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About authors:

Malyshko Vadim Vladimirovich, MD, CMSc, Associate Professor of the Department of Operative Surgery and Topographic Anatomy;
tel.: +79528187872; e-mail: son_sunytch79@mail.ru

Basov Alexander Alexandrovich, MD, PhD, Profess, Professor of the Department of Fundamental and Clinical Biochemistry;
tel.: +79183551302; e-mail: son_sunytch@mail.ru

Dorohova Anna Anatolievna, Researcher of the Department of Radiophysics and Nanothechnology;
tel.: +79180688381; e-mail: 013194@mail.ru

Moiseev Arkady Viktorovich, Researcher of the Scientific Department;
tel.: +78612215874; e-mail: moiseew_a@rambler.ru

Dyakov Oleg Vyacheslavovich, Researcher of the Department of Fundamental and Clinical Biochemistry;
tel.: +79183364414; e-mail: esaulenkoe@bk.ru

Pavlyuchenko Ivan Ivanovich, MD, PhD, Professor, Head of the Department of Biology with a course in Medical Genetics;
tel.: +79183668281; e-mail: pavluchenkoII@ksma.ru

Storozhuk Alexander Petrovich, MD, PhD, Professor of the Department of Fundamental and Clinical Biochemistry;
tel.:+ 79182125530; e-mail: ilya.bh@mail.ru

UDC 611.124.13:616-053.7
DOI – https://doi.org/10.14300/mnnc.2023.18039
ISSN 2073-8137

ANGIOARCHITECTONICS OF THE SUBEPICARDIAL VASCULAR BED OF THE HEART ON THE LATERAL SURFACE OF THE LEFT VENTRICLE IN YOUNG ADULTHOOD

Korobkeev A. A., Alysheva E. V., Khodzhayan A. B., Lezhnina O. Yu.

Stavropol State Medical University, Russian Federation

АНГИОАРХИТЕКТОНИКА СУБЭПИКАРДИАЛЬНОГО СОСУДИСТОГО РУСЛА СЕРДЦА НА БОКОВОЙ ПОВЕРХНОСТИ ЛЕВОГО ЖЕЛУДОЧКА У ЛИЦ ЮНОШЕСКОГО ВОЗРАСТА

А. А. Коробкеев, Е. В. Алышева, А. Б. Ходжаян, О. Ю. Лежнина

Ставропольский государственный медицинский университет, Российская Федерация

In young adulthood, 28 hearts with a uniform variant of coronary branching were studied. The vascular bed of the heart was examined using X-ray, anatomical, histological, and morphometric methods. On the lateral surface of the left ventricle, the spatial relationship of the circumflex branch and the posterior vein of the left ventricle is considered. The average distance

between the arterial and venous vessels, the ratio of the total cross-sectional area of the venous to the arterial bed, and the average displacement of the veins from the arteries were established. The dynamics of their changes on the lateral surface of the left ventricle are considered.

Keywords: circumflex branch, posterior vein of the left ventricle, topographic-anatomical relationships, uniform variant of coronary branching, morphofunctional parameters

У людей юношеского возраста изучены 28 сердец с равномерным вариантом ветвлений венечных артерий. Сосудистое русло сердца исследовано с помощью рентгенологических, анатомических, гистологических и морфометрических методов. На боковой поверхности левого желудочка рассмотрено пространственное взаимоотношение огибающей ветви и задней вены левого желудочка. Установлены среднее расстояние между артериальными и венозными сосудами, отношение суммарной площади сечения венозного русла к артериальному, среднее смещение вен от артерий. Рассмотрена динамика их изменений на боковой поверхности левого желудочка.

