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Radiofrequency ablation of the pulmonary vein ostia in elderly patients with atrial fibrillation

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ABSTRACT

BACKGROUND: Restoration and maintenance of sinus rhythm is one of the most important aspects of managing patients with atrial fibrillation. The greatest effectiveness is achieved when this intervention is performed in young patients without comorbidities and in patients with paroxysmal atrial fibrillation. The appropriateness of performing radiofrequency ablation of the pulmonary vein ostia in elderly patients with atrial fibrillation remains a subject of debate.

AIM: to study the immediate and long-term results of catheter ablation in elderly patients with AF.

MATERIALS AND METHODS: The study group consisted of 88 patients aged 75–88 years who underwent RFA of the pulmonary vein ostia. The technique used was classical, with femoral puncture access, and irrigated ablation catheter. Data analyzed included ECG parameters, incidence of systemic thromboembolic complications, functional class of chronic heart failure according to NYHA, subjective state post-procedure, occurrence of atrial fibrillation recurrences, and the impact of baseline clinical factors on disease recurrence.

RESULTS: In 80 patients (90.9%), atrial fibrillation did not recur during their hospital stay after radiofrequency ablation of the pulmonary vein ostia. In the long term (min 1.5, max 3.1 years), a cross-sectional observational study was conducted on 37 patients. Adherence to oral anticoagulants was 97.6%. No systemic thromboembolic events were recorded among the patients available for contact. Atrial fibrillation recurrences troubled 67.6% of patients after radiofrequency ablation. The main predictors of atrial fibrillation recurrence in elderly patients were the presence of hypertension (p=0.03) and baseline left atrial enlargement (p=0.001). Despite the high recurrence rate, there was a significant reduction in the functional class of chronic heart failure following radiofrequency ablation of the pulmonary vein ostia (p=0.009).

CONCLUSIONS: Strict selection is required for performing catheter ablation in patients with atrial fibrillation older than 75 years. Significant left atrial enlargement and uncontrolled hypertension are major limitations for performing RFA of the pulmonary vein ostia in the elderly. The procedure demonstrates significant effectiveness in terms of reducing chronic heart failure functional class in patients over 75 years old, despite the high recurrence rates in the long term.

Keywords: atrial fibrillation; radiofrequency catheter ablation; surgical treatment of cardiac rhythm disorders; elderly patients.

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Радиочастотная абляция устьев легочных вен у пациентов старческого возраста с фибрилляцией предсердий

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АННОТАЦИЯ

Актуальность. Восстановление и поддержание синусового ритма сердца является одним из важнейших аспектов ведения пациентов с фибрилляцией предсердий. Наибольшая эффективность достигается при выполнении данного вмешательства у некоморбидных пациентов молодого возраста и при пароксизмальной форме фибрилляции предсердий. Целесообразность выполнения радиочастотной абляции устьев легочных вен у больных с фибрилляцией предсердий старческого возраста на сегодняшний день остается предметом дискуссий.

Цель — изучить ближайшие и отдаленные результаты радиочастотной абляции устьев легочных вен у больных с фибрилляцией предсердий старческого возраста.

Материалы и методы. Исследуемая группа была сформирована из 88 пациентов в возрасте 75–88 лет, которым была выполнена радиочастотная абляция устьев легочных вен. Техника проведения классическая, с пункционным бедренным доступом. Анализировались такие данные, как показатели электрокардиограммы, наличие системных тромбоэмолических осложнений, функциональный класс хронической сердечной недостаточности по NYHA, субъективное состояние после вмешательства, наличие рецидивов фибрилляции предсердий, влияние исходных клинических факторов на рецидив заболевания.

Результаты. В 80 (90,9%) случаях после радиочастотной абляции устьев легочных вен за время нахождения в стационаре фибрилляция предсердий не рецидивировала. В отдаленные сроки (от 1,5 до 3,1 года) проведен поперечный обсервационный срез у 37 пациентов. Приверженность пероральным антикоагулянтам составила 97,6%. Системных тромбоэмболических осложнений среди доступных для контакта больных зарегистрировано не было. Рецидивы фибрилляции предсердий после радиочастотной абляции устьев легочных вен беспокоили 67,6% пациентов. Основными предикторами рецидива фибрилляции предсердий у больных старческого возраста стали гипертоническая болезнь (p=0,03) и исходная дилатация левого предсердия (p=0,001). Несмотря на большую долю рецидивов, выявлено значимое снижение функционального класса хронической сердечной недостаточности после радиочастотной абляции устьев легочных вен (p=0,009).

