*Psychiatria Danubina, 2025; Vol. 37, Suppl. 1, pp 374-378*
*Conference paper*

*Research article*

# COGNITIVE FUNCTION EVALUATION IN PATIENTS WITH NEWLY DIAGNOSED PAROXYSMAL ATRIAL FIBRILLATION

**Olga Germanova[1], Yulia Reshetnikova[1], Daria Popova[2] & Giuseppe Galati[1,3]**

*[1]International Centre for Education and Research in Cardiovascular Pathology and Cardiovisualization, Samara State Medical University, Samara, Russia*
*[2]SAGA Group, Samara Institute of Mental Health, Medical University "Reaviz", Samara, Russia*
*[3]I.R.C.C.S. Ospedale Multimedica – Cardiovascular Scientific Institute, Milan, Italy*

## SUMMARY

***Background:*** *To evaluate cognitive function of patients with newly diagnosed paroxysmal atrial fibrillation.*

***Materials and methods:*** *In a single-center case-control study, we undertook 24 hours ECG monitoring of 6630 patients, among whom 97 showed paroxysmal atrial fibrillation (AF) Fourteen of the AF patients have informed consent to participate in the study. All patients had additional 24 hours ECG monitoring, along with transthoracic echocardiography, volumetric sphygmography, and the Montreal Cognitive Assessment (MoCA) test.*

***Results:*** *The median MoCA score was 24 [22; 26], indicating mild cognitive impairment in nine of the 14 patients (64%, age 67.9 ± 8.6 y.o.). The least severe impairment was in visual-spatial perception (median 4 of 5 possible), and the most severe was in executive-functional skills (median 3 of 5). Despite the high mean arterial stiffness (CAVI > 8), there was no significant correlation with MoCA (rs = –0.256, p = 0.364). However, there was a significant negative Spearman correlation between MoCA and LV myocardial mass index (rs = –0.737, 95% CI [–0.914; –0.323], p = 0.003), indicating an association between declining cognitive function and myocardial structure.*

***Conclusions:*** *In most of the patients with asymptomatic paroxysmal newly revealed AF, we observed mild cognitive impairment. Increased LV-indexed mass was associated with worse cognitive function in these AF patients (rs = –0.737, 95% CI [–0.914; –0.323], p = 0.003). This observation calls for investigation of the causal mechanism whereby myocardial remodeling in AF patients may impair brain function.*

***Key words:*** *atrial fibrillation - cognitive function – MoCA test*

***Abbreviations:*** *ABI - ankle brachial index; AF – atrial fibrillation; CAVI - cardio-ankle vascular index; BMI – body mass index; ECG – electrocardiography; EchoCG – echocardiography; ES – extrasystoles; GLS - global longitudinal strain; LA – left atrium; LV – left ventricle; LVEF – left ventricle ejection fraction; MoCA - Montreal Cognitive Assessment test; TTE - transthoracic echocardiography; RV – right ventricle; TR – tricuspid regurgitation*

* * * * *

## INTRODUCTION

Atrial fibrillation (AF) is one of the most common types of heart arrhythmias, ranking second after extrasystole. AF is an important risk factor for cardioembolic complications, among which stroke plays a leading role. However, some patients are asymptomatic for AF, especially when their paroxysms appear for brief episodes. Consequently, AF paroxysm can be an accidental finding during routine 24 hours ECG monitoring. Indeed, prediction and early detection of AF paroxysms are among the highest priority targets in preventing cardioembolic complications, although there is no universal predictive model for the AF paroxysm prediction. In our previous research, we proposed a logistic regression equation that demonstrated high prognostic accuracy for AF (Germanova et al. 2024, Kunts et al. 2024).

In ordinary practice, a brief 12-lead ECG recording does not suffice for accurate diagnosis of short paroxysmal AF. In more specialized settings, prolonged ECGs lasting five minutes or more serve for diagnostic screening of patients for arrythmia (Li et al. 2021). Many independent studies concluded that more prolonged daily Holter ECG monitoring is more informative about the presence of short paroxysmal AF (Raghunath et al. 2021, de Gregorio et al. 2023, Miyazaki et al. 2021, Reiffel et al. 2020, Chua et al. 2020).

