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# An increase of the left atrium sphericity index can serve as a marker of paroxysmal atrial fibrillation in patients with hypertension

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## Abstract

**Aim** – to study the possibility of using the left atrium sphericity index (SI), calculated by echocardiography (EchoCG), to identify patients with hypertension with paroxysmal atrial fibrillation (AF).

**Material and methods.** The study included 298 patients with hypertension, of whom 77 (25.8%) showed paroxysmal AF during 24-hour electrocardiogram monitoring. The control group included 58 patients without cardiovascular diseases. The left atrium volume was determined and the maximum left atrium length was measured. The SI was calculated as the ratio of the left atrium volume to the volume of a sphere whose diameter is equal to the maximum left atrium length.

**Results.** The average values of SI (presented as the median and 95% confidence interval) increased from the control group to the group of patients with hypertension without AF and to the group of patients with hypertension and AF: 0.68 (0.64–0.72), 0.71 (0.69–0.72) and 0.92 (0.91–0.94), p <0.0001. Multiple linear regression analysis showed that 1-year increase of the age is associated with increase in SI by 0.0015 units, the presence of obesity is accompanied by an increase of SI by 0.0241 units, and the presence of paroxysmal AF leads to an increase in SI by 0.2031 units. All patients included in the study were randomly divided into derivation and validation cohorts (238 and 118 patients). In the derivation cohort, the AUC for SI, as a predictor of AF, was 0.955 (0.920–0.977), and cut-off point was 0.82. In the validation cohort, the 'SI>0.82' criterion, a sign of AF, demonstrated sensitivity of 100 (86.8–100.0) % and specificity of 93.5 (86.3–97.6) %.

**Conclusion.** The SI calculated by EchoCG has a high discriminating ability in relation to paroxysmal AF in patients with hypertension.


**Keywords:** arterial hypertension, atrial fibrillation, echocardiography, left atrium, left atrium sphericity index.
**Conflict of interest:** nothing to disclose.

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# Увеличение индекса сферичности левого предсердия может служить маркером пароксизмальной фибрилляции предсердий у больных артериальной гипертензией

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## Аннотация

**Цель** – изучить возможность использования индекса сферичности (ИС) левого предсердия, рассчитанного по данным эхокардиографии (ЭхоКГ), для выявления больных артериальной гипертензией (АГ) с пароксизмальной фибрилляцией предсердий (ФП).

**Материал и методы.** В исследование включены 298 больных АГ, из которых у 77 (25,8%) при суточном мониторировании электрокардиограммы была выявлена пароксизмальная ФП. Контрольную группу составили 58 пациентов без заболеваний сердечно-сосудистой системы. При ЭхоКГ определялся объем левого предсердия и измерялась его максимальная длина. ИС рассчитывался как отношение объема левого предсердия к объему сферы, диаметр которой равен максимальной длине левого предсердия.

**Результаты.** Средние значения ИС (представлены в виде медианы и 95% доверительного интервала) возрастали от контрольной группы к группе больных АГ без ФП и далее к группе больных АГ с ФП: 0,68 (0,64–0,72), 0,71 (0,69–0,72) и 0,92 (0,91–0,94), p<0,0001. Анализ множественной линейной регрессии показал, что увеличение возраста пациента на 1 год ассоциируется с возрастанием ИС на 0,0015 единицы, наличие ожирение сопровождается возрастанием ИС на 0,0241 единицы, а наличие пароксизмальной ФП ведет к возрастанию ИС на 0,2031 единицы. Для изучения дискриминирующей способности ИС в отношении ФП все включенные в исследование пациенты были случайным образом разделены на «обучающую» и «экзаменующую» когорты (238 и 118 пациентов). На «обучающей» когорте площадь под кривой ошибок для ИС, как предиктора ФП, оказалась равна 0,955 (0,920–0,977), а отрезная точка – 0,82. На «экзаменующей» когорте критерий «ИС >0,82», как признак пароксизмальной ФП, продемонстрировал чувствительность 100 (86,8–100,0) % и специфичность 93,5 (86,3–97,6) %.

**Заключение.** ИС, рассчитанный по данным ЭхоКГ, обладает высокой дискриминирующей способностью в отношении пароксизмальной ФП у больных АГ.

**Ключевые слова:** артериальная гипертония, фибрилляция предсердий, эхокардиография, левое предсердие, индекс сферичности левого предсердия.