Заключение. Требуется строгий отбор пациентов с фибрилляцией предсердий старше 75 лет для проведения радиочастотной абляции устьев легочных вен. Выраженная дилатация левого предсердия и неконтролируемая артериальная гипертензия является значимым ограничением для выполнения радиочастотной абляции устьев легочных вен в старческом возрасте. Методика показывает значимую эффективность в плане снижения ФК ХСН у пациентов старше 75 лет, несмотря на большую частоту рецидивов в отдаленные сроки.

Ключевые слова: фибрилляция предсердий; радиочастотная катерная абляция; хирургическое лечение нарушений ритма сердца; пациенты старческого возраста.

Как цитировать

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BACKGROUND

Restoration and maintenance of sinus rhythm are key aspects of managing patients with atrial fibrillation (AF). This approach not only reduces the symptoms associated with AF but also eliminates the electrical heterogeneity of the myocardium, which otherwise leads to cardiac chamber remodeling and chronic heart failure (CHF). However, in many patients requiring sinus rhythm restoration and maintenance, this goal cannot be achieved without invasive techniques. Currently, one of the recommended methods in cases when conservative therapy proves ineffective is radiofrequency ablation (RFA) of the pulmonary vein ostia and/or other arrhythmogenic foci of the atria [1]. The radiofrequency ablation of the pulmonary vein ostia has been demonstrated to be highly effective in patients with paroxysmal AF and in patients of young and middle age [2]. The feasibility of this intervention in patients with a long history of other cardiac disorders and a high degree of cardiovascular comorbidity is still controversial. This group primarily includes elderly patients (>75 years). Changes in the normal structure and fibrosis of the atrial myocardium, resulting in cardiac chamber dilation, significantly worsen the prognosis after RFA of the pulmonary vein ostia, making the effectiveness of this technique in elderly patients a topic of ongoing debate [3, 4].

The study aimed to assess the short-term and long-term outcomes of RFA of the pulmonary vein ostia in elderly patients.

METHODS

The study group consisted of patients from the Cardiac Surgery Department specializing in the surgical treatment of complex cardiac rhythm disorders and cardiac pacing (using *X*-ray surgical techniques) at the Petrovsky Clinic of the North-Western State Medical University named after I.I. Mechnikov. These patients underwent surgical treatment for AF between 2014 and 2022. The study design involved a cross-sectional analysis of the target patient group. The inclusion criteria were age over 75 years, presence of symptomatic AF poorly controlled by conservative treatment, indications for RFA of the pulmonary vein ostia according to the 2020 Russian Society of Cardiology Guidelines for Atrial Fibrillation and Atrial Flutter, ongoing optimal pharmacotherapy (including anticoagulants). A total of 88 patients aged 75–88 years were included in the study. The patients meeting the inclusion criteria were consecutively enrolled in the study group; randomization was not performed. The study did not include a control group, because a comparative analysis between elderly patients and those of other age groups was deemed unnecessary due to the limited relevance of such results. The study was conducted in accordance with Good Clinical Practice (GCP) standards. It was performed in compliance with the principles of the Declaration of Helsinki. All patients signed a written informed consent. The anticoagulant therapy was discontinued no more than 24 hours before surgery (with the last dose taken the evening before the intervention). Primary RFA of the pulmonary vein ostia was performed in 59 patients (67.0%), secondary RFA in 24 patients (27.3%), and tertiary RFA in 5 patients (5.7%).

The clinical characteristics of the patients are presented in Table 1. The study group included 52 female patients (59.1%) and 36 male patients (40.9%). Both paroxysmal and persistent forms of AF were observed. The analysis considered the presence of stage 2 or 3 hypertension, CHF with FC I–III according to the New York Heart Association Classification (NYHA) classification, diabetes mellitus, peripheral artery atherosclerosis, chronic kidney disease, and a history of stroke.

The assessed risk of systemic thromboembolic events according to the CHA_2DS_2-VASc score was as follows: 2 points in 5 patients (5.7%), 3 points in 21 patients (23.9%), 4 points in 36 patients (40.9%), 5 points in 19 patients (21.6%), and 6 points in 7 patients (7.9%). The risk of bleeding according to the HAS-BLED score ranged from 1 to 2 points in all patients.