The Montreal Cognitive Assessment (MoCA Test) is a widely utilized tool for identifying mild cognitive impairment and early indicators of dementia (Ratcliffe et al. 2024). This assessment is useful for pinpointing individuals who are at risk for Alzheimer's disease, as well as for screening various conditions, including Parkinson's disease and the cognitive impact of brain tumors (Figuracion et al. 2024). The 30-point MoCA test has in recent years largely supplanted the Mini-Mental State Examination (MMSE), which was first introduced in 1975. Although valuable for detecting dementia or mild cognitive impairment (MCI), the MoCA test is not designed to distinguish among the different forms of dementia. Completable in approximately ten minutes, it is straightforward to administer, although it does have some limitations, such as the requirement for adjustments based on the individual's education level. A corrected score of 26 or more on the 30-point scale is considered normal.

Several researchers have discovered a risk of cognitive impairment in patients with permanent AF, likely arising in relation to the incidence of emboli and consequent stroke (Shantsila et al. 2023, Fekete et al. 2025). However, there has been no study of the prevalence of cognitive impairment in patients with newly diagnosed, asymptomatic paroxysmal AF. In this study we aimed to investigate cognitive function in patients undergoing routine EEG screening for the presence of newly diagnosed paroxysmal AF.

## MATERIALS AND METHODS

We performed a single-center case-control study. We analyzed the data from 24 hours ECG monitoring of 6630 patients (mean age and SD, % male) undergoing routine examination during hospitalization in the cardiology department of the clinics of Samara State Medical University. Before entering the study, none of the examined patients had AF in their anamnesis, nor had they complained of symptoms associated with heart arrhythmias. Out of the entire cohort of 6630 people, paroxysmal AF was an incidental finding detected in 97 (1.5%; mean age and SD; %male) patients during the 24 hours ECG monitoring. Among these 97 patients, 14 provided signed informed consent to participate in the study.

All 14 patients underwent standard laboratory and instrumental research methods, with performance of instrumental methods, i.e., transthoracic echocardiography, and volumetric sphygmography, in addition to 24 hours ECG monitoring. According to their indications, they also underwent stress echocardiography with physical exercise or pharmacological challenge. The following main parameters were recorded: gender; age; observation time; main pacemaker; analysis of supraventricular and ventricular ectopic activity; the presence of pauses, blocks; the dynamics of ST segment changes; the duration of QT intervals; heart rate variability. We noted the presence of early extrasystoles of the "P on T" and "R on T" types.

For cognitive function evaluation, we used the standard MoCA test translated into Russian language and validated in the Russian Federation. The interpretation of the results was as follows: normal; 28-30 points; MCI – 22-27 points; moderate cognitive impairment – 10-21 points; severe cognitive impairment – 0-9 points.

We performed transthoracic echocardiography (TTE) in all patients (echo machine Philips EpiqCVx, USA). The standard protocol included the parameters under the current recommendations of the EACVI and ESC. The arterial stiffness CAVI index of the right (R-CAVI) and left (L-CAVI) limbs was measured using the Fukuda VaSera 1500N device (Japan); vascular lesions were considered if the ABI value was <0.9.

We followed the principles of evidence-based medicine. The study was performed in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of Samara State medical university. In the statistical analyses, normality of distribution was assessed using the Shapiro–Wilk test. Normally distributed data are presented as mean ± SD, abnormal data as median [Q1; Q3]. For comparison with normative data, a one-sample t-test or Mann–Whitney U-test was used. Relationships between indicators were assessed using Spearman correlation (rs). The confidence interval for the rs coefficient was calculated using bootstrapping (2000 repeated samples). Statistical significance was $p < 0.05$. Analyses were performed in the statistical program SPSS v.27.

## RESULTS

None of the patients previously had diagnosis of stroke. The mean age of the patients was 67.9 ± 8.6 years, and their BMI was 30.63 ± 5.24. The gender and main clinical parameters are presented in Table 1.