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АГ – артериальная гипертензия; ИММЛЖ – индекс массы миокарда левого желудочка; ИОЛП – индекс объема левого предсердия; ИС – индекс сферичности; ЛП – левое предсердие; МДЛП – механическая дисперсия левого предсердия; ОЛП – объем левого предсердия; ЭхоКГ – эхокардиография; AUC – площадь под кривой; E/e' – отношение скорости трансмитрального кровотока в раннюю фазу диастолического наполнения к скорости смещения кольца митрального клапана.

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## INTRODUCTION

Early identification of paroxysmal atrial fibrillation (AF) is crucial for prevention of thromboembolic complications, facilitating timely prescription of anticoagulant treatment to persons with risk factors of cerebral stroke [1, 2]. In the opinion of European experts, predictors of AF may include signs of atrial cardiomyopathy, or a combination of structural, functional and electrophysiological changes of atrial myocardia capable of bringing about the clinically significant symptoms, specifically, atrial fibrillation [3, 4].

One of the early pre-clinical signs of atrial cardiomyopathy is the change of shale of the left atrium, from the relatively elongated (ellipsoid) to globe-shaped (spherical). The sphericity of the left atrium allows evaluation of the Sphericity Index (SI), i.e. the ratio of the actual volume of the left atrium to the volume of the sphere whose diameter is equal to that of the maximum diameter of the left atrium. In their study, S. Nakamori et al. [5] showed that SI over 0.84 might serve as a predictor of late recurrent AF after radio-frequency isolation of pulmonary veins (sensitivity 88%, specificity 59%).

To calculate the SI, magnetic resonance imaging data is used, however, it can be calculated using the transthoracic echocardiography. According to literature data, this approach has not been used before, making a study of its prognostic value especially important.

## AIM

To study the possibility of using the left atrium sphericity index, calculated by echocardiography, to identify patients with hypertension with paroxysmal atrial fibrillation.

## MATERIAL AND METHODS

Between 01.07.2020 and 30.06.2023, 298 patients with previously diagnosed arterial hypertension were consecutively enrolled in the study. All participants underwent evaluation for palpitations, dyspnea, or chest pain. Exclusion criteria included: confirmed or newly detected coronary artery disease, persistent/permanent atrial fibrillation (AF), valvular pathology, or left ventricular systolic dysfunction (ejection fraction <50%). On 24-hour ECG monitoring, paroxysmal AF was diagnosed in 77 patients (25.8%), with arrhythmia episodes lasting ≥30 seconds serving as the diagnostic criterion.

The control group comprised 58 patients with no prior cardiovascular disease (CVD) diagnosis and no ECG or echocardiographic evidence of CVD. While rhythm monitoring to exclude paroxysmal AF was not performed, patients with historical episodes of palpitations were excluded.

Echocardiography was performed using a Vivid S70 system (GE, USA). Left ventricular (LV) structural-functional assessment included LV myocardial mass index (LVMI), E/e' ratio (early mitral inflow velocity to mitral annular tissue Doppler velocity), reflecting LV filling pressure. Left atrial volume (LAV) was measured by disk summation in apical 4- and 2-chamber views; in the same positions, the length of the left atrium was measured. The greater of the two values (D) was used for sphericity index calculation: $SI = LAV/(\pi D/6)$, where $\pi D/6$ represents the volume of the sphere with diameter D.

Two-dimensional echocardiography with speckle-tracking and subsequent analysis was performed on ultrasonic images with at least 50 frames per second. The curves of deformation of the left atrium were re-created by manual tracking of the endocardial border in the apical 4-chamber view in the end of the diastole according to the R-R algorithm (deformation level zero was aligned with R wave). The global longitudinal deformation of the left atrium (reservoir strain) was calculated as the average of peak values of longitudinal deformation in the six segments of the left atrium [6, 7]. Mechanical dispersion of the left atrium (MDLA) was calculated as percentage ratio of the standard deviation of reservoir strain timing in the longitudinal deformation of the myocardium in segments of the left atrium to cardiac cycle duration [8, 9].

The statistical analysis was performed in the MedCalc® Statistical Software suite, version 20.218 (MedCalc Software