According to transthoracic echocardiography (TTE) performed at the prehospital stage, the left ventricular ejection fraction (LVEF) was 54% [51.0–58.0]. The left atrial (LA) diameter was 46.1 ± 1.7 [45.57–46.70] mm, and the pulmonary artery pressure averaged 36.5 [30.7–39.2] mm Hg.

The surgical access for RFA of the pulmonary vein ostia was performed under local anesthesia using a puncture-based groin approach. After cannulation of the right femoral vein, the coronary sinus was catheterized, and a transseptal puncture was performed. A transseptal introducer, either PREFACE® (Biosense Webster Inc., USA) or Swartz™ (St. Jude Medical, USA), was inserted into the left atrium (LA), followed by the introduction of a steerable non-navigational catheter (LASSO®, Biosense Webster Inc., USA) and an irrigated ablation catheter (THERMOCOOL SMARTTOUCH® SF, Biosense Webster Inc., USA). Anatomical and electrophysiological data were collected using the 3D navigation system (CARTO® 3, Biosense Webster Inc., USA). Circular antral ablation of arrhythmogenic zones at the pulmonary vein ostia was performed to achieve complete electrical isolation, with subsequent verification of conduction block using the LASSO® catheter and magnetic navigation. During the procedure, intravenous heparin sulfate was administered at 6000 to 10,000 IU, followed by neutralization with protamine sulfate at the end of the procedure. Intraoperative monitoring included simultaneous fluoroscopic data and 12-lead ECG monitoring.

The procedure was supplemented with right atrial (RA) intervention in the form of RFA of the cavotricuspid isthmus using similar surgical equipment in 17 patients with concomitant atrial flutter. Additionally, radiofrequency

modification of the atrioventricular (AV) junction was performed in 1 patient. At the end of the procedure, a pressure bandage was applied to the puncture site, and the patient was transferred to the intensive care unit for postoperative monitoring.

The statistical analysis was performed using descriptive and analytical statistical methods implemented in SPSS Statistics v. 28 software (IBM Corp., USA). The normality of distribution was assessed using the Kolmogorov–Smirnov and Lilliefors tests. Depending on the distribution pattern, the measures of central tendency were presented as the arithmetic mean ± standard deviation (*M* ± *SD*) with a 95% confidence interval (CI) for normally distributed variables, or as the median (*Me*) with the interquartile range (IQR) for non-normally distributed variables (in square brackets). The factor analysis was performed using Pearson chi-square (χ^2) test. The group comparisons for quantitative variables were performed using Student *t* test or the Mann–Whitney *U* test, depending on the distribution. The comparative analysis of dependent groups was conducted using the Wilcoxon signed rank test. The statistical hypotheses were considered confirmed at $p < 0.05$.

RESULTS

The mean duration of surgery for AF was 128.2 ± 41.1 [114.1–141.9] minutes. By the end of the procedure, sinus rhythm was verified by ECG monitoring in 83 (94.3%) patients; intraoperative cardioversion was required to restore the sinus rhythm in 36 (40.9%) cases. Intraoperative complications occurred in 4 patients: cardiac tamponade in 2 (2.3%) and stroke in 2 (2.3%). No cases of in-hospital death were reported.

During the hospital stay, early recurrence of AF was observed in 8 (9.1%) patients. In the other 80 (90.9%) patients, AF did not recur during the hospital stay.

The main ECG parameters during the early postoperative hospital period after RFA of the pulmonary veins were within normal (Table 2). However, a trend toward an increase in the *PR* interval duration was noted, with this parameter approaching the upper limit of normal in most patients.

Table 1. Brief Clinical Characteristics of the Study Group

Category	Absolute Number	Proportion, %
Paroxysmal atrial fibrillation	65	73.9
Persistent atrial fibrillation	23	26.1
Hypertension (stage 2 or 3)	76	86.4
Post-myocardial infarction myocardial fibrosis	9	10.2
Chronic heart failure, NYHA functional class I	5	5.7
Chronic heart failure, NYHA functional class II	52	59.1
Chronic heart failure, NYHA functional class III	31	35.2
Diabetes mellitus	18	20.4
Peripheral artery atherosclerosis	7	7.9
Chronic kidney disease	26	29.5
History of stroke	10	11.4

Table 2. Electrocardiogram Results in the Early Postoperative Hospital Period After Pulmonary Vein Radiofrequency Ablation

Parameters	*Me (M ± SD)*	95% CI / IQR
Heart rate, bpm (*Me*)	72.0	61.0–79.0
RR interval, s (*M ± SD*)	0.9±0.2	0.8–0.9
PQ interval, ms (*Me*)	175	150–200
QRS interval, ms (*Me*)	90	90–100
QRST interval, ms (*M ± SD*)	398±36	385–411
Corrected *QT* interval, ms (*M ± SD*)	42±44	411–442

Note. CI, confidence interval; IQR, interquartile range.