**Table 1.** Demographic and clinical characteristics of participants (n = 14)

| Parameter | Statistics | Value |
|---|---|---|
| Age, years old | Mean ± SD | 67.9±8.6 |
| Gender M/F, n (%) | - | 8 (57%) / 6 (43%) |
| BMI, kg/m² | Mean ± SD | 30.6±5.2 |
| R-CAVI | Mean ± SD | 8.21±2.03 |
| L-CAVI | Mean ± SD | 8.26±1.89 |
| LA volume, ml | Median [Q1; Q3] | 56.5 [48.0; 64.0] |
| LV indexed mass, g/m² | Mean ± SD | 68.3±14.2 |
| MoCA, points | Median [Q1; Q3] | 24.0 [22.0; 26.0] |

*Notes.* BMI – body mass index; LA – left atrium; LV – left ventricle

In cognitive function evaluation, the median MoCA score was 24 [22; 26], indicating MCI impairment in nine of 14 patients (64%). The least severe impairment was in visual-spatial perception (median 4 of 5 possible), and the most severe was in executive-function skills (median 3 of 5).

There was a significant negative Spearman correlation between MoCA and LV myocardial mass index (rs = –0.737, 95% CI [–0.914; –0.323], p = 0.003), indicating that increased LV indexed mass was associated with worse cognitive function. The arterial stiffness indices (R-CAVI, L-CAVI) and LA dimensions did not show statistically significant associations with MoCA ($p > 0.05$) after Bonferroni correction (Table 2, Figure 1).

Despite the high mean arterial stiffness (CAVI > 8) in the patient group, this showed no significant correlation with MoCA (rs = –0.256, p = 0.364), which may indicate the predominant influence of structural myocardial changes (rather than peripheral vascular changes) on cognitive status in paroxysmal AF.

**Table 2.** Correlation analysis

| Parameter | Spearman's r with MoCA points | 95% CI | p-value |
|---|---|---|---|
| L-ABI | 0.188 | -0.395 to 0.663 | 0.519 |
| LVEF% | 0.183 | -0.400 to 0.660 | 0.532 |
| GLS% | 0.351 | -0.237 to 0.751 | 0.218 |
| LA strain % - Reservoir | 0.350 | -0.238 to 0.750 | 0.220 |
| LA strain % - Conduit | 0.210 | -0.375 to 0.676 | 0.470 |
| LA strain % - Pump | 0.258 | -0.331 to 0.703 | 0.373 |
| LA volume, ml | -0.137 | -0.633 to 0.439 | 0.640 |
| LA indexed volume, ml/m$^2$ | -0.212 | -0.677 to 0.374 | 0.466 |
| E/A | 0.071 | -0.513 to 0.610 | 0.817 |
| E/e' | -0.069 | -0.590 to 0.493 | 0.816 |
| TR speed, m/sec | 0.151 | -0.427 to 0.642 | 0.606 |
| LV wall relative thickness | -0.360 | -0.755 to 0.227 | 0.206 |
| *LV indexed mass g/m$^2$* | *-0.737* | *-0.914 to -0.323* | *0.003* |
| Age | -0.463 | -0.804 to 0.107 | 0.096 |
| BMI | -0.040 | -0.571 to 0.514 | 0.892 |
| R-CAVI | -0.485 | -0.814 to 0.079 | 0.079 |
| L-CAVI | -0.530 | -0.833 to 0.018 | 0.051 |
| R-ABI | 0.134 | -0.441 to 0.631 | 0.647 |

*Notes.* LVEF – left ventricle ejection fraction, LV – left ventricle, LA – left atrium, GLS – global longitudinal strain.

