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The result of the treatment of atrial fibrillation using left atrial and biatrial or radiofrequency ablation procedures in patient's mitral valve surgery.

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ABSTRACT

Radiofrequency ablation is a method of atrial fibrillation treatment for. There are many publications on the effectiveness of this method, which sometimes include conflicting data. This paper presents a retrospective analysis of the treatment of mitral valve defects with the help of valve replacement and the use of RFA procedure for the recovery of permanent sinus rhythm in 131 patients. The ablation lines were laid with the help of ablaters along the LA posterior wall, the mouths of the pulmonary veins (PVM) and in the right atrium (RA) according to the interpretation of "Labyrinth – 4" procedure. Patients were divided into two groups: those having undergone left atrial RFA only – 97 patients (74%), and biatrial RFA – 34 patients (26%). Operation time including RFA procedure in the general group, on average, was extended only by 13.5±1.3 minutes, the exposure time for each line corresponded to the achievement of transmural myocardial damage, and repeated three times. Postoperatively, 11 (8.4%) complications occurred. A correlation analysis showed that neither the preoperational size nor volume of the left atrium affect postoperatively the AF induction. All patients in the postoperative period had a significant reduction in the LA size, thereby leveling the possibility of occurrence of AF. In our group, regardless of bilateral or left atrial RFA, sinus rhythm was restored in 71% and 91% of cases, respectively. After two years, 65% of patients had sinus rhythm in bilateral RFA and 78% - in left atrial RFA.

Keywords: radiofrequency ablation, surgical treatment of AF, atrial fibrillation, mitral valve.

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INTRODUCTION

In cardiac surgery, the choice of strategy of treatment of atrial fibrillation (AF) is of great clinical interest because AF significantly worsens prognosis of heart disease [1-3]. AF has a high incidence in mitral diseases and is associated with an increased morbidity and mortality [4-6]. The application of RF energy in open cardiac surgery for the achievement of transmural damage of atrial myocardium, as a result of interruption of electrical impulses from ectopic foci, is an effective and safe method of eliminating the AF [7-10].

A meta-analysis of six non-randomized trials that involved 451 patients with atrial fibrillation, which had undergone radiofrequency ablation (RFA) on the open heart as an additional procedure, showed a higher survival rate of patients (97.1%) and their freedom from AF (76%) within the 14-month period of observation [11].

The RFA efficacy for the AF treatment has been demonstrated in various forms of AF (both persistent and paroxysmal AF), and on average require 15 minutes additionally to the main phase of the operation [12]. Definitely, the RFA procedure on the open heart is the method of choice for the AF treatment, but the technique and its implementation methods are still developing. Therefore, our objective was a retrospective evaluation of the clinical results of the AF treatment with the use of the RFA procedure in either bilateral or left atrial performance.

METHODS

From 2011 to 2014, the State Autonomous Healthcare Institution "Medical Clinical Diagnostic Center", the city of Kazan, performed 131 surgery (131 patients) for the mitral defect combined with atrial RFA under cardiopulmonary bypass (CPB). The study included patients after surgery. The indications for surgical treatment of the mitral valve (MV) were a severe hemodynamically significant defect of MV, mostly of rheumatic origin - 75.5% (99 patients), a high-grade chronic heart failure (CHF) - 2.82 ± 0.03 , and available atrial fibrillation. The average age of the patients was 57.3 ± 0.7 years, among them women - 62.5% (82 patients). The patients underwent the examinations such as echocardiography, Holter monitoring, coronary angiography. Indications for RFA was the presence of proven AF, with the left atrium (LA) size of not more than 65 mm. The duration and type of AF were not taken into account. The mitral valve, depending on the etiology, was replaced (111 cases) with a mechanical prosthesis in 68% of patients, or a biological prosthesis in 32% of patients. In 20 (15%) cases, valve reconstruction was performed with the use of a synthetic support ring. Electrical isolation of atria was performed with the use of bipolar radiofrequency energy and unipolar ablator AtriCure® Synergy. The ablation lines were laid with the help of ablaters along the LA posterior wall, the mouths of the pulmonary veins (PVM) and in the right atrium (RA) according to the interpretation of "Labyrinth - 4" procedure [13,14]. The lines were performed using a unipolar clamp from PVM to MV and from the coronary sinus to TV, and using a bipolar clamp on the posterior wall of the LA, PVM and RA. The transmural myocardial damage was confirmed by achieving the impedance less than... The first stage was RFA on the left atrium, PVM and the LA appendage. 34 (26%) patients had RFA conducted on the right atrium. As a result, the left atrial RFA was performed in 97 patients (74%), and the bilateral RFA - in 34 patients (26%). Access to the mitral valve was performed through the left atrium. All the patients had their LA appendage was disconnected from the circulation by inner ligation or suturing. Postoperatively, all patients within 6 months were prescribed Amiodarone. Warfarin prescription was determined according to the valve readings. Postoperatively, the evaluation of cardiac rhythm was conducted with Holter monitoring and ECG. Also, changes in anatomical and functional cardiac parameters were evaluated after the correction of the valve defect and heart rate using echocardiography. Control evaluation of the echocardiographic data was carried out 10 days after the operation. Clinical observations were carried out within two years; by the end of this period there were 129 (98.4%) patients under observation.