The postoperative period ranged from 2 to 4 days, after which the patients were discharged and referred for outpatient follow-up.

During the long-term follow-up period, a cross-sectional observational study was conducted, with 37 patients available for follow-up. The mean follow-up period after RFA of the pulmonary vein ostia was 2.3 years (range: 1.5–3.1 years). Clinically, patients available for long-term follow-up did not differ significantly from the initial sample. The outcome analysis was based on the data obtained during follow-up visits, including outpatient examination (ECG, 24-hour ECG monitoring, TTE, and coagulation profile assessment), as well as patient-reported outcomes, in accordance with the European Society of Cardiology (ESC) guidelines on the management of atrial fibrillation [5]. The data from the other patients were lost due to the inability to contact the patients who had received treatment outside their place of residence at a federal center; fatalities could not be excluded. However, the study design was cross-sectional, so 100% follow-up in the long term was not anticipated. Additionally, the target study group consisted of elderly patients whose mean age exceeded the average age at death in the Russian Federation (according to official statistics, the average age at death in 2023 was 74 years).

During the long-term follow-up, no systemic thromboembolic events were recorded among the patients available to follow-up. Over the extended period, medication adherence remained extremely high (97.6%). The primary group of medications consisted of direct oral anticoagulants (DOACs), including apixaban in 17 (45.9%) patients, rivaroxaban in 14 (37.8%) patients, and dabigatran etexilate in 3 (8.1%) patients. Additionally, 1 (2.7%) patient received warfarin, and 2 (5.4%) patients received acetylsalicylic acid (Fig. 1).

The antiarrhythmic therapy was administered to 25 (67.6%) patients, while 12 (32.4%) patients did not receive antiarrhythmic drugs. Among those receiving antiarrhythmic therapy, class I drugs were prescribed to 2 (5.4%) patients, class II drugs to 10 (27.0%) patients, class III drugs to 8 (21.6%) patients, and class IV drugs to 5 (13.5%) patients; combination therapy was used in 3 (8.1%) cases. None of the patients received cardiac glycosides. Other medication groups included antihypertensive therapy, prescribed to 32 (86.5%) patients, including diuretics in 11 (29.7%) cases.

According to the NYHA classification, the distribution CHF FC after RFA of the pulmonary vein ostia was as follows: class I in 8 patients (21.6%), class II in 21 patients (56.8%), and class III in 8 patients (21.6%). No patients from the study group available for follow-up in the long-term period had class IV CHF FC.

A significant improvement in CHF FC was observed in the long-term period after RFA of the pulmonary vein ostia compared with baseline values. Although the median CHF FC in both periods was 2, the IQR showed a significant difference: the baseline CHF FC at hospitalization was 2 [1.8–2.8], whereas in the long-term period, this indicator significantly decreased to 2 [1.2–2.0], p= 0.009.

The subjective assessment of patients' condition corresponded to the severity criteria of AF manifestations according to the European Heart Rhythm Association (EHRA) score. A total of 19 patients (51.3%) reported an improvement in the quality of life and exercise tolerance after the intervention, 7 patients (18.9%) reported no changes in their condition, and 11 patients (29.7%) assessed the RFA outcome as negative.

A deterioration in general condition, manifested as a decrease in exercise tolerance, was reported by 29.7% of patients. A further analysis of this patient group revealed that the unfavorable outcome in the long term after RFA of the pulmonary vein ostia was not age-dependent (p = 0.971) (see Fig. 1).