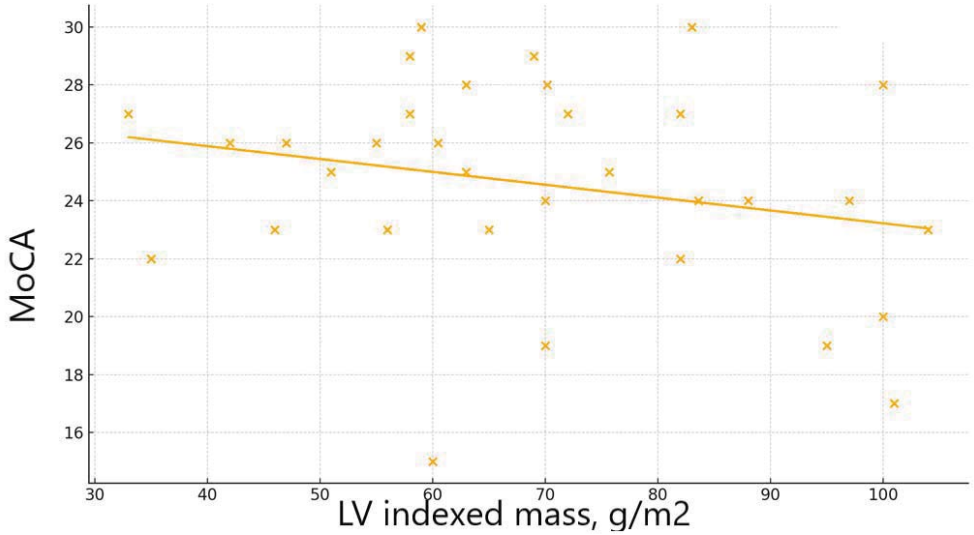


**Figure 1.** Relationship between LV indexed mass and total MoCA score. Trend line and 95% confidence interval were obtained by linear regression

## DISCUSSION

Prevention of cardiovascular complications is a priority target for all medical specialists, including cardiologists and neurologists. Among patients with heart arrhythmias, AF is one the most important risk factor for stroke all over the world. In addition to motor deficits, Stroke often leads to cognitive impairment, which leads to worsening quality of life and disability. Consequently, stroke prevention and early diagnosis of AF are very important aspects of medical interventions. . Patients with AF paroxysms are often asymptomatic, especially in normosystolic cases with brief AF episodes during the night, when it may pass unnoticed. Basing on our previous research, findings of early extrasystoles types "P on T" or "R on T" on the ECG, are associated with a very high risk of appearance of AF (Germanova et al. 2024, 2025, Kunts et al. 2024).

In our current work, we studied a population of asymptomatic heart patients with paroxysmal AF, which was an incidental finding during their routine 24 hours ECG monitoring upon admission. Evaluation of their cognitive function indicated a median MoCA score of 24 [22; 26], corresponding to MCI incidence of 64% of the patients. To meta-analysis, the world-wide prevalence of MCI is approximately 14% in individuals aged around 69 years (Bai et al.2022), which is strongly suggestive of a disproportionate prevalence in our cross-sectional AF group. There was a significant negative Spearman correlation coefficient between MoCA score

and LV myocardial mass index, indicating that increased LV indexed mass is associated with worse cognitive function. Most researchers attribute the cognitive function impairment frequently encountered in AF patients to the effects of prior stroke (Miyazaki et al. 2020, Reiffel et al. 2020). However, none of the patients in our cohort had stroke in their anamnesis. We suppose that the mechanism could rather reflect pathophysiological changes in brain due to a chronic microcirculation insufficiency in this arrhythmia, with additional contributions from the mechanical effects of the pulse waves in AF on arterial integrity. Pulse waves, which appear after a long pause following the ventricular contraction in AF, are associated with increased hemodynamic parameters, which in cases of multifocal atherosclerosis, can become a trigger for plaque rupture with subsequent microembolism along cerebral arteries (Germanov et al. 2020, 2022, 2023, Galati et al. 2022), resulting progressively in cognitive impairment, without conspicuous incidence of stroke. Furthermore, AF patients showed lower cognitive performance in association with reduced structural integrity of the glymphatic system, a brain-wide pathway for clearance of interstitial fluid, thus presenting a mechanism for promotion of brain pathology (Guo et al. 2025).