Table 1: Patient clinical characteristics.

Parameter	Value
age, years	57.3 ± 0.7
sex: male	49 (37.5%)
female	82 (62.5%)

valve defect etiology: Chronic rheumatic heart disease	99 (75.5%)
Atherosclerosis (degree 3 AV+MV stenosis)	6 (4.5%)
MV prolapse	16 (12.2%)
Ischemic heart disease	8 (6%)
Infective endocarditis	2 (1.8%)
AF: paroxysmal (PAF)	31 (24%)
non-paroxysmal (nPAF)	100 (76%)
AF age, months: General	26.5±3.03
PAF	22.3±4.8
nPAF	26.7±3.1
CHF function capacity: II	26 (20%)
III	105 (80%)

Table 2: Surgical technique.

Operative technique	Value
MV replacement	111(85%)
mechanical prosthesis	76(68%)
biological prosthesis	35(32%)
with AV replacement	9(8.1%)
with TV repair	41(37%)
MV repair	20(15%)
with AV replacement	5
Left atrial RFA	97(74%)
Bilateral RFA	34(26%)
Aortic clamping time, min.	59.7±7.8

Statistical analysis was performed by continuous variables expressed as mean ± standard deviation. Comparisons have been made by a pair, bilateral *t*-test for normally distributed continuous variables. The sample groups of the same distribution were compared by using Wilcoxon Rank Sum test. Statistical significance was set at $p \leq 0.05$. Evaluation of linear relation between the maintained AF and sizes and volumes of the LA was carried out with the help of correlation analysis. All data analyzes were performed using the software product Statistika 6.0 (StatSoft Inc., for Windows).

RESULTS

Operation time including RFA procedure in the general group, on average, was extended by 13.5±1.3 minutes. During this time, the exposure with ablators was conducted for each line until the achievement of transmural myocardial damage, and repeated three times. Postoperatively, 11 (8.4%) complications occurred: bleeding from the sternal wound in 6 cases, the development of heart failure in 2 cases, renal failure in two cases, and one stroke. Implantation of a pacemaker was required in 12 (9.1%) cases, 5 of them (42%) were implanted with a single chamber pacemaker due to preserved AF and bradysystole. A dual-chamber pacemaker for sinus bradycardia was implanted in 7 (58%) patients. According to echocardiography, the general group showed a decrease in size and volume of LA ($p \leq 0.05$) decrease in pulmonary hypertension ($p \leq 0.05$) and left ventricular ejection fraction less than 50% in 18 (13.7%) patients.

Table 3: ECG-detected changes in functional heart parameters.

Parameters	pre-operatively M±SD	post-operatively M±SD	p value
EDD, cm	5.1±0.06	4.8±0.05	0.002
ESD, cm	3.5±0.06	3.3±0.07	0.002
LA, cm	5±0.06	4.5±0.06	0.000
LA volume, ml	135±3.6	100.7±3.3	0.000

EDV, ml	96.1±3.6	84.8±2.3	0.002
EDV, ml	51.6±1.9	44.1±1.03	0.0002
EF, %	55±0.7	52.8±0.6	0.1
PA, mm Hg	48.1±1.3	33.1±0.6	0.000

Thirty-day mortality was 0%, 2 (1.5%) patients died during two years of observation. One death was due to the developed cancer pathology, the second was the result of acute stroke. Rhythm monitoring was necessarily carried out after 6, 12 and 24 months.