The main factor contributing to the deterioration of condition in the long term was AF recurrence. Despite the use

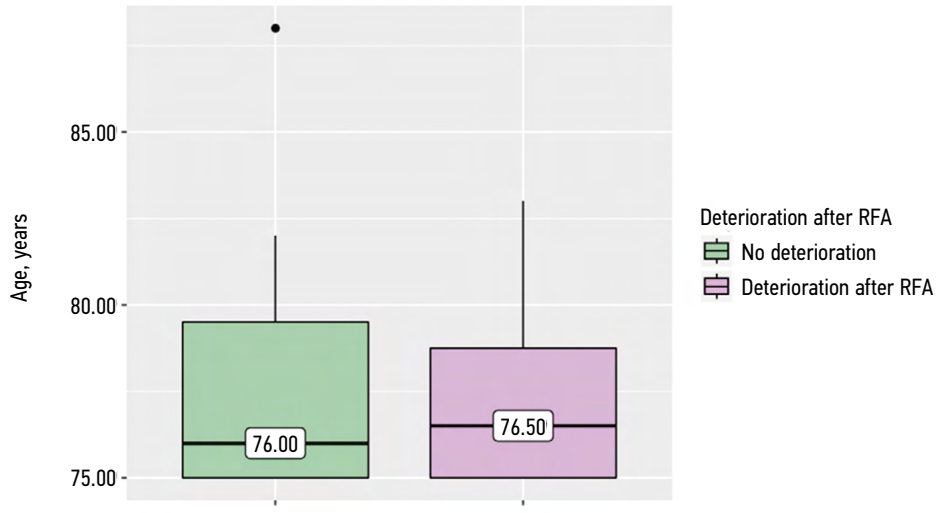

Fig. 1. Analysis of the impact of age on deterioration of condition in the long term after radiofrequency ablation of the pulmonary vein ostia (p = 0.971). The median value is shown in the center of the box plot; the box represents the interquartile range, and the "whiskers" indicate the full range of values.

of antiarrhythmic drugs, tachysystolic episodes significantly worsened quality of life and satisfaction with treatment outcomes. In patients whose condition deteriorated long after RFA of the pulmonary vein ostia, the frequency of AF recurrence was significantly higher (p = 0.007) (Fig. 2).

AF recurrences after RFA of the pulmonary vein were observed in 67.6% of patients available for follow-up. Despite AF recurrences, not all patients rated the treatment outcome as negative. Comparing the number of patients with AF recurrence and the number of patients who negatively assessed the treatment outcome (29.7%), it can be concluded that nearly half of the patients (53.8%) did not experience a decrease in quality of life or physical exercise tolerance after RFA of the pulmonary vein ostia.

In the long term, the absence of AF recurrence was reported by only 12 (32.4%) patients. The nature of the antiarrhythmic therapy did not significantly affect the absence of AF recurrence. The significance levels for the association between the absence of long-term AF recurrence and the class of antiarrhythmic drugs were as follows: class I, p = 1.0; class II, p = 0.445; class III, p = 1.0; class IV, p = 1.0; and no therapy, p = 0.146. The initial form of AF also had no substantial impact on the absence of recurrences (p = 0.240) (Fig. 3).

A significant association was found between long-term AF recurrence after RFA of the pulmonary vein ostia and arterial hypertension. AF recurrences were significantly more frequent in patients with hypertension (p = 0.030) (Fig. 4).

The presence of hypertension was reflected in the ECG results. The postoperative ECG data showed a tendency toward a longer *PR* interval in patients with hypertension: 185 ± 35 ms versus 140 ± 8 ms in patients without hypertension (p = 0.017).

When analyzing other factors influencing long-term AF recurrence after RFA of the pulmonary vein ostia, a direct association was also found between recurrence

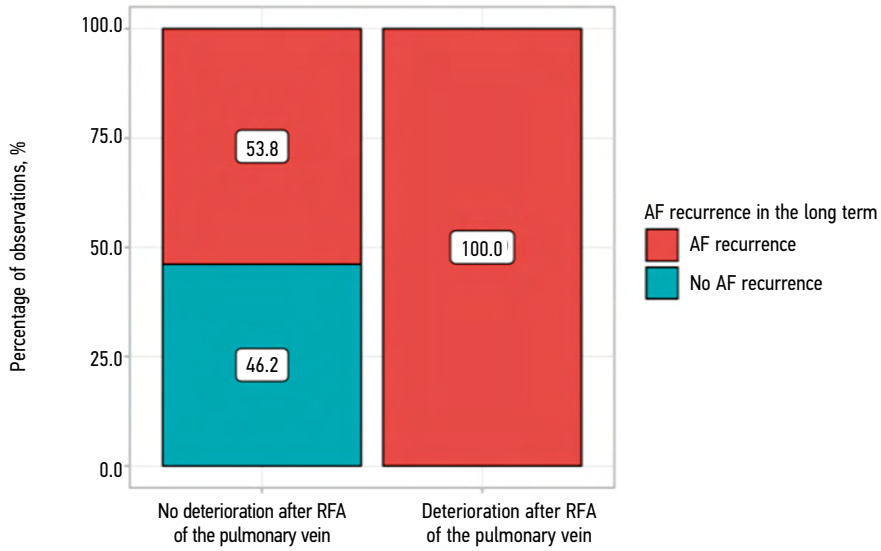

Fig. 2. Association between deterioration occurred long after radiofrequency ablation of the pulmonary vein ostia and atrial fibrillation recurrence in the study group (p = 0.007).

