Computers in biology and medicine. 2019;106:71-81. https://doi.org/10.1016/j.compbiomed.2019.01.013
25. Lawhern V. J., Solon A. J., Waytowich N. R., Gordon S. M., Hung C. P., Lance B. J. EEGnet: a compact convolutional neural network for EEG-based brain – computer interfaces. *Journal of Neural Engineering*. 2018;15(5):056013. https://doi.org/10.1088/1741-2552/aace8c
26. Amin S. U., Muhammad G., Abdul W., Bencherif M., Alsulaiman M. Multi-CNN feature fusion for efficient EEG classification. In: 2020 IEEE International Conference on Multimedia & Expo Workshops (ICMEW). 2020:1-6. https://doi.org/10.1109/icmew46912.2020.9106021
27. Sheykhivand S., Mousavi Z., Rezaii T. Y., Farzamnia A. Recognizing emotions evoked by music using CNN-LSTM networks on EEG signals. *IEEE*. 2020:139332-139345. https://doi.org/10.3390/s22062346
28. Schetinin V., Schult J. Learning polynomial networks for classification of clinical electroencephalograms. *Soft Computing.* 2006;10(4):397-403. https://doi.org/10.1007/s00500-005-0499-3
29. Nyah N., Jakaite L., Schetinin V., Sant P., Aggoun A. Evolving polynomial neural networks for detecting abnormal patterns. 8th IEEE International Conference on Intelligent Systems. *IEEE.* 2016:74-80. https://doi.org/10.1109/IS.2016.7737403
30. Nguyen P., Tran D., Huang X., Sharma D. A proposed feature extraction method for EEG-based person identification. In: Proceedings on the International Conference on Artificial Intelligence. 2012.
31. Chang W., Wang H., Yan G., Liu C. An EEG based familiar and unfamiliar person identification and classification system using feature extraction and directed functional brain network. *Expert Systems with Applications.* 2020:113448. https://doi.org/10.3390/brainsci11111424
32. Gold I. Does 40-hz oscillation play a role in visual consciousness? *Consciousness and Cognition.* 1999;8(2): 186-195. Available at: https://www.sciencedirect.com/science/article/pii/S1053810099903999
33. Nguyen P., Tran D., Huang X., Sharma D. A proposed feature extraction method for EEG-based person identification. In: Proceedings on the International Conference on Artificial Intelligence (ICAI). 2012.
34. Schetinin V., Jakaite L. Classification of newborn EEG maturity with bayesian averaging over decision trees. *Expert Syst.* 2012;39(10):9340-9347. https://doi.org/10.1016/j.eswa.2012.02.184
35. Selitskiy S. Kolmogorov's gate non-linearity as a step toward much smaller artificial neural networks. In: Proceedings of the 24th International Conference on Enterprise Information Systems. *ICEIS.* 2022:492-499. https://doi.org/10.5220/0011060700003179
36. Tolstikhin I. O., Houlsby N., Kolesnikov A., Beyer L., Zhai X. [et al.] MLP-mixer: An all-MLP architecture for vision. Advances in Neural Information Processing Systems. 2021. Available at: https://papers.nips.cc/paper/2021/file/cba0a4ee5ccd02fda0fe3f9a3e7b89fe-Paper.pdf
37. Yang H., Han J., Min K. A multi-column CNN model for emotion recognition from EEG signals. *Sensors*. 2019;19(21):4736. https://doi.org/10.3390/s19214736
38. Yang S., Deravi F. On the effectiveness of EEG signals as a source of biometric information. In: 2012 Third International Conference on Emerging Security Technologies. *IEEE*. 2012:49-52. https://doi.org/10.1109/EST.2012.8

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CHARACTERISTICS OF LUMEN OF THE ANTERIOR INTERVENTRICULAR BRANCH WITH DIFFERENT VARIANTS OF CORONARY BRANCHING IN HEARTS WITH MYOCARDIAL BRIDGING

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ХАРАКТЕРИСТИКА ПРОСВЕТА ПЕРЕДНЕЙ МЕЖЖЕЛУДОЧКОВОЙ ВЕТВИ ПРИ РАЗЛИЧНЫХ ВАРИАНТАХ ВЕТВЛЕНИЙ ВЕНЕЧНЫХ АРТЕРИЙ НА СЕРДЦАХ С МИОКАРДИАЛЬНЫМ МОСТИКОМ

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The anterior intraventricular branch has been examined in the systole phase on 60 antemortem angiograms with left-anterior and right-vertebral variants of branching of coronal arteries in people of second adult age with a myocardial bridge. Data on a comparative examination of the lumen of the anterior intraventricular branch at the left-vertebral and right-vertebral variants of branching of coronal arteries in the subepicardial and intramural departments of the main highway are presented.

