

L.O. Miakinkova, Ye.M. Liulka¹, I.P. Katerenchuk, A.V. Teslenko¹, B.O. Pysana¹
 Poltava State Medical University, Poltava
¹Municipal Enterprise "Poltava Regional Clinical Medical Cardiovascular Center
 Of Poltava Regional Council", Poltava

RHYTHM CONTROL IN PATIENTS WITH BRADYASYSTOLIC ATRIAL FIBRILLATION

e-mail: milamy2009@gmail.com

Atrial fibrillation is the most common cardiac arrhythmia associated with thromboembolism, heart failure, depression, deterioration of quality of life, and reduced physical endurance. The rhythm control strategy is considered optimal in its treatment but is not always achievable. Right ventricular endocardial pacing is recommended for patients with bradycardic atrial fibrillation and preserved ejection fraction but can cause ventricular dyssynchrony. The aim of the study was to evaluate the effectiveness of implanting a dual-chamber pacemaker as an alternative method for sinus rhythm control in patients with long-standing bradysystolic atrial fibrillation and preserved ejection fraction, compared with single-chamber right ventricular pacing. Diastolic function, left atrial volume index, exercise tolerance, and quality of life were studied. Dual-chamber pacing is effective in rhythm control, and the severity of symptoms is reduced. Compared with single-chamber right ventricular pacing, there were decreased left atrial volume, tricuspid regurgitation rate, natriuretic peptide levels, increased exercise tolerance, improved quality of life indices, and reduced anxiety and depression.

Key words: atrial fibrillation, heart failure, endocardial pacing, pacemaker, quality of life, exercise tolerance

Л.О. Мякінькова, Є.М. Люлька, І.П. Катеренчук, Ю.В. Тесленко, Б.О. Писана КОНТРОЛЬ РИТМУ У ПАЦІЄНТІВ З БРАДИСИСТОЛІЧНОЮ ФОРМОЮ ФІБРИЛЯЦІЇ ПЕРЕДСЕРДЬ

Фібриляція передсердь є найпоширенішою серцевою аритмією яка асоціюється з тромбоемболіями, серцевою недостатністю, депресією, погіршенням якості життя та фізичної витривалості. Стратегію збереження синусового ритму вважають оптимальною у її лікуванні, але не завжди досяжною. У пацієнтів з брадисistolічною формою фібриляції передсердь та збереженою фракцією викиду показана правощлуночкова стимуляція яка може сприяти розвитку шлуночкової диссинхронії. Метою дослідження було оцінити ефективність імплантації двокамерного електрокардіостимулятора як альтернативного методу контролю синусового ритму у пацієнтів з тривало персистуючою брадисistolічною фібриляцією передсердь, збереженою фракцією викиду у порівнянні з однокамерною правощлуночковою стимуляцією. Досліджували показники діастолічної функції, індекс об'єму лівого передсердя, толерантність до фізичного навантаження, якість життя. Двокамерна стимуляція ефективна у контролі ритму та зменшенні тяжкості симптомів. У порівнянні з однокамерною стимуляцією правого шлуночка визначено зменшення об'єму лівого передсердя, швидкості трикуспідальної регургітації, натрійуретичного пептиду, зростання толерантності до фізичного навантаження показників якості життя, зниження тривоги та депресії.

Ключові слова: фібриляція передсердь, серцева недостатність, електрокардіостимуляція, штучний водій ритму, якість життя, толерантність до фізичного навантаження

The work is a fragment of the research project "Clinical assessment of the combined effect of cardiovascular risk factors on the comorbidity of arterial hypertension, coronary heart disease and chronic kidney disease, features of prevention and rehabilitation", state registration No. 0119U102851

Atrial fibrillation (AF) is the most common persistent cardiac arrhythmia in the adult population worldwide. AF is not considered a directly life-threatening arrhythmia but its occurrence is associated with an increased risk of thromboembolic complications and stroke, heart failure (HF) even in patients with preserved ejection fraction (pEF) of the left ventricle (LV), cognitive dysfunction and depression, worsening quality of life, decreasing tolerance to physical exertion, increasing the number of hospitalizations, thus representing a medical, social and economic problem [5]. Restoring and preserving sinus rhythm (SR) strategy is considered as optimal for treating patients with AF but is not always achievable. A long-standing AF, old age, remodeling of the left atrium (LA), and long-term use of antiarrhythmic drugs are factors of the development of the bradyarrhythmic form [1], when opportunities for maintaining the SR are significantly limited, it result in a permanent AF.