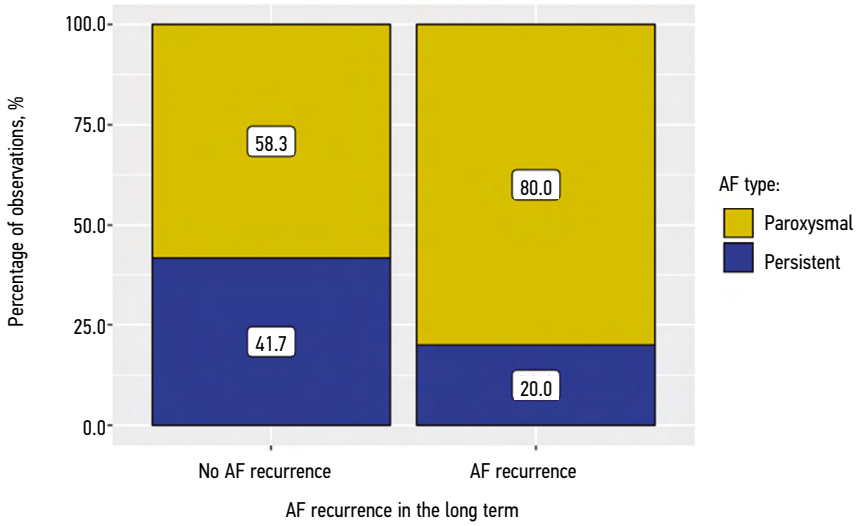

Fig. 3. Recurrence of atrial fibrillation in the study group during long-term follow-up after radiofrequency ablation of the pulmonary vein ostia, depending on the initial form of AF (p = 0.24).

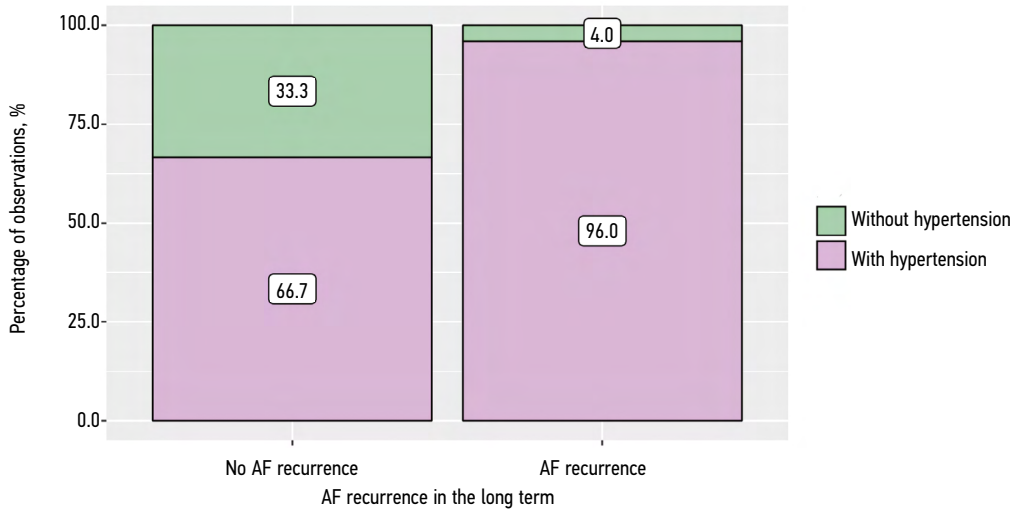

Fig. 4. Recurrence of atrial fibrillation in the study group during long-term follow-up after radiofrequency ablation of the pulmonary vein ostia, depending on the presence of hypertension (p = 0.030).

