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EXTENDED CATHETER ABLATION WITH MINIMAL FLUOROSCOPY IN A PATIENT WITH ATRIAL FIBRILLATION AND ATRIAL FLUTTER AND HEART FAILURE

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Current clinical case demonstrates the catheter treatment of longstanding persistent atrial fibrillation and atrial flutter without the use of fluoroscopy in patient with chronic heart failure. The effect on the parameters of heart remodeling, as well as the dynamics of NT-proBNP after 6 months of follow-up is demonstrated.

Key words: atrial fibrillation; atrial flutter; chronic heart failure; catheter ablation; non-fluoroscopic approach

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Chronic heart failure (CHF) and atrial fibrillation (AF) are among the most common cardiovascular diseases, having a major impact on mortality, hospitalization rates and quality of life in the population [1]. The risk of fatal complications increases exponentially in the presence of simultaneous CHF and AF, as demonstrated in the Framingham study [2]. Current approaches to the treatment of AF in CHF are based on the choice of frequency control or rhythm control strategy. Early studies to determine optimal therapeutic approaches for AF in this patient cohort have not shown the benefit of restoring and maintaining sinus rhythm, but it should be noted that in these studies antiarrhythmic drugs were used exclusively for rhythm control [3, 4]. In 2001, the DIAMOND-CHF study on the efficacy of maintaining sinus rhythm with dofetilide in patients with AF and reduced ejection fraction CHF (HFrEF) was published, demonstrating a decrease in hospitalisations due to CHF decompensation in patients with AF [5]. At present, the list of possible antiarrhythmic drugs for prescription in patients with HFREF is limited. Thus, according to the recommendations of the European Society of Cardiology for the treatment of AF, amiodarone is the only possible drug that can be prescribed to patients with reduced left ventricular (LV) ejection fraction (EF) with a high level of recommendation, but many adverse events significantly limit the prescription of the therapy for this category of patients [6].

With the development of modern surgical approaches to the treatment of cardiac arrhythmias, such as catheter ablation (CA) [7], a new era in the treatment of AF on the background of CHF has begun [8, 9]. In the European and Russian guidelines for the treatment of heart failure, CA is indicated in symptomatic AF when restoration of sinus rhythm and preservation of heart rate are considered likely [10]. In the guidelines for the treatment of AF, CA has a wider range of indications, including heart failure: in patients with a high probability of developing tachycardic cardiomyopathy, CA has the highest recommendation class. CA AF can be considered in selected cases of HFREF to improve survival and reduce the rate of hospitalizations due to CHF (recommendation class IIa) [11]. Several works, such as AATAC, CASTLE-AF, as well as a subanalysis of the large CABANA study, which included patients with CHF, demonstrate significant effectiveness of CA in both reducing mortality and improving quality of life in patients with AF and CHF [12- 14].

A significant number of patients with CHF have persistent AF [15, 16]. It is well known that the efficiency of CA decreases with prolonged existence of AF. A number of clinical trials have demonstrated the inadequate efficacy of isolated pulmonary vein (PV) exposure in patients with non-paroxysmal AF, forcing electrophysiologists to develop new approaches for the catheter-based treatment of arrhythmias. Anatomical isolation of the PV ostium in combination with influences on the posterior wall of the LA is associated with a decrease in the recurrence of AF in patients with persistent forms [7, 18]. The size of the LA cavity is of great importance in determining treatment tactics for patients with persistent and prolonged AF and CHF, but there are no clear parameters in the literature for LA size increase that limit the indications for CA in patients. Modern imaging techniques such as intracardiac

echocardiography (ICE) make it possible to significantly reduce and sometimes completely avoid X-ray exposure during catheter interventions for the treatment of cardiac arrhythmias [19].

Below is a clinical case of CA in a patient with HFREF and a long persistent form of atrial fibrillation and flutter with minimal use of X-ray radiation.