Keywords: myocardial bridge, anterior interventricular branch, systole, left variant of coronary branching, right variant of coronary branching, internal diameter

Исследована передняя межжелудочковая ветвь в фазу систолы на 60 прижизненных ангиограммах с левовенечным и правовенечным вариантами ветвлений венечных артерий у людей второго периода зрелого возраста с миокардиальным мостиком. Представлены данные о сравнительном изучении просвета передней межжелудочковой ветви при левовенечном и правовенечном вариантах ветвлений венечных артерий в субэпикардиальных и интрамуральных отделах основной магистрали.

Ключевые слова: миокардиальный мостик, передняя межжелудочковая ветвь, систола, левовенечный вариант ветвлений, правовенечный вариант ветвлений, внутренний диаметр

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AIT – anterior interventricular branch
BVCA – branching variant of the coronary arteries
DD – division derivative
LCBCA – left coronary branching of the coronary arteries
MT – main trunk
RCBCA – right coronary branching of the coronary arteries

The myocardial bridge is a common anomaly of the coronal arteries [1]. The presence of this anatomical phenomenon is a significant predictor. Some researchers note structural changes in the intramural artery wall, increasing its propensity for spasm and thrombosis [2–5]. Myocardial bridges are thought to play an essential role in the pathogenesis of acute coronary syndrome in the absence of atherosclerotic alterations of coronary arteries [6]. Therefore, the study of coronary arteries with myocardial bridges remains relevant.

Modern literary data demonstrate the regularities of the topography of the myocardial bridges [7], characterize its length [8], and establish correlations between the bridge length and the size of the ventricular heart complex [9]. However, the evolution of the lumen of the coronal arteries in different branching phases of the cardiac cycle has not been studied before.

Purpose of the study: to carry out a comparative analysis of changes in the lumen of the anterior interventricular branch (AIV) in the left vein (LCBCA) and right vein (RCBCA) variants of coronary artery branching (BVCA) in the systole phase on hearts with a myocardial bridge.

Material and Methods. Sixty intravital coronary angiograms with myocardial bridges in persons in the second period of adulthood were examined. For LCBCA and RCBCA, 30 archival records of each option were considered. Inclusion criteria for the study were objects with a myocardial bridge length of at least 20 mm and AIT stenosis within the myocardial bridge from 50 to 70 %. Consideration of the AIT lumen was carried out in the systole phase of the heart, both in the subepicardial and intramural sections. Morphometric parameters were calculated using a special computer program «RadiAnt DICOM Viewer» (Poznan, Poland). Particular attention is paid to the comparative characteristics of the vessel diameter during immersion, passage and exit of the AIT from under the myocardial bridge.

Statistical processing of the obtained data was carried out using the program SPSS Statistics 22 (IBM, USA). Morphofunctional indicators were recorded as a median, the values of the 25th and 75th percentiles (Me [25 %; 75 %]). The comparison was carried out according to the Mann – Whitney U-test. Differences were considered statistically significant at $p<0.05$.

Results and Discussion. As a result of the division of the left coronary artery, the AIT is formed, which in the systole phase on hearts with BVCA has a diameter of 2.41 mm [2.19; 2.43], and with LCBCA – 3.19 mm [2.97; 3.62] (U=12, Z=–6.48, $p<0.0001$). It was revealed that AIT forms 4±1 subepicardial ramifications in all objects, with division levels I–III located before the vessel enters the intramural section along the myocardial bridge. At the same time, generation VI AIT is formed after the artery exits the tunnel section. In subepicardial generations of hearts with BVCA, the lumen of the main AIT artery statistically significantly prevailed over its value during BVCA along its entire length (Table).