## CONCLUSIONS

- Most of the patient (64%) with newly diagnosed, asymptomatic paroxysmal AF showed MCI mild cognitive impairment (mean MoCA score 24 [22; 26]).
- Increased LV indexed mass is associated with worse cognitive function in patients with paroxysmal AF (rs = –0.737, 95% CI [–0.914; –0.323], p = 0.003).
- Despite the high mean arterial stiffness (CAVI > 8), there was no significant correlation with MoCA (rs = –0.256, p = 0.364), suggesting a predominant influence of structural myocardial changes on cognitive status in paroxysmal AF.

### *Acknowledgements:*

We express our sincere gratitude to Professor Paul Cumming of Bern University, Bern, Switzerland, for language review of the manuscript and valuable commentaries.

### *Conflict of interest:* None to declare.

### *Contribution of individual authors:*

Olga Germanova & Yulia Reshetnikova: search and analysis of literature, collection of clinical data, data interpretation, writing the first draft.

Daria Popova & Giuseppe Galati: search and analysis of literature, data interpretation, and editing.

All authors approved the final manuscript.

## References

1. *Bai W, Chen P, Cai H, Zhang Q, Su Z, Cheung T, et al.: Worldwide prevalence of mild cognitive impairment among community dwellers aged 50 years and older: a meta-analysis and systematic review of epidemiology studies. Age Ageing. 2022 Aug 2;51(8):afac173. doi: 10.1093/ageing/afac173.*
2. *Chua SK, Chen LC, Lien LM, Lo HM, Liao ZY, Chao SP, et al.: Comparison of Arrhythmia Detection by 24-Hour Holter and 14-Day Continuous Electrocardiography Patch Monitoring. Acta Cardiol Sin. 2020 May;36(3):251-259. doi: 10.6515/ACS.202005_36(3).20190903A.*
3. *de Gregorio C, Di Franco A, Panno AV, Di Franco M, Scaccianoce G, Campanella F, et al. & The Safari Study Group: Subclinical Atrial Fibrillation on Prolonged ECG Holter Monitoring: Results from the Multicenter Real-World SAFARI (Silent Atrial Fibrillation ANCE-Sicily Research Initiative) Study. J Cardiovasc Dev Dis. 2023 Aug 4;10(8):336. doi: 10.3390/jcdd10080336.*
4. *Fekete M, Liotta EM, Molnar T, Fülöp GA & Lehoczki A: The role of atrial fibrillation in vascular cognitive impairment and dementia: epidemiology, pathophysiology, and preventive strategies. Geroscience. 2025 Feb; 47(1):287-300. doi: 10.1007/s11357-024-01290-1.*
5. *Figuracion KCF, Donald CM, Hunt D, McGranahan T, Lewis FM, Rockhill J, et al.: Environmental Enrichment and Health Outcomes Among Low-Grade Glioma Brain Tumor Survivors. J Neurosci Nurs. 2024 Dec 1;56(6):229-235. doi: 10.1097/JNN.0000000000000793.*
6. *Galati G, Germanova O, Iozzo RV, Buraschi S, Shchukin YV, Germanov A, et al.: Hemodynamic arterial changes in heart failure: a proposed new paradigm of "heart and vessels failure". Minerva Cardiol Angiol 2022; 70:310-320. doi:10.23736/S2724-5683.21.05786-0*
7. *Germanova OA, Galati G, Kunts LD, Usenova AA, Reshetnikova YB, Germanov AV et al.: Predictors of paroxysmal atrial fibrillation: Analysis of 24-hour ECG Holter monitoring. Science and Innovations in Medicine 2024;9(1):44-48. doi: 10.35693/SIM626301.*
8. *Germanova O, Galati G, Germanov A & Stefanidis A: Atrial fibrillation as a new independent risk factor for thromboembolic events: hemodynamics and vascular consequence of long ventricular pauses. Minerva Cardiol Angiol. 2023 Apr;71(2):175-181. doi: 10.23736/S2724-5683.22.06000-8.*
9. *Germanova OA, Germanov AV, Galati G, Prokhorenko IO & Germanov VA: Cryptogenic stroke in atrial fibrillation without intra-heart thrombi: possible mechanisms. Bulletin of the Medical Institute "REAVIZ" (REHABILITATION, DOCTOR AND HEALTH). 2022;12(2):80-89. doi: 10.20340/vmi-rvz.2022.2.CLIN.7*
10. *Germanov AV, Germanova OA, Germanov VA & Prokhorenko IO: Atrial fibrillation: functional classification. Bulletin of the Medical Institute "REAVIZ" (REHABILITATION, DOCTOR AND HEALTH). 2020;(2):129-134.*
11. *Germanova OA, Reshetnikova YuB, Syunyakov TS & Germanov AV: Prediction of paroxysmal atrial fibrillation based on data from 24-hour ambulatory electrocardiography. Kazan Medical Journal. 2025. doi: https://doi.org/10.17816/KMJ631754*
12. *Germanova O, Smirnova D, Usenova A, Tavormina G, Cumming P & Galati G: Cryptogenic Stroke In The Context of Pandemic-Related Stress: The Role of Arterial Hemodynamics. Psychiatr Danub 2022; 34(Suppl 8):256-261*