Ключевые слова: огибающая ветвь, задняя вена левого желудочка, топографо-анатомические взаимоотношения, равномерный вариант ветвлений венечных артерий, морфофункциональные параметры

For citation: Korobkeev A. A., Alysheva E. V., Khodzhayan A. B., Lezhnina O. Yu. ANGIOARCHITECTONICS OF THE SUBEPICARDIAL VASCULAR BED OF THE HEART ON THE LATERAL SURFACE OF THE LEFT VENTRICLE IN YOUNG ADULTHOOD. *Medical News of North Caucasus.* 2023;18(2):177-180. DOI – https://doi.org/10.14300/mnnc.2023.18039

Для цитирования: Коробкеев А. А., Алышева Е. В., Ходжаян А. Б., Лежнина О. Ю. АНГИОАРХИТЕКТОНИКА СУБЭПИКАРДИАЛЬНОГО СОСУДИСТОГО РУСЛА СЕРДЦА НА БОКОВОЙ ПОВЕРХНОСТИ ЛЕВОГО ЖЕЛУДОЧКА У ЛИЦ ЮНОШЕСКОГО ВОЗРАСТА. *Медицинский вестник Северного Кавказа.* 2023;18(2):177-180.
DOI – https://doi.org/10.14300/mnnc.2023.18039

Ds – average distance between the arterial and venous channels
EB – envelope branch of the left coronary artery
LSLV – lateral surface of the left ventricle
PBLV – posterior branch of the left ventricle
R – ratio of the total cross-sectional area of the venous bed to the arterial
Sh – average displacement of the venous bed from the arterial

Cardiovascular diseases remain the leading cause of death worldwide [1–4]. This is primarily due to the development of atherosclerotic lesions of arterial vessels [5, 6]. To develop new diagnostic and therapeutic approaches to the personalized treatment of cardiovascular diseases, objective morphological data on the variability of subepicardial arterial and venous heart channels and their mutual topography are necessary.

In some publications, features of different types of intra-organ arterial heart dichotomies with hemodynamic changes [2, 7] are considered. The researchers described anatomical features of blood flow in congenital heart defects [8, 9] and coronary vascular anomalies [10]. The studied literature contains information on the distance from the coronary sinus to the intraloop artery, the cross-section of the artery with muscle loops in mature and older adults [11], and morphometric topography of the left coronary artery and left auricular [12]. At the same time, studies on the characteristics of the mutual location of arterial and venous heart channels are rare. The publications present separate data on the spatial localization of heart veins and coronary vessels in the right ventricular version of coronary artery branches in old age and old age [13] in adolescents [14]. The aim of the study was to present angioarchitectonics of subepicardial arteries and cardiac veins on the lateral surface of the left ventricle (LSLV) with a single variant of coronary artery branching in adolescents.

Material and Methods. Twenty-eight hearts with uniform coronary artery branches have been studied in young men. The vascular bed of the heart was studied by radiological, anatomical, histological, and morphometric methods. The spatial relationship of the envelope branch (EB) and the posterior vein of the left ventricle (PBLV) is considered on the LSLV. Morphometry of arterial branching components and venous fusion levels was performed using «Video-Test-Morpho, 2005» (Zenit NPK, Russia). Angles are measured in each bifurcation and venous fusion; lengths of the main trunk, branches, and tributaries; diameters of the main trunk, derivatives, and tributaries. To characterize the topographic-anatomical relationship between the EB and the PBLV, the following morphofunctional parameters were calculated in the original computer program: the ratio of the total cross-sectional area of the venous bed to the arterial (R), the average distance between the arterial and venous beds (Ds) and the average displacement of the venous bed from the arterial (Sh).

Processing of the obtained results was carried out in the program SPSS Statistics 24 (IBM, USA) [15]. For descriptive statistics, the arithmetic means, and its standard error (M±m) are determined. The level of statistical significance was $p<0.05$.

Results and Discussion. A study of vascular angioarchitectonics showed that in the upper third of the LSLV, there were the main barrels of the I generation of EB and levels of coronary sinus fusion (Fig. 1). These ships never crossed paths.

Within the middle third of the LSLV, the I branch of the EB was formed, the right «daughter» branch, which penetrated into the myocardium in the specified topographic area. The left derivative spread to the lower third of the LSLV and became the main trunk of the II arterial generation. During the middle third of the LSLV, the first level of the merger of the PBLV was also revealed, the origins of which were formed in this area. The most significant number of arterial bifurcations was observed in the lower third of the LSLV. Here the II and III branches of the EB and their «daughter» branches were formed.