| Parameter | Group 1 (n = 58) | Group 2 (n = 221) | Group 3 (n = 77) | p |
|---|---|---|---|---|
| Age, years | 50.5 (45.0–54.0)2. 3 | 61.0 (60.0–63.0)1. 3 | 66.0 (64.0–67.0)1. 2 | <0.0001 |
| Women, n (%) | 32 (55.2)3 | 147 (66.5) | 58 (75.3)1 | 0.0488 |
| Obesity, n (%) | 8 (13.8)2. 3 | 115 (52.0)1 | 42 (54.5)1 | <0.0001 |
| LVMI, g/m2 | 86.5 (82.1–90.9)2. 3 | 117.0 (116.0–120.0)1 | 120.0 (117.0–126.1)1 | <0.0001 |
| E/e’ | 8.0 (7.1–8.6)2. 3 | 10.0 (9.6–10.5)1 | 10.2 (9.5–10.6)1 | <0.0001 |
| LAVI, ml/m2 | 25.0 (24.0–27.0)2. 3 | 29.0 (27.3 30.0)1. 3 | 37.0 (34.2–40.0)1. 2 | <0.0001 |
| LA strain, % | 32.0 (28.0–33.0)2. 3 | 22.0 (21.0–22.4)1. 3 | 20.0 (19.0–20.7)1. 2 | <0.0001 |
| MDLA, % | 0.89 (0.72–1.01)2. 3 | 1.00 (0.95–1.14)1. 3 | 3.02 (2.87–3.28)1. 2 | <0.0001 |
| SI | 0.68 (0.64–0.72)2. 3 | 0.71 (0.69–0.72)1. 3 | 0.92 (0.91–0.94)1. 2 | <0.0001 |

*Notes: p – statistical significance of the grouping factor’s effect on the variable; the upper index means the number of the group, in which the post-hoc analysis revealed statistically significant difference in values (p <0.05). LVMI – left ventricle myocardial mass index, E/e’ ratio – the ratio of early mitral inflow velocity (E) to mitral annular tissue Doppler velocity (e’), LAVI – left atrium volume index, LA – left atrium, MDLA – mechanical dispersion of the left atrium, SI – sphericity index.*

***Table 1.*** *Characteristics of the examined patients*

***Таблица 1.*** *Характеристика обследованных пациентов*

Ltd, Ostend, Belgium). As most numerical variables deviated from normal distribution, data are presented as medians with 95% confidence intervals (95% CI). The Kruskal-Wallis test assessed groupwise differences, with post-hoc Conover analysis for pairwise comparisons. Median differences are reported with 95% CIs.

Chi-square test assessed the impact of grouping factor on the distribution of categorical variables, Bonferroni-adjusted Chi-square test for post-hoc comparison of groupwise comparisons. Multiple linear regression involving consecutive exclusion of independent variables is used to identify the factors providing independent influence on the structural and functional parameters of the left atrium. The predictive utility of left atrial structural-functional parameters for paroxysmal atrial fibrillation (AF) and hypertension-mediated left ventricular changes was evaluated using receiver operating characteristic (ROC) curve analysis in a training cohort (n=238). Areas under the curve (AUC) and inter-curve differences are reported with 95% CIs. Predictive performance was validated in a testing cohort (n=118). Statistical significance was set at p<0.05 for all analyses with a null hypothesis probability threshold <5%.

## RESULTS

The results of examination of 58 patients of the control group (Group 1), 221 patients with hypertension without paroxysmal AF (Group 2) and 77 patients with hypertension and paroxysmal AF (Group 3) are shown in Table 1.

Regardless of atrial fibrillation (AF) status, hypertensive patients were older than controls, had a higher proportion of women and individuals with obesity, and showed significantly higher mean left ventricular mass index (LVMI) and E/e’ ratios. No statistically significant differences in left ventricular status were observed between hypertensive patients with and without AF.

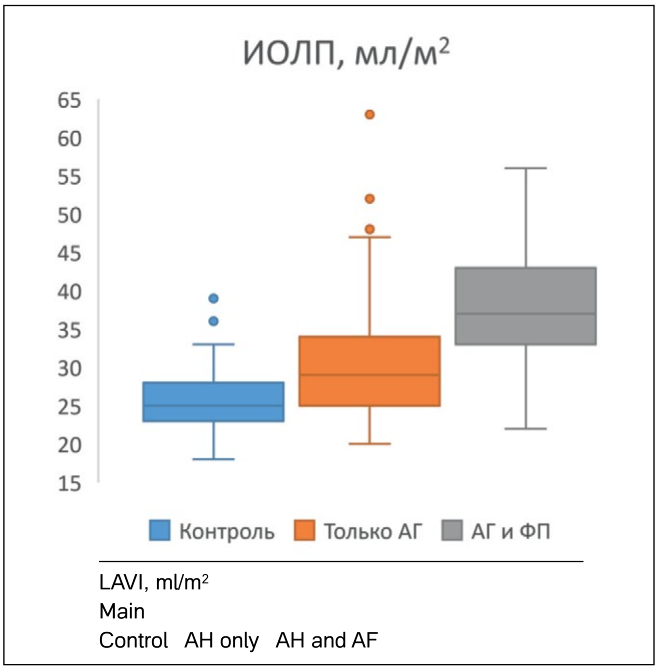


***Figure 1.*** *Left atrium volume index (LAVI) in patients without cardiovascular disease (Control) and patients with arterial hypertension without rhythm disturbances (AH only) and with paroxysmal atrial fibrillation (AH+AF).*