13. *Guo J, Zhang Z, Meng X, Jing J, Hu Y, Yao Y, et al.: Atrial fibrillation catheter ablation, brain glymphatic function, and cognitive performance. Eur Heart J. 2025 May 7;46(18):1733-1743. doi: 10.1093/eurheartj/ehaf036.*
14. *Kunts LD, Germanova OA, Reshetnikova YB, Galati G, Milevskaya IV & Biondi-Zoccai G: Extrasystolic arrhythmia as an atrial fibrillation predictor. Science and Innovations in Medicine 2024;9(2):117-123. doi:10.35693/SIM624503.*
15. *Li Q, Su B & Liu J: Diagnostic values of different ECG durations in paroxysmal AF diagnosis. Ann Noninvasive Electrocardiol. 2022 Mar; 27(2):e12921. doi:10.1111/anec.12921. Epub 2021 Dec 16.*
16. *Miyazaki Y, Toyoda K, Iguchi Y, Hirano T, Metoki N, Tomoda M, et al.: Atrial Fibrillation After Ischemic Stroke Detected by Chest Strap-Style 7-Day Holter Monitoring and the Risk Predictors: EDUCATE-ESUS. J Atheroscler Thromb. 2021 May 1; 28(5):544-554. doi:10.5551/jat.58420.*
17. *Raghunath S, Pfeifer JM & Ulloa-Cerna AE: Deep Neural Networks Can Predict New-Onset Atrial Fibrillation From the 12-Lead ECG and Help Identify Those at Risk of Atrial Fibrillation-Related Stroke. Circulation. 2021 Mar 30; 143(13):1287-1298. doi:10.1161/CIRCULATIONAHA.120.047829. Epub 2021 Feb 16.*
18. *Ratcliffe LN, Hale AC, McDonald T, Hewitt KC, Nguyen CM, Spencer RJ et al.: The Montreal Cognitive Assessment: Norms and Reliable Change Indices for Standard and MoCA-22 Administrations. Arch Clin Neuropsychol. 2024 Aug 24;39(6):747-765. doi: 10.1093/arclin/acae013.*
19. *Reiffel JA, Verma A, Kowey PR, Halperin JL, Gersh BJ, Elkind MSV, et al. & REVEAL AF Investigators: Rhythm monitoring strategies in patients at high risk for atrial fibrillation and stroke: A comparative analysis from the REVEAL AF study. Am Heart J. 2020 Jan;219:128-136. doi: 10.1016/j.ahj.2019.07.016.*
20. *Shantsila E, Choi EK, Lane DA, Joung B & Lip GYH. Atrial fibrillation: comorbidities, lifestyle, and patient factors. Lancet Reg Health Eur. 2024 Feb 1;37:100784. doi: 10.1016/j.lanepe.2023.100784.*

*Correspondence:*
*Olga Germanova, MD*
*International Centre for Education and Research in Cardiovascular Pathology and Cardiovisualization, Samara State Medical University*
*18 Gagarina Street, 443096 Samara, Russia*
*E-mail: olga_germ@mail.ru*