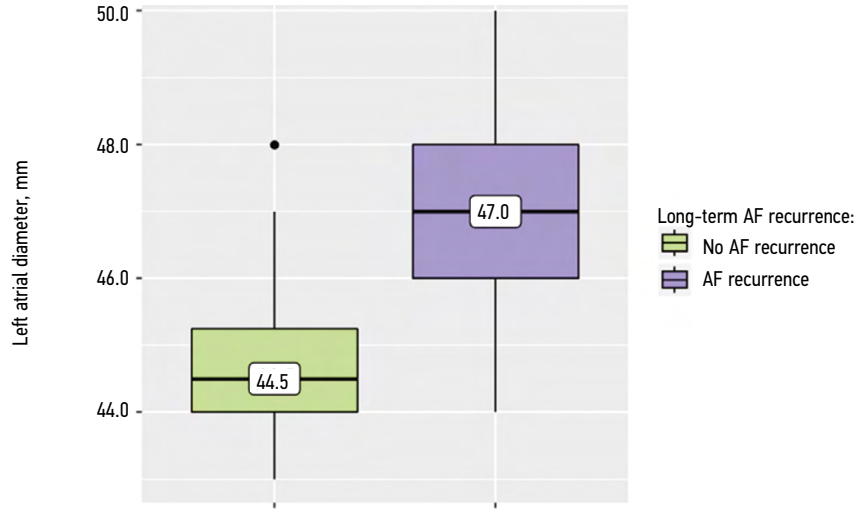

Fig. 5. Left atrial diameter according to transthoracic echocardiographic data in patients with and without atrial fibrillation recurrence (p = 0.001). The median value is shown in the center of the box plot; the box represents the interquartile range, and the "whiskers" indicate the full range of values.

and the baseline LA size. In patients with AF recurrence, the baseline LA diameter according to TTE was significantly larger: 47 [46.0–48.0] mm versus 44.5 [44.0–45.3] mm (p = 0.001) (Fig. 5).

Thus, the risk of AF recurrence primarily increased in patients with hypertension and/or LA dilation.

DISCUSSION

According to the EORP-AF registry (EURObservational Research Programme on Atrial Fibrillation), which includes 70 centers from 9 countries, 33.7% of patients with AF are aged over 75 years [6]. It has been demonstrated that AF in the elderly population significantly affects both quality of life and survival rates [4, 6]. The mortality rate among patients aged over 75 years with AF was 11.5% compared with 3.7% among patients with AF younger than 75 years. Additionally, elderly patients with AF are more likely to develop complications within 1 year after surgery, including stroke, transient ischemic attack, and systemic thromboembolic events (13.6% in patients older than 75 years with AF compared with 4.9% in those younger than 75 years with AF).

We observed only intraoperative complications in four patients (stroke and cardiac tamponade), which were caused by technical and clinical difficulties during surgical treatment in specific patients. The antithrombotic therapy in our study was optimally selected based on age, body weight, and comorbid conditions; however, the selected drug doses for individual patients (considering all the aforementioned factors) do not always achieve target levels to prevent systemic thromboembolic events in elderly patients. According to studies [7], in elderly patients with AF and optimal prophylaxis of systemic thromboembolic events, the incidence of ischemic stroke is 11.9%.

The key factors influencing AF recurrence were the presence of hypertension and LA size. The contribution of these two predictors to AF recurrence is not coincidental. One of the primary causes of LA dilation in patients with hypertension is chronic atrial pressure overload due to increased afterload on the LV. According to the published sources [8–10], baseline LA enlargement is one of the key predictors of recurrence after RFA of the pulmonary vein ostia. The studies have shown [11] that the risk of AF recurrence after RFA of the pulmonary vein ostia can increase by up to five times in the presence of LA dilation. Therefore, the feasibility of RFA of the pulmonary vein ostia in patients with LA dilation is questionable. It should be noted that if target blood pressure values are not achieved after RFA of the pulmonary vein ostia and hypertension persists, the risk of AF recurrence significantly increases.

Although the mean *PR* interval in patients after RFA of the pulmonary vein ostia remained within normal, an upward trend was observed in patients with hypertension. This finding indicated a relative slowing of impulse conduction through the atria and the atrioventricular junction. One possible reason for this could be the enlargement of both atrial chambers. An increase in the *PR* interval (referred to as the *PR* interval rather than the *PQ* interval in English published sources) in the general population correlates with the severity of atrial remodeling and serves as an independent predictor of future AF development [12]. Moreover, a *PR* interval exceeding 200 ms significantly correlates with LA size and LA volume index. There is also evidence suggesting that the recurrence rate of AF in patients with a PR interval greater than 200 ms almost doubles after RFA of the pulmonary vein ostia [13].