***Рисунок 1.*** *Индекс объема левого предсердия (ИОЛП) у пациентов без заболевания сердечно-сосудистой системы (Контроль) и больных артериальной гипертензией без нарушений ритма (Только АГ) и с пароксизмальной фибрилляцией предсердия (АГ и ФП).*

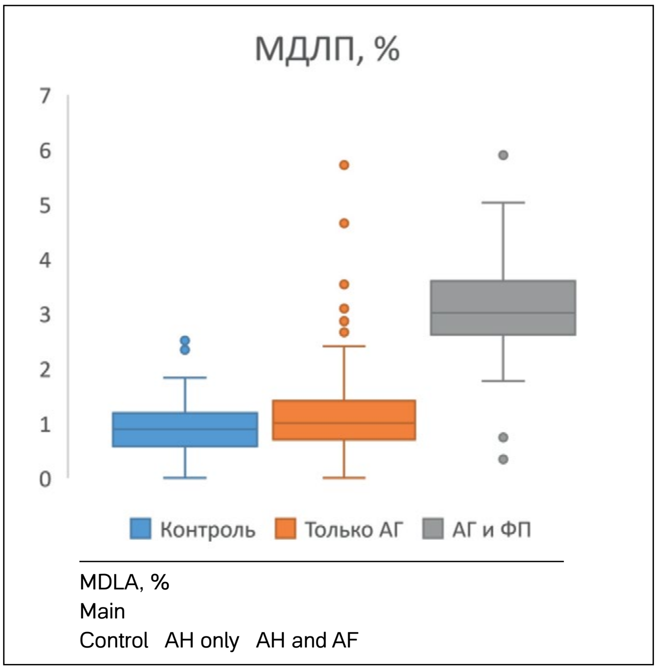


***Figure 2.*** *Mechanical dispersion of the left atrium (MDLA) in patients without cardiovascular disease (Control) and patients with arterial hypertension without rhythm disturbances (AH only) and with paroxysmal atrial fibrillation (AH+AF).*

***Рисунок 2.*** *Механическая дисперсия левого предсердия (МДЛП) у пациентов без заболевания сердечно-сосудистой системы (Контроль) и больных артериальной гипертензией без нарушений ритма (Только АГ) и с пароксизмальной фибрилляцией предсердия (АГ и ФП).*

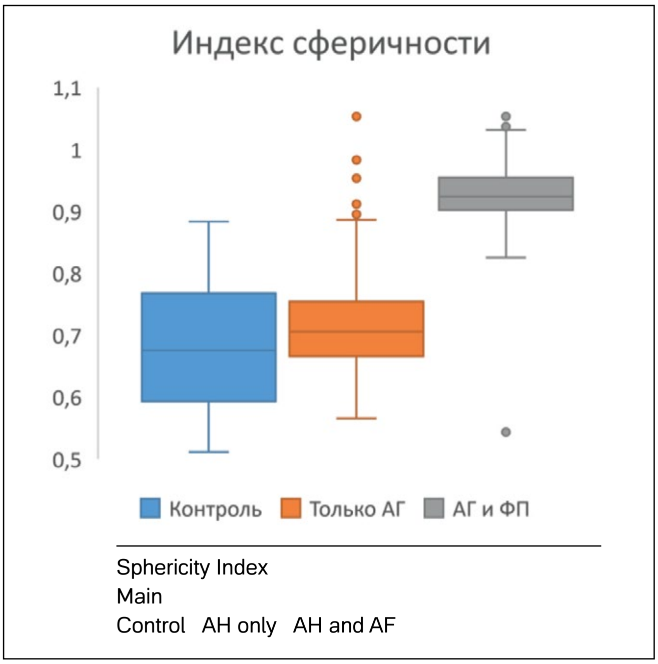


*Figure 3.* Left atrium sphericity index in patients without cardiovascular disease (Control) and patients with arterial hypertension without rhythm disturbances (AH only) and with paroxysmal atrial fibrillation (AH+AF).