A 59-year-old patient was hospitalized at the National Research Institute of Cardiology named after A.I. Chazov of the Russian Ministry of Health due to worsening of his condition in the form of increasing dyspnea, swelling of feet, and decreased tolerance to physical activity. Has no history of high blood pressure, does not smoke, no history of cardiovascular disease. At the time of hospitalization, he considered himself ill for one and a half years, when he noticed an increase in abdominal volume and decreased appetite, and later episodes of dyspnoea to suffocation occurred in the supine position. A month after the onset of severe dyspnea on the background of significant clinical deterioration, episodes of irregular heartbeat appeared, for which he sought medical attention and was admitted to the hospital at the place of residence, where ECG data recorded paroxysm of AF with ventricular contractions up to 140 beats/min. The transthoracic echocardiography (EchoCG) revealed pleural effusion, traces of fluid in pericardium, enlarged left heart (end-diastolic dimension (EDD) of LV 5.6 cm, LA volume 94 ml) and signs of pulmonary hypertension (SPPA 51 mm Hg). LV EF was 29%, diffuse hypokinesis was observed. A multispiral computed tomography scan of the chest revealed a bilateral hydrothorax, edema up to the upper third of the tibia, and marked ascites. The patient underwent a right pleural puncture, with 1200 ml of fluid evacuated, and diuretic therapy was administered with a positive effect. After stabilization, the patient underwent coronary angiography, which revealed intact coronary arteries. Thus, ischemic genesis of heart failure was excluded.

Given the significant enlargement of the LV cavity and the lack of evidence for long-term persistence of AF, no restoration of sinus rhythm was performed. The patient was diagnosed with dilated cardiomyopathy and prescribed CHF drug therapy: sacubitril + valsartan in a starting dose of 50 mg twice a day, with titration of the dose to 100 mg twice a day by the time of discharge, spironolactone 50 mg, torasemide 5 mg, metoprolol 100 mg, digoxin 0.25 mg. Anticoagulant therapy with rivaroxaban at a dose of 20 mg was initiated. Against the background of the treatment, there was a regression of congestion in the lungs, a reduction in abdominal volume, the absence of dyspnoea at rest, but subjectively the patient continued to be plagued by fatigue, weakness and the inability to exercise. Two months after discharge from the hospital, his condition worsened in the form of increasing dyspnea and constant palpitations. He was repeatedly hospitalized at the regional hospital, where intravenous diuretic therapy was administered with little clinical improvement. During the next 12 months, the patient was monitored by a cardiologist, but outpatient therapy did not compensate for the CHF phenomena. The patient was referred to the National Research Institute of Cardiology named after A.I. Chazov of the Russian Ministry of Health

On admission: complaints of dyspnea on minimal physical exertion, weakness, pronounced heart palpita-