Only the compatible decision of the patient and the doctor to stop attempts to restore SR is the basis for ascertaining this fact [9]. Bradysystole, high degree of atrioventricular blockade, syncop are indications for the pacemaker implantation.

There is significant evidence that apical right ventricular pacing may lead to the ventricular dyssynchrony and have an adverse effect on the diastolic and systolic LV functions, which leads, in the long term, to the development of heart failure.

Therefore, for patients with permanent AF who require frequent ventricular pacing and have systolic dysfunction, a physiological stimulation of the ventricles – Cardiac Resynchronization Therapy (CRT) Devices, or conduction system pacing are recommended. As opposed to right ventricular pacing it helps to avoid ventricular dyssynchrony and HF progressing, as shown in the BLOCK-HF (Biventricular Pacing for Atrioventricular Block and Systolic Dysfunction) study [4].

If pacing indicated for patients with AF and pEF, currently, it is recommended to use single chamber ventricular pacing, with suggested for dyssynchrony prevention are implantation of a right ventricular electrode in the intraventricular septum area; however, according to data [3], in the long term, this does not prevent the progression of diastolic dysfunction and remodeling of heart cavities in this category of patients.

The concept of “quality of life” includes the symptomatology and the patient's tolerability of AF, qualified according to the EHRA. The EHRA AF-Related Symptom Severity Scale considers palpitations, fatigue, dizziness, shortness of breath, chest pain, and anxiety during AF, and rates the impact on the patient's daily activities from no impact to a cessation of all daily activities.

In the study, an unfavorable prognosis of AF is associated with greater severity of symptoms (score of 3-4 points) compared to patients with a score of 1-2 points [10]. Rhythm control in symptomatic patients with bradysystolic form of AF and pEF, which is considered permanent due to ineffective maintenance of SR in the anamnesis, can contribute to the slowing down of LA dilatation and remodeling, restoration of LA contribution to LV filling with normalization of transmitral blood flow, improvement of LV diastolic function, reducing the pressure in the pulmonary veins and the right heart, thereby HF prevention.

The purpose of the study was to evaluate the effectiveness of the implantation of a dual chamber pacemaker as an alternative method of sinus rhythm control in comparison with a single chamber right ventricular pacing in the treatment of long-standing persistent bradysystolic atrial fibrillation in elderly patients with a preserved left ventricular ejection fraction and indications for permanent pacing.

Materials and methods. The study included 22 patients with bradysystolic atrial fibrillation with EHRA IIb-III class symptoms severity, duration of the last paroxysm more than 1 year, in NYHA functional class (FC) II-III. The CHA₂DS₂-VAS_c thrombotic risk was 2–4 points, and the HAS-BLED hemorrhagic risk was 1–3 points. The 11 patients (7 men and 4 women, average age 71.1±5.1 years) were in test group (TG), rhythm control strategy was chosen. 8 patients had hypertension, and 4 patients had type II diabetes mellitus. The 11 patients with comparable parameters were in control group (CG). The single chamber pacemaker in the VVIR mode was implanted to rate control strategy.

Including criteria: left ventricular ejection fraction ≥ 50 %, left atrial volume index (LAVI) 35-48 ml/m², NT-proBNP ≥ 125 pg/ml, indications for permanent pacing. All patients had a history of non-emergency electrical cardioversion (ECV) with SR restoration without effective retention, the term of effective SR drug control was from 4 hours to 5 days.

Patients underwent implantation of a right ventricular endocardial electrode in the intraventricular septum area with a control measurement of the widthness of the stimulated QRS complex within 120–130 ms. ECV was performed intraoperatively in the premedicated state. Atrial electrode was implanted if during the 5 minutes control time, the preservation of the SR was observed. Optimization of the duration of the atrioventricular (AV) delay was carried out under the control of the transmitral flow signal until reaching the maximum diastolic filling time (DFT) without signs of shortening of the A wave and corresponding to its end with the closing of the mitral valve. Checking the pacemaker with the programmer was carried out after 24–48 hours, 1 and 3 months after implantation, and thereafter - twice a year.