***Рисунок 3.*** *Индекс сферичности левого предсердия у пациентов без заболевания сердечно-сосудистой системы (Контроль) и больных артериальной гипертензией без нарушений ритма (Только АГ) и с пароксизмальной фибрилляцией предсердия (АГ и ФП).*

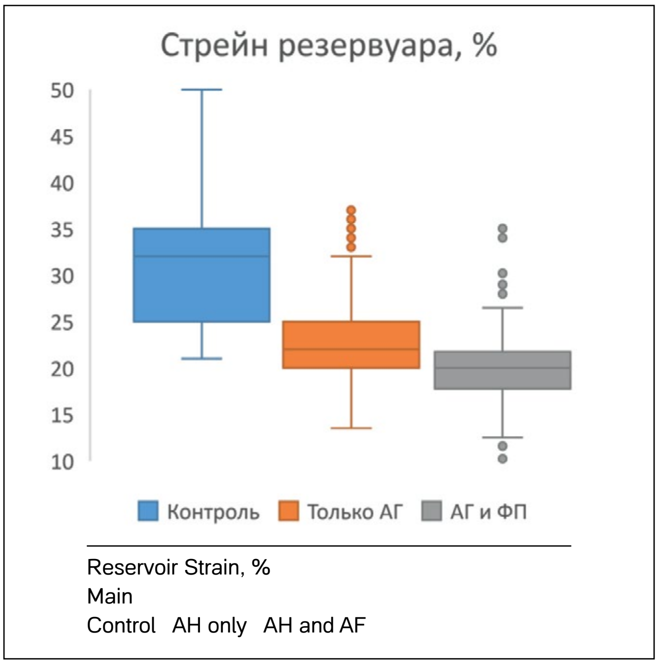


*Figure 4.* Strain of the left atrium in the reservoir phase in patients without cardiovascular disease (Control) and patients with arterial hypertension without rhythm disturbances (AH only) and with paroxysmal atrial fibrillation (AH+AF).

***Рисунок 4.*** *Стрейн левого предсердия в фазу резервуара у пациентов без заболевания сердечно-сосудистой системы (Контроль) и больных артериальной гипертензией без нарушений ритма (Только АГ) и с пароксизмальной фибрилляцией предсердия (АГ и ФП).*

The parameters of the left atrium were statistically different in all the three groups, but the groupwise differences were manifested to various extent. Thus, the difference in the median left atrium volume index (LAVI) between Group 1 and Group 2 was twice as low as that between Group 2 and Group 3: 4.0 (2.0–5.6) and 8.0 (6.0–9.6) ml/m2. The difference in the median mechanical dispersion of the left atrium (MDLA) between Group 1 and Group 2 was by one order of magnitude less than between Group 2 and Group 3: 0.18 (0.02–0.33) and 1.99 (1.80–2.18) percentage points. In the same way, the similar differences of SI medians were varied: 0.04 (0.01–0.06) and 0.22 (0.21–0.24). The reservoir strain in Group 2 was lower, on average, than in Group 1, and in Group 3, lower than in Group 2, at the same time, the difference between Group 1 and Group 2 was 2.5 times lower than the difference between Group 2 and Group 3: 7.0 (9.0–5.0) and 2.9 (4.0–2.0) percentage points.

| Dependent variable | Independent variable | | | | | Constant |
|---|---|---|---|---|---|---|
| | Age, years | Sex | Obesity | AH | AF | |
| Strain, % | -0,2018 | – | -2,1290 | -4,5478 | -2,0624 | 41,254 |
| LAVI, ml/m2 | 0,1636 | – | – | 3,0849 | 6,6060 | 17,309 |
| MDLA, % | 0,0160 | – | – | – | 1,8193 | 0,1893 |
| SI | 0,0015 | – | 0,0241 | – | 0,2031 | 0,6099 |

*Notes: LAVI – left atrium volume index, MDLA – mechanical dispersion of left atrium, SI – sphericity index, AH – arterial hypertension, AF – atrial fibrillation.*

***Table 2.*** *Factors in multiple linear regression equations reflecting the dependence of the characteristics of the left atrium on the clinical characteristics of the patient*

***Таблица 2.*** *Коэффициенты в уравнениях множественной линейной регрессии, отражающих зависимость характеристик левого предсердия от клинических особенностей пациента*

Thus, paroxysmal AF affects LAVI, MDLA and SI in a stronger way than hypertension-mediated structural and functional changes of the left ventricle; the condition of the left ventricle, not the AF, affects the reservoir strain in a stronger way (Fig. 1–4). The same conclusions follow the results of multivariate linear regression that studies the relation between the parameters of the left atrium and the patient's age and sex, obesity, hypertension and paroxysmal AF status (Table 2).