Table

The size of the AIT lumen during subepicardial vessel

Division level	Division component	Inner diameter of AIT, mm		Mann – Whitney U-test	p
		LCBCA	RCBCA		
I	MT	3.17 [2.94; 3.52]	2.31 [2.17 2.33]	12.0	<0.0001
I	DD	3.16 [2.94; 3.49]	2.24 [2.19; 2.41]	16.0	<0.0001
II	MT	3.16 [2.93; 3.47]	2.15 [2.11; 2.36]	16.5	<0.0001
II	DD	3.09 [2.89; 3.45]	2.16 [2.11; 2.35]	16.5	<0.0001
III	MT	3.05 [2.87; 3.42]	2.17 [2.12; 2.39]	19.0	<0.0001
III	DD	3.04 [2.79; 3.40]	2.15 [2.12; 2.39]	17.0	<0.0001
VI	MT	2.46 [2.31; 2.59]	1.78 [1.56; 1.98]	19.0	<0.0001
VI	DD	2.38 [2.21; 2.56]	1.49 [1.28; 1.69]	19.0	<0.0001

Note: p is the significance of differences between LCBCA and RCBCA; MT – the main trunk of the branch; DD is a division derivative that continues the main line of the AIT.

In the average third of the anterior interventricular groove on hearts with LCBCA and RCBCA, after the III branching of the AIT, a «systolic expansion» of the vessel is formed through 4.57 mm [3.89; 5.31] and 5.64 mm [3.19; 6.71] (U=342, Z=–1.59, $p=0.110$), respectively. The lumen of the examined artery in this section achieves the greatest increase in objects with LCBCA – 3.50 mm [3.23; 3.88], while at RCBCA, it is 2.33 mm [2.28; 2.93] (U=39, Z=–6.08, $p<0.0001$). The length of the «systolic» extension was longer on coronary angiograms with RCBCA (5.50 mm [4.84; 5.84]) compared with LCBCA (2.90 mm

[2.63; 3.18] (U=0.0001, Z=–6.66, p<0.0001)). After «systolic expansion», the AIT plunges into the myocardium with a sharp decrease in diameter both in LCBCA and RCBCA, respectively, to 2.62 mm [2.39; 2.95] and 1.66 mm [1.27; 2.01] (U=36, Z=–6.12, p<0.0001), further forming a tunnel section within the myocardial bridge. During the middle third of the anterior interventricular sulcus, the intramural AIT forms 2±1 branches in both BVCA. The main stem of the IV generation of the vessel in LCBCA has a larger diameter (2.34 mm [2.07; 2.49]) compared to its value in objects with BVCA (1.57 mm [1.42; 1.66] (U =21.5, Z=–6.34, p<0.0001). mm [1.42; 1.64] (U=23, Z=–6.31, p<0.0001) Before generation V of the intramural AIT, the vessel lumen decreases by an average of 1.06 times, while the diameter of the main the trunk of this division is 2.19 mm [1.92; 2.39] and 1.52 mm [1.41; 1.58] (U=25.5, Z=–6.28, p<0.0001) in LCBCA and RCBCA, respectively. [1.42; 1.58] (U=26.5, Z=–6.26, p<0.0001)). Mean after 7.04 mm [4.70; 11.36] and 13, 80 mm [11.19; 15.32] (U=246, Z=–3.02, p=0.003), respectively, on objects with LCBCA and RCBCA the vessel exits the myocardium. In this area, there is a decrease in the AIT lumen with a minimum diameter in the section of the vessel exit on hearts with RCBCA – 0.91 mm [0.73; 1.09] and demonstrating large values of the parameter at LCBCA 1.56 mm [1.35; 1.75] (U=30.5, Z=–6.20, p<0.0001). With all BVCA, the AIT lumen further increases the formation of the VI generation on objects with RCBCA by 1.95 times; with LCBCA it increases by 1.58 times.