The results were evaluated by monitoring the electrocardiogram (ECG), echocardiography (ECHO), the 6-minute walk test (6MWT) before and after 6 months, and the statistics of rhythm disturbances during the pacemaker testing. Drug therapy was carried out according to recommendations [5]. The level of anxiety and depression was assessed using the HADS scale. The evaluation of the quality of life (QoL) was carried out using the SF-36 questionnaire [2].

Mathematical processing of the results was carried out using the Statistica 8.0 software (StatSoft Inc, USA). Mean (M), variance, standard deviation, and median (m), as well as probability and significance level (p) were calculated. Differences were considered statistically significant at p<0.05.

Results of the study and their discussion. Implantation of a dual chamber pacemaker in the DDDR mode in patients of the TG has proven effective in restoring and controlling SR. All patients maintained SR after 12 months. During the studied period, patients in the TG experienced paroxysms of AF lasting from 30 seconds to 48 hours, which were restored with medication, and a reduction in the EHRA symptoms severity to I-IIa was observed. During routine checks of the pacemaker, it was established that the percentage of right ventricular stimulation in the TG was 95 %±3.1 %. During 12 months of

observation, the widthness of the stimulated QRS complex was 126 ± 10 ms. The average duration of the optimized AV delay was 155 ± 15 ms; the DFT duration was 460 ± 30 ms. The ratio of transmitral blood flow E/A corresponded to diastolic dysfunction of the first type and was 0.8 ± 0.15 , and there were no significant changes during the regular check of the pacing. The speed of tricuspid regurgitation (TR) in the TG decreased from 2.1 ± 0.7 m/sec to insignificant level. In the CG, there was no observation of reliable dynamics of the speed of tricuspid regurgitation.

As a result of the treatment, there was a statistically significant increase in exercise tolerance (ET) according to the 6MWT test in patients of the TG compared to patients of the CG. Thus, the 6MWT test index in patients of the TG increased from 213.6 ± 42.5 m to 435.9 ± 70.0 m ($p<0.01$), in contrast to the same index in patients of the CG, which had insignificant dynamics and showed 211.0 ± 42.5 and 297.5 ± 95.0 m, ($p>0.05$) respectively (Fig. 1).

The LAVI was used to evaluate the changes in the left atrial architecture in the control and test group. Before pacing, the average value of LAVI in the TG was 43.1 ± 1.41 ml/m²; after one month, the value decreased to 38.3 ± 1.44 ml/m², which has a statistically significant difference ($p=0.035$). In the CG, the LAVI index was 42.8 ± 1.44 ml/m² at the beginning of the study, 1 month after single chamber pacing – 43.1 ± 1.49 ml/m² (Fig. 2). In the CG, LAVI decreased slightly, but without a statistically significant difference ($p>0.05$). In the TG, LAVI significantly decreased ($p=0.035$) within 1 month after restoration of SR to patients with dual chamber pacing, in contrast to the CG, which has a single chamber pacing, where LAVI did not undergo significant changes. The LAVI decreasing in the TG signifies the improvement of the architecture of the left atrium and the prognosis regarding the course of the disease.

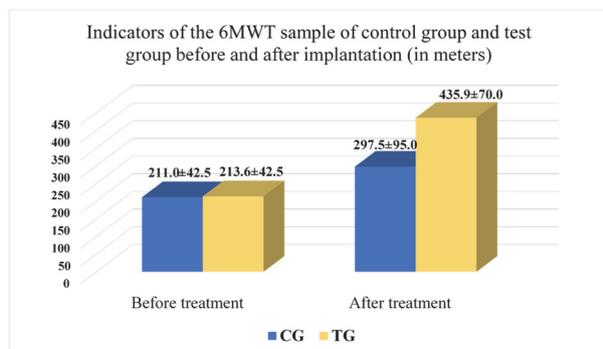


Fig. 1. Indices of the 6MWT sample of control group and test group before and after pacemaker implantation