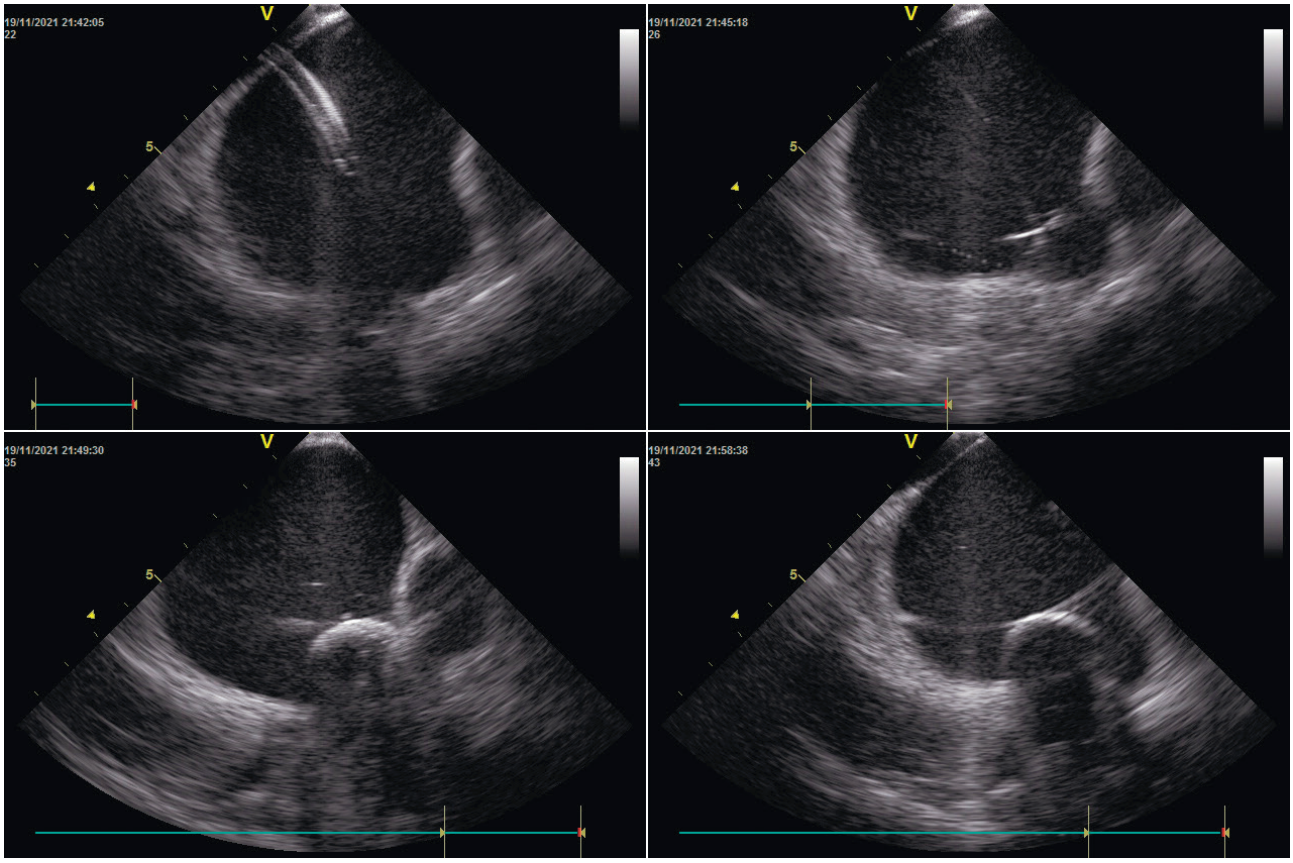

Fig. 1. Cryoballoon positioning technique in the pulmonary vein orifices under control of intracardiac echocardiography.

tions, pastosity of shins and feet, ECG recorded AF with a ventricular contraction rate of 136 beats/min. The six-minute walk test on admission was 214 m, EchoCG showed LV EF of 30%, atrial cavity dilatation (LA 4.8 cm; LA volume 100 ml, right atrial area 32 cm2), right ventricular cavity enlarged to 3 cm, 2nd degree tricuspid valve failure, SPPA 32 mm Hg. The NT-proBNP level was 1735 pg/ml. Daily ECG monitoring recorded AF and atrial flutter (2:1, 3:1, 5:1, 8:1 conduction) with an average ventricular contraction rate of 124 bpm. Taking into account the anamnesis data, the duration of persistence of AF and atrial flutter was more than 18 months. Based on the findings, the excluded ischemic genesis of the cardiomyopathy, the absence of other causes of CHF apart from AF, it was decided to treat this patient's CHF as tachycardia-induced. The presence of symptomatic (EHRA III) tachycardia, persistent AF and atrial flutter with the development of ventricular dilatation was the indication for surgery - extended catheter ablation of the LA and cavotricuspid isthmus (CTI). The patient underwent extended cryoballoon ablation of the LA with minimal use of X-ray radiation under ICE monitoring.

Under local anesthesia using the Seldinger method, access to the central veins was performed. The catheters and intraducts were positioned in the heart cavities under ICE control, the interatrial septum was punctured. After transseptal access and systemic heparinization, the FlexCath Advance delivery system was positioned in the LA cavity and the second-generation ArcticFront Advance cryoballoon was inserted into the LA. Then, under ICE control, after reaching PV occlusion under temperature control, cryosurgery was performed (left upper PV: vein closure time: 34 s; vein closure temperature: -33 °C; freezing time: 180 s; minimum temperature: -53 °C; left lower PV: vein closure time: 44 s, vein closure temperature: -31 °C; freezing time: 180 s; minimum temperature: -51 °C; upper right PV: vein closure time: 30 s; vein closure temperature: -32 °C; freezing time: 160 s; minimum temperature: -52 °C; lower right PV: vein closure time: 52 s; vein closure temperature: -37 °C; freezing time: 160 s; minimum temperature: -49 °C) (Figure 1). After PV isolation was achieved, additional images were taken along the posterior wall of the LA using fluoroscopy with a cryoballoon for 120-140 s each with temperature parameters of -30-40 °C. On the endogram, a conversion from AF to atrial flutter with right excitation front, cycle length 260 ms and conduction of 2:1 was detected. The FlexCath delivery system is brought out to the RA and positioned on the CTI. The ablation catheter was inserted into the right ventricle through the delivery system and radiofrequency ablation of the CTI (temperature 43°C, power 35 W, irrigation rate 30 ml/min) was performed under HFrEF monitoring (Fig. 2). On exposure there was restoration of sinus rhythm with heart rate of 65-70 bpm.