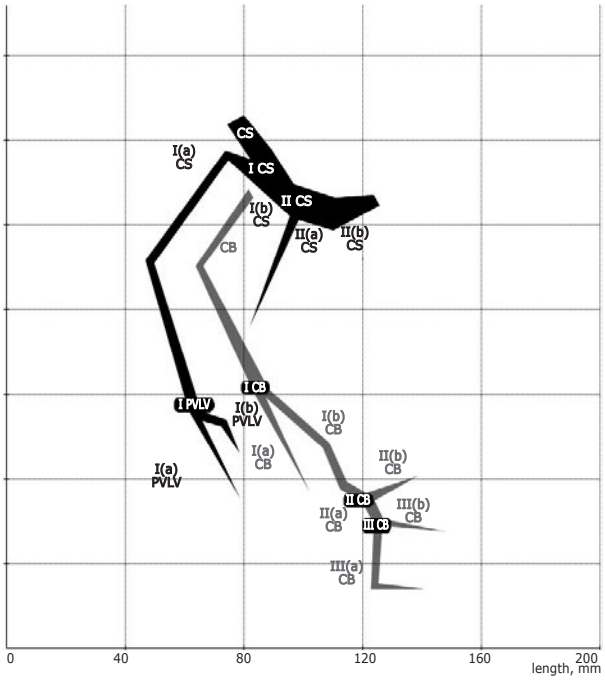

Fig. 1. Morpho-mathematical model of the vascular bed of the heart on the LSLV with a uniform variant of coronary branching in young adulthood.
Note: I–III – levels of division of arteries and confluence of veins; a – the right branch of the artery or tributary of the vein; b – the left branch of the artery or tributary of the vein; CS – coronary sinus

Analysis of the change in the parameter R in young men with a uniform variant of the branching of the coronary arteries showed its intensive increase from 2.66±0.20 to 12.62±1.18 ($p<0.05$) at the beginning of the upper third of the LSLV. Then a sharp decrease to 3.76±0.28 ($p<0.05$) (Fig. 2). However, in the final sections of the upper third the value of R increased again to 5.40±0.43. During the middle third of the LSLV, there was a tendency to a gradual decrease in the parameter values to 0.29±0.01 ($p<0.05$). Within the lower third of the LSLV, the value of the parameter R varied slightly, with a maximum increase to 1.30±0.11 and a decrease to 0.48±0.03.

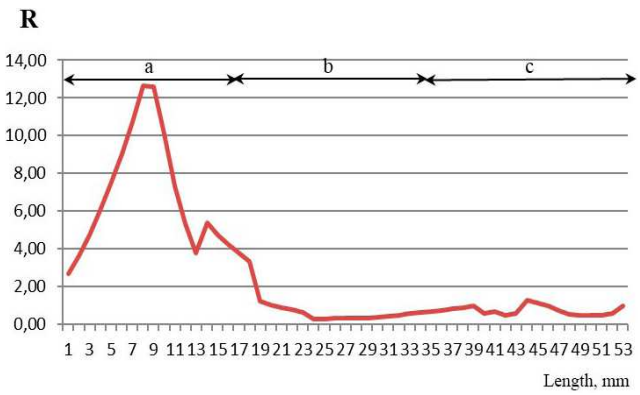

Fig. 2. Change of the morphofunctional parameter R on the lateral surface of the left ventricle in young adulthood with a uniform variant of coronary branching.
Note: a – upper third LSLV; b – middle third LSLV; c – lower third LSLV

Throughout the LSLV, the values of the parameter Ds increased uniformly with the most significant magnitude in the upper and middle thirds, reaching 10.20±1.02 mm and 16.10±1.50 mm, respectively. The maximum value of the parameter in the lower third of the LSLV was 26.30±2.00 mm. A slight decrease in Ds values was noted in the middle of the upper third of the LSLV (from 4.60±0.35 mm to 4.40±0.30 mm) and at the beginning of its middle third (from 10.20±1.02 mm to 8.40±0.50 mm).