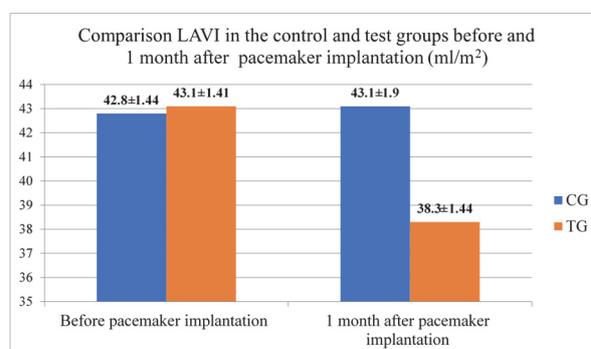
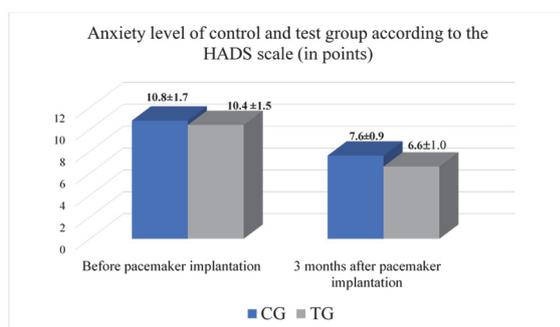
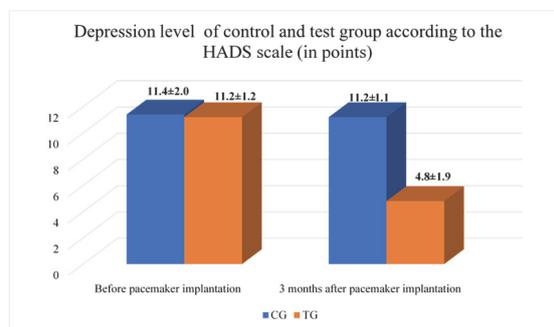


Fig. 2. Comparison LAVI in the control and test groups before and 1 month after pacemaker implantation

All patients of the control and test groups at the time of hospitalization were tested according to the HADS hospital scale for anxiety and depressive disorders assessment. In the CG, the average index of the level of anxiety was 10.8 ± 1.7 points, which indicated clinically expressed anxiety; the average index of the level of depression was 11.4 ± 2.0 points, which indicated clinically expressed depression. In the TG, the average level of anxiety was estimated at 10.4 ± 1.5 points, the level of depression was 11.2 ± 1.2 points, which confirmed the presence of clinically significant anxiety and depression in the patients of the TG.



A



B

Fig. 3. Anxiety (A) and depression (b) levels of control and test group according to the HADS scale

Re-testing according to the HADS hospital scale was carried out 3 months after single chamber pacing in the CG and a dual chamber pacing in the TG. After 3 months, the indices of the level of anxiety and depression in the patients of the CG were 7.6 ± 0.9 points and 11.2 ± 1.1 points, respectively, which indicated subclinically expressed anxiety and clinically expressed depression. In the patients of the TG, after 3 months, the levels of anxiety and depression were 6.6 ± 1.0 points and 4.8 ± 1.9 points, respectively, which indicated the absence of anxiety and depressive disorders (Fig. 3a, 3b). The decrease in the level of

anxiety and depression in the TG was significant and amounted to $p=0.05$ and $r=0.01$, respectively, unlike the CG, in which changes in the level of anxiety and depression had insignificant dynamics ($p>0.05$).

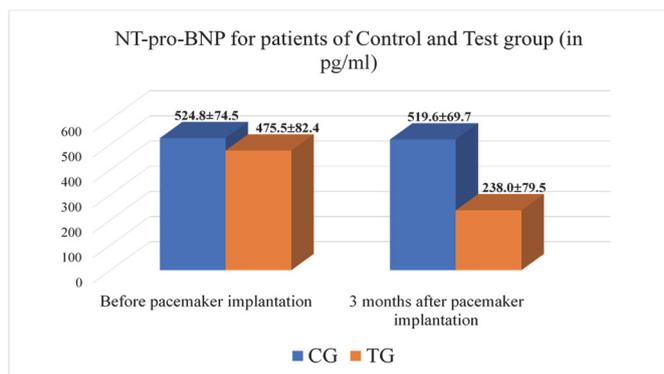


Fig. 4. NT-pro-BNP level before and 3 months after of pacemaker implantation (in pg/ml) for patients of Control and Test group

on the day of hospitalization and 3-months after the pacemaker implantation. Table 1 shows the average QoL indices according to the questionnaire results.