The control EchoCG 2 days after the surgery showed positive dynamics in the form of atrial cavity size decrease (LA 4.0 cm; LA volume 67 ml, S of the right atrium 26 cm2), increase of global LV contractility (LV EF 48%), reverse remodeling of the right ventricle size (2.7 cm). The patient was initiated on antiarrhythmic therapy with amiodarone (at a saturation dose of 600 mg/day with transition to 400 mg/day). CHF therapy was performed in the following amounts: sacubitril + valsartan 200 mg, bisoprolol 1.25 mg, dapagliflozin 10 mg, and spironolactone 25 mg. Rivaroxaban 20 mg was continued for anticoagulant purposes. During daily ECG monitoring a sinus rhythm was registered with an average heart rate of 58 bpm (min. 51 bpm and max. 81 bpm). 23 single ventricular extrasystoles, 55 single extrasystoles, 1 verse of supraventricular extrasystoles, supraventricular tachycardia of 3 complexes, including with aberrant conduction were recorded.

Six months after the CA at the follow-up visit, clinical improvement was noted, as well as an increase in exercise tolerance, which was confirmed by the six-minute walking test, which was 563 m. EchoCG showed pronounced inverse remodeling of cardiac cavities: LV - 3.3 cm, LV volume - 44 ml, LV EDD - 5.0 cm, S of the right atrium - 13 cm2. LV EF increased to 60% (Table 1, Fig. 3). There was also a significant decrease in NT-proBNP levels to 28.7 pg/ml. It should be noted that the patient had no need for loop diuretics for 6 months.

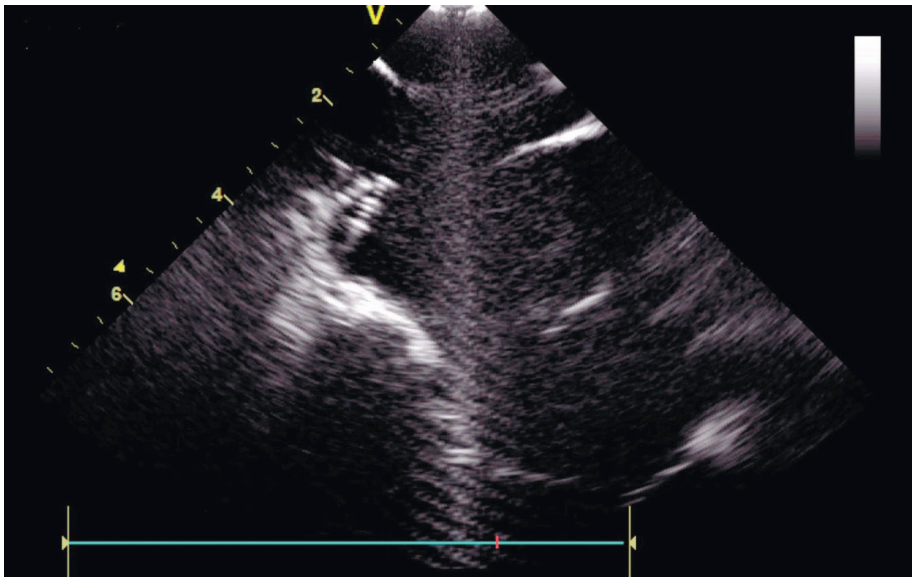

Fig. 2. Radiofrequency ablation of cavotricuspidal isthmus under control of intracardiac echocardiography.

DISCUSSION

Currently, cardiomyopathy triggered by AF is a diagnosis of exclusion and can usually be suspected in patients with non-ischaemic CHF genesis and persistent form of AF in the absence of efficacy of optimal drug therapy against a background of rate control. The diagnosis can be confirmed only if LV systolic function improves or normalizes after AF elimination [20]. The previously mentioned studies confirm the effectiveness of surgical restoration and maintenance of sinus rhythm in patients with AF and heart failure, but it should be noted that there is only one paper on this topic in Russia

describing the use of radiofrequency LV isolation as the method of choice [9, 21]. A special feature of our approach was the use of extended cryoballoon ablation of the LA with minimal use of fluoroscopy.