It follows from the table that the patient's age has an independent statistically significant positively manifested effect on all studied parameters of the left atrium. With every decade of life, the reservoir strain decreases by 2 percentage points (on average), the LAVI increases by 1.6 ml/m2, MDLA, by 0.16 percentage points, and the SI by 0.015 units. The patient's sex demonstrated no independent effect on the parameters of the left atrium, and was not included in any of the created models. The obesity status has no significant effect on the LAVI and MDLA, but is associated with decrease of the reservoir strain and increase of sphericity index. Atrial fibrillation affects all studies parameters of the left atrium, and the arterial hypertension, only on the reservoir strain and left atrium volume index. It is to be noted that arterial hypertension affects the reservoir strain more than does the atrial fibrillation, while the latter has a more pronounced effect on the volume index.

To study the possibilities of using the parameters of the left atrium as predictors of paroxysmal atrial fibrillation, all the patients included in the study were randomly divided into the training and testing cohorts by the factor of 2:1 (238 and 118 patients). The training cohort included 39 (16.4%)

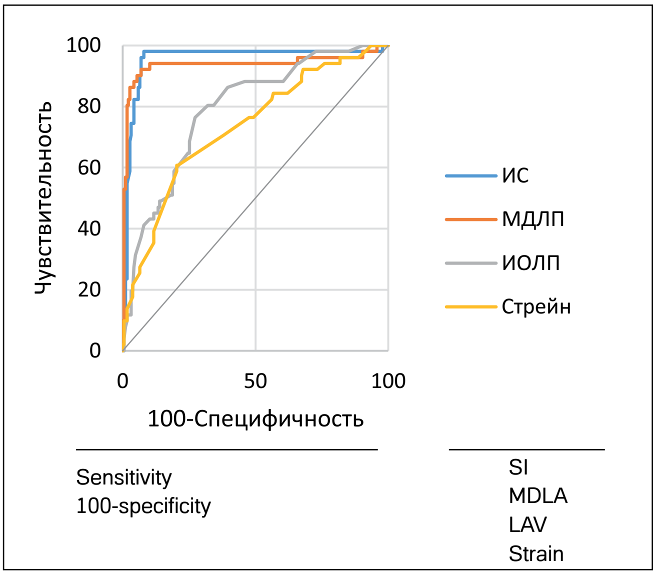


***Figure 5.** Receiver operating characteristic curves for the sphericity index (SI), left atrium mechanical dispersion (LAMD), left atrium volume index (LAVI), and reservoir strain as predictors of atrial fibrillation (derivation cohort).*

***Рисунок 5.** Кривые ошибок для индекса сферичности (ИС), механической дисперсии левого предсердия (МДЛП), индекса объема левого предсердия (ИОЛП) и стрейна резервуара как предикторов фибрилляции предсердий («обучающая» когорта).*

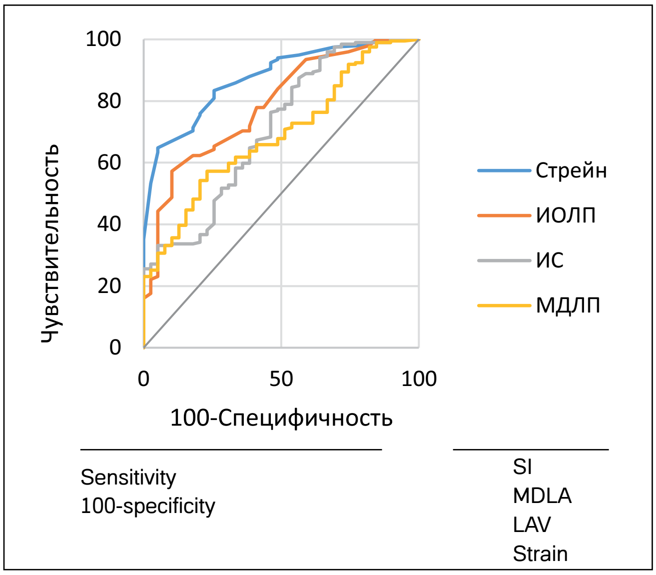


***Figure 6.** Receiver operating characteristic curves for the sphericity index (SI), left atrium mechanical dispersion (LAMD), left atrium volume Index (LAVI), and reservoir strain as predictors of hypertension (validation cohorts).*

***Рисунок 6.** Кривые ошибок для индекса сферичности (ИС), механической дисперсии левого предсердия (МДЛП), индекса объема левого предсердия (ИОЛП) и стрейна резервуара как предикторов артериальной гипертензии («экзаменующая» когорта).*

patients of the control group, 148 (62.2%) patients with hypertension but without AF, and 51 (21.4%) patients with arterial hypertension and paroxysmal AF. For the testing cohort, the respective numbers were 19 (16.1%), 73 (61.9%) and 26 (22.0%) patients.