Table 1

QoL indices before and 3 months after of pacemaker implantation for patients of Control and Test group

QoL criteria according to SF-36	Test group before	Test group after	Control group before	Control group after
Physical functioning	45.8 ± 10.1	87.9 ± 12.8	44.7 ± 9.8	32.1 ± 8.9
Role Physical Functioning	51.3 ± 7.9	78.2 ± 8.4	50.9 ± 7.6	44.9 ± 8.1
Pain intensity	78.5 ± 0.3	80.1 ± 0.5	75.1 ± 0.7	76.1 ± 0.6
General wellness	41.9 ± 12.4	76.7 ± 10.9	42.3 ± 11.8	55.3 ± 9.9
Vitality	34.5 ± 11.2	80.3 ± 10.9	35.6 ± 10.4	52.1 ± 9.5
Social functioning	32.9 ± 10.8	78.2 ± 12.4	33.2 ± 9.2	44.6 ± 8.6
Role emotional functioning	35.6 ± 10.8	77.4 ± 10.2	34.8 ± 9.5	47.8 ± 8.7
Mental health	31.9 ± 11.1	87.1 ± 10.7	32.7 ± 9.1	50.1 ± 10.3

According to the indices in Table 1, a higher level of QoL was established in the patients of the TG, both in the physical sphere of life and in the psycho-social sphere ($p=0.05$), compared to the patients of the CG, where the changes in indices were not statistically significant ($p>0.05$), which indicates a better effectiveness of treatment using the method of dual chamber pacing and rhythm control in patients of the TG in comparison with indices of QoL in patients of the CG, who were with a single chamber pacing and rate control.

The diagnosis of heart failure in patients with AF and preserved LV EF is problematic due to the difficulty in separating the symptoms of diastolic dysfunction, which are caused by HF, from those caused by AF. Echocardiography can help detect HF in patients with symptomatic AF by providing evidence of the presence or absence of structural heart disease: LV hypertrophy, indices of diastolic dysfunction.

With the following echocardiographic changes: $LAVI > 40 \text{ ml/m}^2$, the ratio of early transmitral diastolic flow to early diastolic myocardial velocity (E/e') at peak load ≥ 15 or TR velocity $> 3.4 \text{ m/s}$, the course of AF and HF is associated with a significant increase in the risk of cardiovascular death, as even under the condition that AF causes HF, their course is considered more favorable [7].

Diagnostic differentiation can be achieved by restoring SR and clinical reassessment of symptom improvement. The level of NT-proBNP is part of the diagnostic evaluation, although NT-proBNP levels are elevated in patients with AF, and the optimal diagnostic cut-off has not been established [8].

Thus, analyzing the indices of the patients of the TG, which characterize the hemodynamic changes inherent in heart failure with preserved LV EF, against the background of restored SR and a high frequency stimulation of the right ventricular, no progression of ventricular dyssynchrony is observed. A positive tendency to decrease the level of NT-proBNP, indices of diastolic dysfunction, such as the TR velocity and the LAVI was noted. The obtained results testify to the importance of atrial fibrillation in the development

of heart failure with preserved LV EF and the effectiveness of preserving SR in improving the prognosis of patients [6].

The approach to assessing the QoL of patients against the background of treatment includes stress testing, AF symptomatology before and after treatment according to the chosen strategy (rhythm control or ventricular rate control), compliance with well-being in the physical, social, and psychological spheres of the patient's health. Implantation of a dual chamber pacemaker in the DDDR mode and restoration of SR reliably improves tolerance to physical exertion, helps to reduce the level of anxiety and depression, and restores the health status of patients in the TG in comparison with patients in the CG, for whom selected treatment method was rate control.

Conclusion

Implantation of a dual chamber pacemaker in the DDDR mode proves to be effective as an alternative method of sinus rhythm control in comparison with the single chamber pacing in the VVIR mode in the treatment of long-standing persistent bradysystolic atrial fibrillation in elderly patients with a preserved left ventricular ejection fraction and indications for permanent pacing.