Consideration of the variability of the Sh parameter in the upper third of the LSLV showed an increase in its values to +10.20±1.15 mm (Fig. 3). However, at the beginning of the middle third of the LSLV, a decrease in the parameter to –9.90±0.85 mm was noted. In its final sections, an intensive rise to +14.80±1.50 mm ($p<0.05$) was detected. A section with negative parameter values from –15.50±1.48 mm to –16.60±1.51 mm was detected between the middle and lower thirds of the LSLV. In the future, the parameter increased sharply to +17.30±1.60 mm ($p<0.05$). During the lower third of the LSLV as a whole, there was an increase in the values of the Sh parameter with a maximum rise to +26.30±2.18 mm.

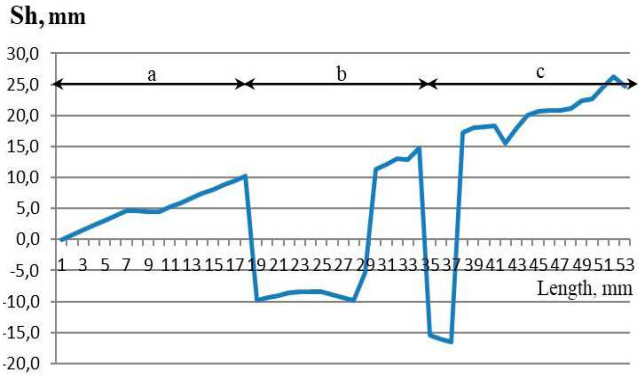

Fig. 3. Change of the parameter Sh on the lateral surface of the left ventricle in young adulthood with a uniform variant of coronary branching.
Note: a – upper third LSLV; b – middle third LSLV; c – lower third LSLV

The obtained data on the values of R in adolescents showed the most significant value of the total area of the venous bed within the upper third of the LSLV; however, in older adults with a uniform variant of branching of the coronary arteries, this parameter showed the maximum total lumen of the subepicardial veins in the lower third of the LSLV [16]. The most significant distance between venous tributaries and arterial branches revealed in young men within the lower third of the LSLV disagrees with the data of other authors. Thus, in persons of older age periods (elderly and senile age), the most significant distance between the venous and arterial channels is determined in the middle third of this area [9, 12]. The established displacement of the veins relative to the coronary arteries to the left within the middle third of the LSLV is confirmed by the data obtained during the study of these vessels in senile people [8, 13]. However, in old age, the venous bed deviates from the arterial one to the left only during the upper third of the LSLV [16]. In adolescents with the right-ventral variant of branching on the sternocostal surface of the heart, the venous bed shifts all along for the arterial one only to the right [14].

Conclusion. The obtained data on the angioarchitectonics of the vascular bed of the heart demonstrate the most significant number of arterial branches in the lower third of the LSLV. At the same time, the structures of the venous department are more pronounced in its middle and upper thirds. The total cross-sectional area of the venous bed significantly prevailed over the same arterial indicator in the upper third of the

LSLV, which is confirmed by the most significant value of R in this area. Whereas within the middle third of the BPLF, a significant increase in the total cross-sectional area of the arterial bed was revealed. Throughout the LSLV, the distance between the subepicardial arteries and veins increased uniformly with maximum distancing in its lower third. The displacement of the venous bed of the heart from the arterial to the left was noted within the middle third of the LSLV and on its border with the lower one, where negative values of the Sh parameter were established. In other areas, the veins shift to the right of the arterial derivatives.

Disclosures: The authors declare no conflict of interest.

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About authors:

Korobkeev Alexander Anatolyevich, MD, Professor, Head of the Department of Anatomy;
tel.: +78652353229; e-mail: korobkeev@stgmu.ru; ORCID: 0000-0002-5909-9821

Alysheva Evgeniya Viktorovna, Senior lecturer of the Department of Anatomy;
tel.: +78652353229; e-mail: chto-tam@inbox.ru

Khodzhayan Anna Borisovna, DMSc, Professor, First Vice-Rector, Vice-Rector for educational activities;
tel.: +78652353442; e-mail: kafedrabiologii@stgma.ru; ORCID: 0000-0002-0428-2899

Lezhnina Oksana Yuryevna, MD, Associate Professor, Professor of the Department of Anatomy;
tel.: +78652353229; e-mail: okliz26@mail.ru; ORCID: 0000-0002-0348-0447