The results were obtained to characterize the dynamics of changes in the lumen of the AIT in LCBCA and RCBCA at various distances from the starting point of the vessel. However, there are no studies on the variability of the morphometric parameters of the main AIT artery in various BVCA in hearts with myocardial bridges. Only the lack of correlation between the type of blood supply of the heart and the presence of the bridge [7] has been noted in the studies, as well as the predominance of the height of the myocardial bridge in the right-vertebral type of blood supply of the heart compared to mixed [10]. In the present work, it was found that the diameter of the AIT in the proximal part of the vessel before entering the muscle bridge prevails over its value in the tunnel section and after leaving the intramural segment, which is confirmed in the works of several researchers [11, 12]. Other authors, by contrast, consider that there are no significant differences in the diameter of the three arteries concerned [13]. Our findings on the considerable narrowing of artery lumen in hearts with a myocardial bridge to the systole phase are consistent with the results of other researchers who noted that the pronounced artery compression in the systole affects the fractional flow [2, 6].

Conclusions. A comparative analysis of changes in the lumen of the AIT during the systole phase of the hearts with a myocardial bridge showed that the internal diameter was statistically significantly more prevalent in objects with LCBCA throughout the main vascular line. With all BVCA in the systole phase, the formation of a «systolic expansion» of the AIT before its immersion into the myocardium in the region of the myocardial bridge was established. This section of the AIT has a greater length on coronary angiograms with RCBCA compared to objects with LCBCA. A significant narrowing of the lumen of the periphery is established at the areas of immersion and return from the tunnel part of the artery with the most significant reduction in diameter in the area of the outlet of the myocardium vessel to the epicardium.

In this way, the obtained data demonstrate the dynamics of the change in the luminosity of the PML into the systole phase at different BBBA on hearts with a myocardial bridge.

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References

1. Nakaura T., Nagayoshi Y., Awai K., Utsunomiya D., Kawano H. [et al.] Myocardial bridging is associated with coronary atherosclerosis in the segment proximal to the site of bridging. *J. Cardiol.* 2014;2(63):134-139. https://doi.org/10.1016/j.jjcc.2013.07.005
2. Lee M. S., Chen C. H. Myocardial bridging: an up-to-date review. *J. Invasive Cardiol.* 2015;27(11):521-528. https://doi.org/10.5935/1678-9741.20150082
3. Sara J. D. S., Corban M. T., Prased M., Prasad A., Gulti R. [et al.] Prevalence of myocardial bridging associated with coronary endothelial dysfunction in patients with chest pain and non-obstructive coronary artery disease. *Eur. Intervention.* 2020;15(14):1262-1268. https://doi.org/10.4244/EIJ-D-18-00920
4. El-Am E. A., Corban M. T., Pollak A. W., Lerman A., Ammash N. M. A challenging combination: anomalous left anterior descending coronary artery, myocardial bridging, and endothelial dysfunction. *Front. Cardiovasc. Med.* 2020;7:57. https://doi.org/10.3389/fcvm.2020.00057
5. Arai R., Kano H., Suzuki S., Semba H., Arita T. [et al.] Myocardial bridging is an independent predictor of positive spasm provocation testing by intracoronary ergonovine injections: a retrospective observational study. *Heart Vessels.* 2020;35(4):474-486. https://doi.org/10.1007/s00380-019-01518-7
6. Sandodze T. S., Azarov A. V., Asadov D. A., Gyulmisaryan K. V., Semitko S.P. [et al.] O vozmozhnoy roli miokardialnykh myshechnykh «mostikov» v patogeneze ostrogo koronarnogo sindroma. *Siberian scientific medical journal.* 2020;40(5):84-91. https://doi.org/10.15372/SSMJ20200510
7. Dmitriyeva Ye. G., Yakimov A. A. Zakonomernosti raspredeleniya miokardialnykh mostikov nad vetvyami venechnykh artery. *Journal of Anatomy and Histopathology.* 2020;9(3):16-21. https://doi.org/10.18499/2225-7357-2020-9-3-16-21
8. Teofilovski-Parapid G., Jankovic R., Kanjuh V., Virmani R., Danchin N. [et al.] Myocardial bridges, neither rare nor isolated. Autopsy study. *Annals of Anatomy – Anatomischer Anzeiger.* 2017;210:25-31. https://doi.org/10.1016/j.aanat.2016/09/007
9. Kabak S. L., Melnichenko Yu. M., Gordionok D. M., Kalenchits T. I., Gaydel I. K. [et al.] Miokardialnye mostiki i obstruktivny ateroskleroz venechnykh artery. *Proceedings of the National Academy of Sciences of Belarus. Medical series.* 2020;17(1):38-48. https://doi.org/10.29235/1814-6023-2020-17-1-38-48
10. Tsibizova Yu. A., Trushel N. A., Ilyina T. V. Osobennosti topografii i stroyeniya uchastkov venechnykh artery, raspolozhennykh pod myshechnymi mostikami patsiyentov s kardiovaskulyarnoy patologiyey. *Medical Journal.* 2022;1:122-127. https://doi.org/10.51922/1818-426X.2022.1.122
11. Bokeriya L. A., Sukhanov S. G., Sternik L. I., Shatakhyan M. P. Miokardialnye mostiki. Moscow: Bakulev National Medical Research Center for Cardiovascular Surgery. 2013.
12. Medushevskaya Yu. A., Trushel N. A. Osobennosti stroyeniya i gemodinamiki vetvey venechnykh artery, raspolozhennykh pod myshechnymi mostikami. Vesenniye anatomicheskiye chteniya: materialy nauchno-prakticheskoy konferentsii, posvyashchennoy pamyati dotsenta D. D. Smirnova. Grodno, 2017. Available at: https://elibrary.ru/item.asp?id=32441388
13. Dmitrieva E. G. Characteristic of morphometric parameters of intramural coronary arteries and myocardial bridges in the adult human heart. *Medical News of North Caucasus.* 2022;17(1):71-74. https://doi.org/10.14300/mnnc.2022.17019