The receiver operating curves obtained on the training cohort for the parameters of the left atrium as predictors of paroxysmal AF are shown in Fig. 5.

The areas under curves (AUC) for SI and MDLA were similar, and were significantly more than the AUC for the LAVI and reservoir strain (Table 2). The paroxysmal AF prediction criteria obtained on the training cohort for the SI and MDLA showed a high discriminating performance in the testing cohort (Table 3). At the same time, the discriminating performance of LAVI and reservoir strain with respect to paroxysmal AF was rather low.

The receiver operating curves obtained on the testing cohort for the parameters of the left atrium as hypertension predictors, or hypertension-mediated changes in the structural and functional condition of the left ventricle, are shown in Fig. 6. In this case, the greatest discriminating performance was found in the reservoir strain, and the lowest, in the MDLA (Table 4).

Thus, the SI and MDLA demonstrated considerably high discrimination performance with respect to paroxysmal atrial fibrillation, and low performance with respect to arterial hypertension; therefore, these indicators may be used to identify individuals with high probability of non-diagnosed atrial fibrillation among persons with arterial hypertension and persons without cardiovascular pathologies.

## DISCUSSION

This study investigated the utility of echocardiography-derived sphericity index (SI) for detecting paroxysmal atrial fibrillation (AF) in hypertensive patients. The rationale stemmed from prior evidence demonstrating that increased SI measured by computed tomography (CT) or magnetic resonance imaging (MRI) correlates with higher risks of late AF recurrence after ablative pulmonary vein isolation (PVI) [5, 10, 11].

The discriminative performance of SI with respect to AF status in hypertensive patients was compared with the discriminating performance of another three indicators of remodeling of the left atrium: volume index, reservoir strain, and mechanical dispersion. The discriminative performance

| Variable | Training cohort (n = 238) | | Testing cohort (n = 118) | | | |
|---|---|---|---|---|---|---|
| | AUC (95% CI) | Criterion | Se | Sp | +LR | -LR |
| SI, units | 0.955 (0.920–0.977) | >0.82 | 100.0 | 93.5 | 15.33 | 0.00 |
| MDLA, % | 0.937 (0.899–0.965) | >1.91 | 92.3 | 85.9 | 6.53 | 0.090 |
| LAVI, ml/m2 | 0.791 (0.734–0.841) | >32.0 | 76.9 | 71.7 | 2.72 | 0.32 |
| Strain, % | 0.732 (0.671–0.787) | ≤20.3 | 61.5 | 80.4 | 3.15 | 0.48 |

*Note: AUC – area under the curve, Se – sensitivity, Sp – specificity, +LR – positive likelihood ratio, -LR – negative likelihood ratio, CI – confidence interval, SI – sphericity index, MDLA – mechanical dispersion of the left atrium, LAVI – left atrium volume index.*

***Table 3.** Characteristics of the structural and functional state of the left atrium as predictors of paroxysmal atrial fibrillation*

***Таблица 3.** Характеристики показателей структурно-функционального состояния левого предсердия как предикторов пароксизмальной фибрилляции предсердий*

| Variable | Training cohort (n = 238) | | Testing cohort (n = 118) | | | |
|---|---|---|---|---|---|---|
| | AUC (95% CI) | Criterion | Se | Sp | +LR | -LR |
| SI, units | 0.875 (0.826–0.914) | ≤22.5 | 59.6 | 84.2 | 3.77 | 0.48 |
| MDLA, % | 0.787 (0.730–0.837) | >29 | 53.5 | 89.5 | 5.09 | 0.52 |
| LAVI, ml/m$^2$ | 0.709 (0.647–0.766) | >0.65 | 82.8 | 42.1 | 1.43 | 0.41 |
| Strain, % | 0.690 (0.627–0.748) | >1.05 | 63.6 | 52.6 | 1.34 | 0.69 |

*Note: AUC – area under the curve, Se – sensitivity, Sp – specificity, +LR – positive likelihood ratio, -LR – negative likelihood ratio, CI – confidence interval, SI – sphericity index, MDLA – mechanical dispersion of the left atrium, LAVI – left atrium volume index.*

***Table 4.** Characteristics of indicators of the structural and functional state of the left atrium as predictors of arterial hypertension*