SUMMARY

Treatment of AF in patients with open heart intervention using radiofrequency energy is an effective method [13, 15-18]. Our study had no cases of complications that would have resulted from the application of RFA. The occurrence of malignant sinus bradycardia in 5% of patients that required the implantation of a dual chamber pacemaker, in our view, cannot be considered a complication. Preoperatively, some patients had a tendency to bradycardia (2 patients), and the detection of sinus bradycardia in patients with permanent AF was impossible because of malfunction of the sinus node [19]. A single-chamber pacemaker implantation for AF and bradysystole was considered by us as an uncured AF.

We conducted the analysis of the size of the left atrium as a predictor of AF recurrence. Preoperatively, the average volume of LA was 135±3.6 ml, postoperatively – 100.7±3.3 ml (p<0.05), linear LA size before surgery was 5±0.06 cm., after – 4.5±0.06 cm (p<0.05). A correlation analysis showed that postoperative size and volume of LA affects neither the preservation nor recurrence of AF (figure 1). All patients in the postoperative period showed a significant reduction in the size of the LA, which negates the possibility of AF. As other studies show, the increased volumetric and linear dimensions of the LA are factors of AF induction [20].

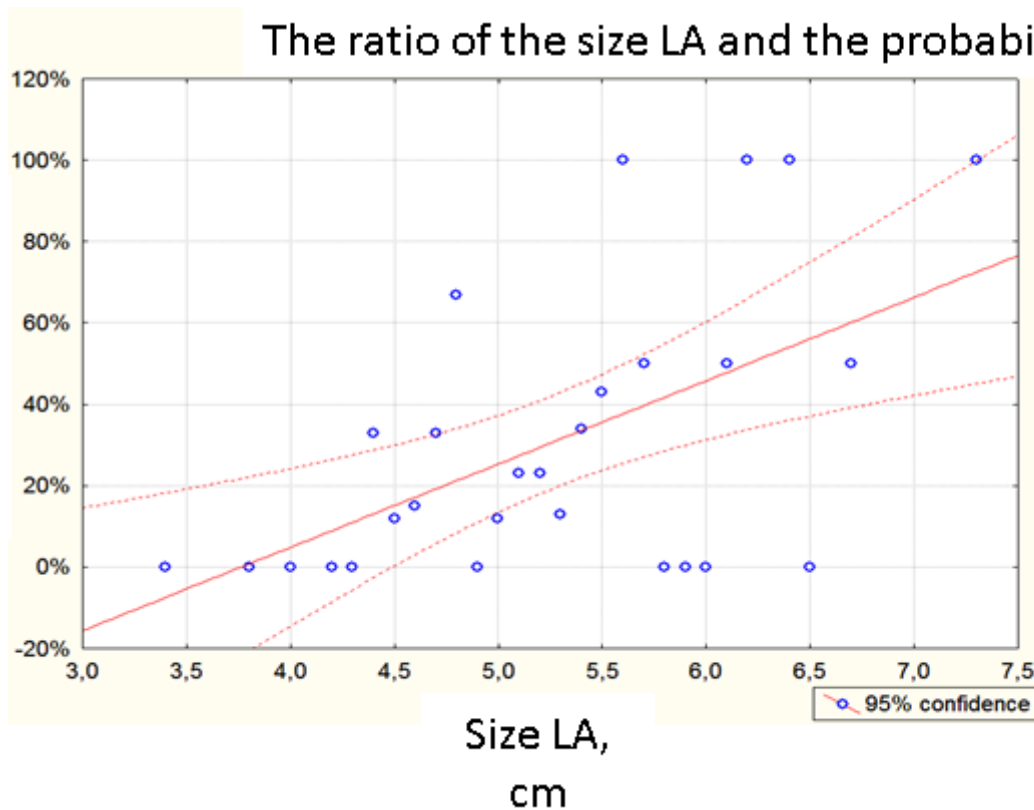


Figure 1. The ratio of the LA linear dimension before surgery and the likelihood of postoperative AF.

