathology. This method allows not only to detect muscle damage but also to obtain objective information on the degree of changes in muscle architecture (such as atrophy and hypertrophy) and the extent of the pathological process [1,2]. One of the problems addressed by morphologists, physiologists, orthopedists, and biomechanists is the response of soft tissues of the limbs to lengthening and the methods of restoring the functional capacity of muscles and the limb as a whole. The structure of the terminal vascular bed of human skeletal muscles depends on their anatomy and function. It has specific features not only in muscles of different body regions but also in different muscles and even in various parts of the same muscle [3,4]. The most significant differences in the blood supply of organs are found in the structure of the microcirculatory bed, where metabolic processes occur. However, data on the vessels of the human intercostal muscles mainly concern variants of their location and the relationships between components of the neurovascular bundles [5,6].

Aim of the Study. To investigate the anatomical and topographic relationships of the intercostal muscles and their organ-specific blood supply in humans.

Materials and Methods. The intraorgan blood bed of human intercostal muscles was studied on 34 adult cadavers (aged 20 to 88 years) using a macro-microscopic

method after injection of vessels with transcapillary masses, followed by fixation in formalin and clearing in glycerin.

Results. Our findings showed that the branching pattern of muscular arteries is determined by the angle of their origin from the source vessel and their caliber. Branching becomes more complex because the vessels divide not only on the outer and inner surfaces of the muscles within the plane of the intercostal space but also in the deep layers of the intercostal muscles between their bundles. As a rule, each artery, before plunging deeper, gives off a series of branches located on the surface of the bundles. There is a close relationship between the direction and type of branching of the muscular arteries and the arterioles arising from them, as well as the relationship of the latter to the muscle bundles. For example, arteries located transversely to the muscle bundles are accompanied by arterioles oriented along them, and vice versa: an artery lying along the muscle bundles gives off arterioles positioned transversely to the bundles. In addition to these most common variants, transitional forms may occur. The position of precapillaries within the muscle bundles is determined by the direction of the arterioles branching from them. Along with precapillaries located transversely to the muscle fibers, there are some that cross them at an acute angle or run along them. Precapillaries give off capillaries in all directions, with their number ranging from 7 to 10. Some capillaries arise from a common trunk, which then immediately or sequentially divides into 2–4 daughter branches. As it approaches the opposite edge of the muscle bundle, the precapillary decreases in diameter and terminates in two final, usually the widest, capillaries that form an open angle. These are directed along the edge of the bundle and form the initial segment of the postcapillary. The postcapillary runs in the opposite direction to the precapillaries, receiving venous segments of capillaries from all sides. Because the capillaries branching from the precapillary repeatedly divide into daughter branches, while their confluence toward the postcapillary occurs less frequently, the total number of capillaries draining into the postcapillary exceeds the number that arise from the precapillary.

At the points where capillaries divide into daughter branches, the ends of the meshes are rounded. The capillary network of the intercostal muscles, characterized by small mesh size, frequent anastomoses between neighboring capillaries, and the proximity of each capillary to several muscle fibers, indicates high intensity of metabolic processes in these muscles. The diversity in size and shape of muscle bundles in the intercostal muscles makes it possible to trace the dependence of the microcirculatory bed architecture on the mutual arrangement of muscle fibers and connective tissue within the bundle. In the myotendinous zone of the bundles, three sections can be distinguished based on vessel diameter, direction, and branching pattern:

1. The first section is represented by a delicate network with irregularly shaped meshes in the peritenonium of the tendinous part of the bundle.
2. The second section is located at the border between the tendon and the muscle fibers of the bundle. It consists of arterioles, precapillaries, and corresponding venous components. The majority of vessels in this section are oriented along the fibers of the muscle bundle. Anastomoses between them are almost absent. Only single capillaries are observed. This area appears poorly vascularized.
3. In the third section, capillaries predominate. From two to six capillaries branch off from a precapillary at an acute angle. The capillary meshes are narrow and long (1.5–2 mm), pointed at one or both ends. Anastomoses between neighboring capillaries occur less frequently than in the middle parts of the muscle bundles.

Conclusion. Different parts of the human intercostal muscles have characteristic features in the structure of the terminal blood bed, concerning the mutual arrangement of vascular components, the modes of vessel branching, and the architecture of the capillary network.

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