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RADICAL TREATMENT OF UNFORMED INTESTINAL FISTULAS

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РАДИКАЛЬНОЕ ЛЕЧЕНИЕ НЕСФОРМИРОВАННЫХ ТОНКОКИШЕЧНЫХ СВИЩЕЙ

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The occurrence of unformed enteric fistulas remains an urgent problem. This is due to the low effectiveness of conventional treatment methods, leading to an increase in the number and progression of fistulas and death. Thirty patients who underwent elective abdominal emergency surgeries have been studied. Two to 5 fistula tracts have been identified; 11 (36.7 %) patients had complex fistulas. Twenty-three patients were operated on 3 to 36 times in other healthcare facilities. We operated patients after the onset of fistulas which was usually between 2 and 4 weeks. In 26 (86.7 %) cases, radical surgery was performed to remove small bowel carrying fistulas, mesentery and a segment of the anterior abdominal wall involved in the conglomerate; 3 patients underwent a bilateral disconnection of the fistulas due to severe condition, and one patient received a unilateral procedure. Thus, the treatment of unformed enteric fistulas is a complicated problem. Carrying out radical surgical treatment of this pathology is possible subject to the principles of preoperative preparation and the technical features of the implementation of the surgery.

Keywords: unformed small bowel fistulas, complex small bowel fistulas, multiple small bowel fistulas, curative therapy of unformed small bowel fistulas

Возникновение несформированных тонкокишечных свищей остается актуальной проблемой, обусловленной малой эффективностью общепринятых методов лечения, часто приводящих к увеличению количества и прогрессированию свищей и, как следствие, летальному исходу. Проанализированы результаты лечения 30 больных, перенесших плановые и экстренные оперативные вмешательства на органах брюшной полости. Выявлено от 2 до 5 свищевых ходов, у 11 (36,7 %) больных – многоуровневые свищи. Двадцать три больных были оперированы от 3 до 36 раз в других лечебных учреждениях. Оперативное лечение выполнялось в сроки от 2 суток до 4 недель. В 26 (86,7 %) случаях выполнено радикальное удаление тонкой кишки, несущей свищи, брыжейки и вовлеченного в конгломерат участка передней брюшной стенки, 3 больным из-за тяжести состояния выполнено двустороннее и 1 одностороннее отключение свищей. Таким образом, лечение несформированных тонкокишечных свищей является чрезвычайно сложной проблемой. Проведение радикального хирургического лечения данной патологии возможно только при соблюдении принципов предоперационной подготовки и технических особенностей выполнения оперативного пособия.

Ключевые слова: несформированные тонкокишечные свищи, многоуровневые тонкокишечные свищи, множественные тонкокишечные свищи, радикальное лечение несформированных тонкокишечных свищей