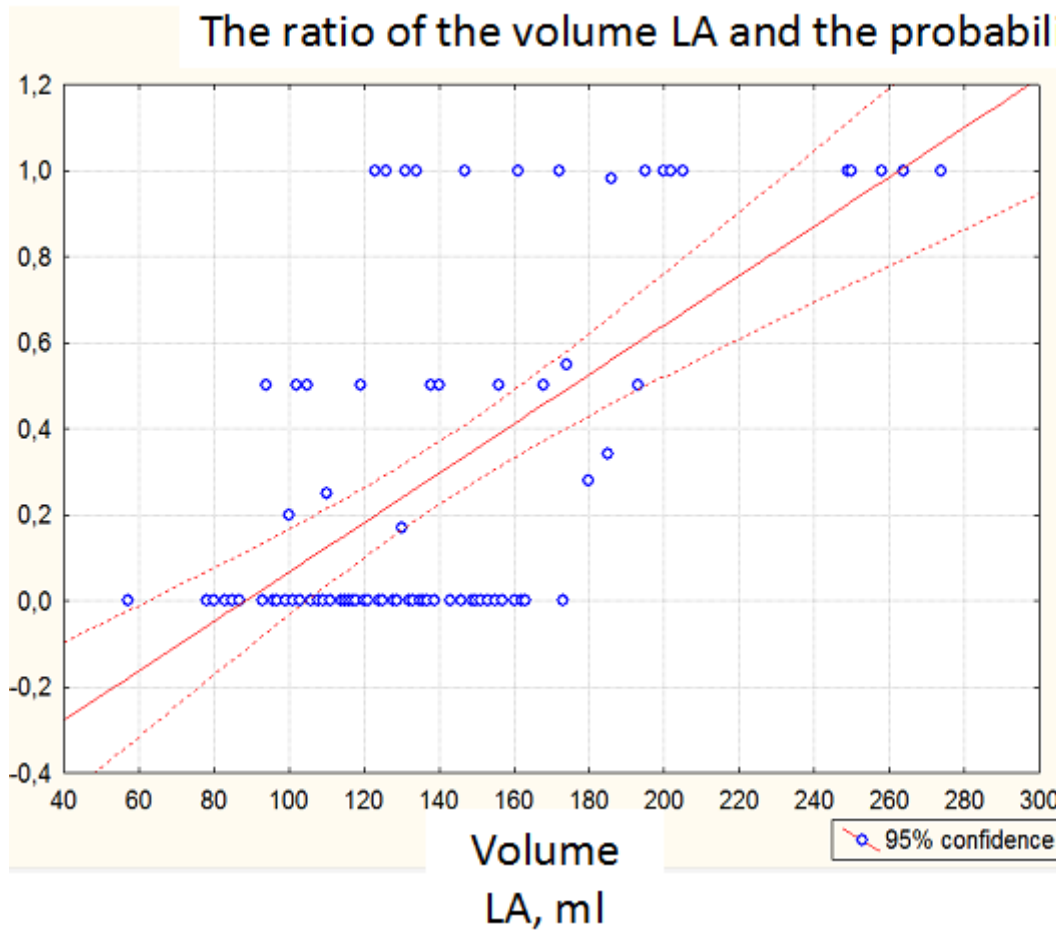


Figure 2. The ratio of the LA volume before surgery and the likelihood of postoperative AF.

Regardless of bilateral or left atrial RFA, sinus rhythm was restored in 71% and 91% of cases, respectively (figure 2). Over the time, there was a gradual decrease in the number of patients with sinus rhythm. After two years, 78% of patients treated with left atrial RFA had sinus rhythm, and 65% of patients treated with biatrial RFA showed no statistical difference. As a result, the RFA performance only in the left atrium may maintain sinus rhythm for a long time.

CONCLUSION

We can conclude that the performance of the RFA in MV intervention is a safe method of the AF treatment. Laying ablation lines only on the left atrium and pulmonary veins according to the interpretation of "Labyrinth – 4" procedure is the key to successful maintenance of sinus rhythm for a long period (two years) in 78% of patients. For the final justification of performing only left atrial RFA the further monitoring of patients, new research and identification of effective groups of patients is required.

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