Implantation of a dual chamber pacemaker in the DDDR mode improves the quality of life and physical endurance of patients with long-standing persistent bradysystolic atrial fibrillation; contributes to the slowing down of left atrium remodeling and heart failure prevention.

Dual chamber pacing in the DDDR mode allows the effective use of antiarrhythmic drugs to restore SR during paroxysms of atrial fibrillation.

References

1. Myakynkova LA, Teslenko YV, Pustovoyt AL, Yarmola TI, Tsyganenko IV. Antytrombotychna terapiya u patsiyentiv iz tripotinniam peredserd pered planovoyu kardioversiyeyu. Wiadomosci Lekarskie. 2016. T. LXIX, Nr. 6. p. 742–746. PMID: 28214808 [in Ukrainian]
2. Nakaz MOZ Ukrainy vid 25 hrudnia 2014 roku №1003 Unifikovanyi klinichniy protokol pervynnoyi, vtorynnoyi (spetsializovanoyi) ta tretynnoyi (vysokospetsializovanoyi) medychnoyi dopomohy «Depresiya (lehkyi, pomirnyi, tiazhkyi) depresyvni epizody bez somatychnoho syndromu abo z somatychnym syndromom, rekurentnyi depresyvnyi rozlad, dystymiya» <http://www.dec.gov.ua/mtd/reestr.html> [in Ukrainian]
3. Andrew EE, John PD, Kenneth AE, NA Mark Estes 3rd, Roger AF, Leonard SG, et al. 2012 ACCF/AHA/HRS focused update incorporated into the ACCF/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society J Am Coll Cardiol. 2013 Jan 22;61(3):e6–75. doi: 10.1016/j.jacc.2012.11.007.
4. Anne BC, Seth JW, Philip BA, Eugene SC, Imran N, Lou S, et al. Biventricular Pacing for Atrioventricular Block and Systolic Dysfunction. N Engl J Med 2013; 368:1585–1593 doi: 10.1056/NEJMoa1210356
5. Gerhard H, Tatjana P, Nikolaos D, Elena A, Jeroen JB, Carina BL, et al. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association of Cardio-Thoracic Surgery (EACTS). Eur Heart J. 2021 Feb 1; 42(5):373–498. doi: 10.1093/eurheartj/ehaa612.
6. Nauta JF, Hummel YM, van der Meer P, Lam CSP, Voors AA, van Melle JP. Correlation with invasive left ventricular filling pressures and prognostic relevance of the echocardiographic diastolic parameters used in the 2016 ESC heart failure guidelines and in the 2016 ASE/EACVI recommendations: a systematic review in patients with heart failure with preserved ejection fraction. Eur J Heart Fail. 2018 Sep;20(9):1303–1311. doi: 10.1002/ejhf.1220. Epub 2018 Jun 7.
7. Pieske B, Tschope C, de Boer RA, Fraser AG, Anker SD, Donal E, et al. How to diagnose heart failure with preserved ejection fraction: the HFA-PEFF diagnostic algorithm: a consensus recommendation from the Heart Failure Association (HFA) of the European Society of Cardiology (ESC). Eur Heart J 2019;40:3297–3317. doi: 10.1093/eurheartj/ehz641.
8. Theresa AM, Marco M, Marianna A, Roy SG, Andreas B, Michael B, et al. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure Eur Heart J 2021 Sep 21;42(36):3599–3726. doi: 10.1093/eurheartj/ehab368.
9. Walters TE, Wick K, Tan G, Mearns M, Joseph SA, Morton JB, et al. Symptom severity and quality of life in patients with atrial fibrillation: psychological function outweighs clinical predictors. Int J Cardiol 2019; 279:84–89. doi: 10.1016/j.ijcard.2018.10.101.
10. Wynn GJ, Todd DM, Webber M, Bonnett L, McShane J, Kirchhof P, et al. The European Heart Rhythm Association symptom classification for atrial fibrillation: validation and improvement through a simple modification. Europace 2014 Jul;16(7):965–72. doi: 10.1093/europace/eut395.

Стаття надійшла 3.09.2022 р.