***Таблица 4.** Характеристики показателей структурно-функционального состояния левого предсердия как предикторов артериальной гипертензии*

of SI was comparable with that of the MDLA (AUC = 0.955 and 0.937) and was significantly higher than the LAVI and reservoir strain properties (AUC = 0.791 and 0.732). The reason for such manifested differences is that the values of volume index and reservoir strain depend not only on paroxysmal AF, but hypertension-mediated structural and functional changes of the left ventricle. Thus, following the multivariate linear regression analysis, the atrial fibrillation is associated with an increase of volume index by approx. 6.6 ml/m2 and a decrease of reservoir strain by 2.1 percentage points; the hypertensive status is associated with an increase of volume index by 3.1 ml/m$^2$ and a decrease of the reservoir strain by 4.5 percentage points. The hypertensive status of patients had no statistically significant effect on sphericity index and mechanical dispersion of left atrium, while the atrial fibrillation results in an increase of SI by 0.2 units and an increase of mechanical dispersion by 1.8 percentage points. Thus, SI and MDLA reflect the specific features of remodeling of the left atrium related to atrial fibrillation, whereas the volume index and reservoir strain do not demonstrate such specificity.

The findings of this study find acceptable explanation within the concept of atrial cardiomyopathy, or a combination of structural, functional and electrophysiological changes of the atrial myocardia of different origin [3]. The reasons for the development of atrial cardiomyopathy might lie in the increased load on the atria in the event of disruption of the diastolic function of the ventricles or in the structural heart defects, persistent tachy-arrhythmias, and some extracardiac factors including old age, general and epicardial fat, diabetes mellitus, and genetic predisposition. The most prevalent clinical manifestations of atrial cardiomyopathy are atrial fibrillation [4] and, probably, non-AF-mediated left atrial appendage thrombus [12].

Depending on the prevalent histological changes in the myocardium, four classes of atrial cardiomyopathy are identified. Class I is characterized with changes in the cardiac myocytes (hypertrophy and myocytolysis), Class II, mainly with fibrous changes, Class III, with combined changes in the cardiac myocytes and fibrosis, Class IV, with extracellular infiltration with amyloid (IVa), fat (IVf) or inflammatory cells (IVi) without manifested accumulation of collagen fibers. Classification boundaries remain arbitrary, as cardiomyopathy progression alters histological patterns. Moreover, regional heterogeneity in atrial myocardial histology may simultaneously exhibit features of distinct cardiomyopathy classes [3].

Arterial hypertension leads to left ventricle hypertrophy and disorder of its diastolic function, increasing the strain on the left atrium and promoting development of Class I cardiomyopathy. The findings of this study indicate that a manifestation of such cardiomyopathy is the increase of the volume index and the decrease of the reservoir strain. The morphologic substrate of atrial fibrillation is myocardial fibrosis, i.e. Class II atrial cardiomyopathy. Some studies show that mechanical dispersion of the left atrium allows a more accurate evaluation of the degree of atrial fibrosis than the results of magnetic resonance imaging [13, 14]. We believe that this accounts for the high discriminating performance of MDLA with respect to atrial fibrillation. Sphericity index (SI) demonstrated similarly high discrimination performance in this study, which allows regarding the 'spherification' of the left atrium as a sign of atrial fibrosis.

Unlike mechanical dispersion of the left atrium, a parameter whose calculation requires speckle-tracking echocardiography, the sphericity index is calculated using the findings of regular echo-CG. This facilitates the use of SI in broad clinical practice to identify hypertensive patients with high probability of non-diagnosed paroxysmal AF.

### Limitations of this study

In this study, Sphericity Index demonstrated high discrimitating performance with respect to paroxysmal AF in hypertensive patients with left atrial hypertrophy. The possibility of using this parameter to identify isolated AF, as well as AF in individuals with left ventricle systolic dysfunction remains an open question requiring further research [15]. The threshold value of SI, the exceeding of which indicates high probability of paroxysmal AF, needs to be clarified as well. This is all the more important since the SI values depend on the method of measurement of the left atrium volume. The 'area-length' method usually provides higher values of the left atrium volume than the disk method; therefore, the SI values calculated using the 'area-length' method are generally higher than those calculated using the disk method.

## CONCLUSION

Sphericity Index calculated using echo-CG data manifests high discriminating performance with respect to paroxysmal AF in hypertensive patients. The sensitivity of the parameter 'SI>0.82' as a predictor of paroxysmal AF reaches 100% (95% CI 86.8–100.0), and its specificity is 93.5% (65% CI 86.3–97.6).

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|---|---|
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