When deciding to perform CA in patients with AF and CHF, the deciding factor is usually the size of the LA and the duration of persistence of AF. At present, none of the clinical guidelines gives clear figures on the cut-off value of the LA cavity volume. There are data in the literature on performing surgical treatment of arrhythmias in patients with persistent and long-term persistent forms of AF and LA volumes of 120-150 ml, using a hybrid approach (thoracoscopic ablation combined with follow-up CA) or advanced cryoballoon ablation of LA as a technique [22-24]. It should be noted that there are no studies comparing different techniques of surgical treatment of arrhythmias in patients with heart failure, so the question of choice of interventional technique remains open. In this patient, the enlarged LA cavity up to 100 ml, as well as the persistent form of AF were the reasons for choosing the method of extended cryoballoon ablation of the LA. Clinical studies comparing different CA techniques in patients with persistent and long-onset AF, the need for additional exposure lines or more "aggressive" techniques, such as thoracoscopic ablation, are ongoing.

Modern perioperative imaging techniques such as HfrEF or navigation mapping make it possible to minimize and, in most cases, eliminate radiation exposure when performing CA. This principle is referred to in the literature as "ALARA (as low as reasonably achievable)," in which the radiation level should be as low as reasonably achievable [25]. At the same time, research data demonstrate efficacy not inferior to that of standard CA using fluoroscopy [26, 27].

Of course, predisposing factors for the maintenance of sinus rhythm, such as EchoCG data (size and volume of LA, presence of valve regurgitation), duration of AF persistence should be considered, but as clinical practise shows, it is often difficult to predict the actual effect of the planned surgical intervention. Initially, this patient had a significant dilatation of the LA cavity, so the chosen tactic for frequency control seemed reasonable at first. This clinical example shows how the use of CA to treat AF and atrial flutter resulted in significant clinical improvement in the form of complete restoration of exercise tolerance, reduction of NT-proBNP levels to below threshold, and complete regression of heart failure at 6 months follow-up. In the absence of clinical, laboratory and instrumental data that would indicate the presence of heart failure, the question of the need to diagnose this syndrome and to take medications that represent the optimal therapy for heart failure arises after surgical treatment.

CONCLUSION

Catheter ablation gives new opportunities in treatment of CHF and AF, promoting not only improvement of quality of life, increase of tolerance to physical load, but also change of heart size and increase of myocardial contractility, cardinally changing prognosis of patients.

Таблица 1.

Параметры эхокардиографии в динамике

EchoCG parameters	Before CA	48 hours after CA	Six months after CA
LA, cm	4.8	4.0	3.3
LA volume, ml	100	67	44
EDD, cm	5.7	5.8	5.0
ESD, cm	4.5	3.9	3.2
LV EF, %	30	48	60
AD RV, cm	3.0	2.7	2.4
RA area, cm^2	32	26	13
SPPA, mm Hg	32	29	29

Note: EchoCG - echocardiography; CA - catheter ablation; LV - left atrium; EDD and ESD - end diastolic and systolic dimensions; LV - left ventricle; EF - ejection fraction; AD - anteroposterior dimension; RV - right ventricle; RA - right atrium; SPPA - systolic pressure in pulmonary artery.

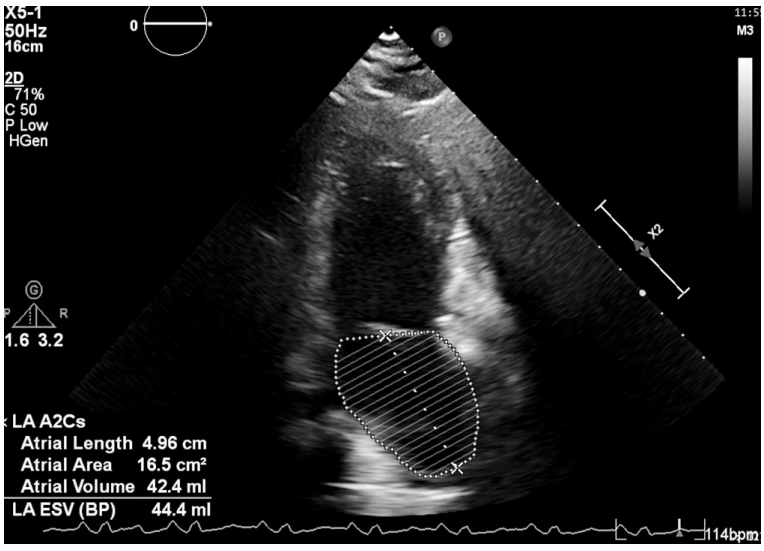

Fig. 3. Echocardiography 6 months after surgery.

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