The high recurrence rate of AF following RFA of the pulmonary vein ostia remains an unresolved issue in modern clinical electrophysiology. The multicenter FREEZE study [10, 11] demonstrated that the recurrence rate of AF after catheter ablation averages 30%–50% within the first year. Notably, the type of energy used (radiofrequency or cryoablation) did not significantly impact recurrence rates [14]. Whereas it is generally believed that the effectiveness of repeat RFA of the pulmonary vein ostia improves with each procedure, our findings do not support this assumption. In our study, the number of RFA of the pulmonary vein ostia procedures performed in elderly patients did not influence the long-term recurrence rate.

Taking into account the high recurrence rate of AF, including asymptomatic episodes, RFA of the pulmonary vein ostia cannot be considered a superior strategy for preventing systemic thromboembolic events compared with rate control. Specifically, previous studies [15, 16] have demonstrated no significant differences in survival rates or reductions in systemic thromboembolic incidence between rhythm control and rate control strategies in AF patients over long-term follow-up. The most extensive randomized trial in this field, the CABANA Trial [17], involved 126 clinical sites across 10 countries. The patients with AF were assigned to either a rhythm control or rate control group. With anticoagulation therapy, the four-year incidence of disabling ischemic stroke was similar between the groups: 0.3% in the rhythm control group and 0.6% in the rate control group. No systemic thromboembolic events in other vascular territories were observed in either group.

During follow-up after RFA of the pulmonary vein ostia in the present study, no hospitalizations due to systemic thromboembolic events of any localization were recorded among patients available for follow-up. However, adherence to anticoagulation therapy was exceptionally high in the study cohort (97.6%). This value significantly exceeded the expected long-term adherence to anticoagulation therapy in AF patients, as reported by national and international sources [18, 19].

Despite its questionable effectiveness in preventing systemic thromboembolic events in AF patients over the long term, RFA of the pulmonary vein ostia was associated with a reduction in CHF FC in the present study. Following RFA of the pulmonary vein ostia, the mean of this parameter decreased from 2.3 ± 0.6 to 2.0 ± 0.7 (p = 0.009). The ability of RFA of the pulmonary vein ostia to improve exercise tolerance in patients with AF and concomitant CHF, despite a high recurrence rate, has been confirmed in the available publications. A detailed analysis of the CABANA Trial (2021) [20] demonstrated that in patients with AF and a baseline CHF FC greater than II, long-term survival and quality of life after RFA of the pulmonary vein ostia were significantly better than in those receiving conservative treatment.

It is important to acknowledge the limitations of our study regarding the long-term outcomes of RFA of the pulmonary vein ostia. Regrettably, long-term follow-up could not be established for 51 patients (57.9%), leaving their outcomes unknown. A major contributing factor was that most patients aged >75 years in the analysis resided in remote regions. At baseline, St. Petersburg residents accounted for only 53.4% (47 patients) of the study population. Other regions of the Russian Federation were represented as follows: 17 (19.3%) in the Republic of Karelia,8 (9.1%) in the Vologda Region, 6 (6.8%) in the Leningrad Region, 2 (2.3%) in the Novgorod Region, 2 (2.3%) in the Pskov Region, 2 (2.3%) in the Tula Region, 1 (1.1%) in the Kirov Region, 1 (1.1%) in the Rostov Region, 1 (1.1%) in the Stavropol Territory, and 1 (1.1%) person in the Tver Region. In practice, long-term follow-up for patients from remote regions is often challenging. Nevertheless, the primary cross-sectional analysis aimed to assess in-hospital mortality and postoperative complications. These findings indicate the need for further research in this patient population.

CONCLUSION

Thus, considering the low incidence of postoperative complications and the absence of in-hospital mortality,

RFA of the pulmonary vein ostia appears to be a relatively safe procedure even in elderly patients with significant comorbidities. However, to minimize AF recurrences and the associated patient dissatisfaction with treatment, careful patient selection is required in this age group. The main indication for RFA of the pulmonary vein ostia in elderly patients with AF is high CHF FC or elevated EHRA scores despite optimally adjusted pharmacological therapy. A limitation to RFA of the pulmonary vein ostia in elderly patients is marked LA dilation and uncontrolled hypertension. With strict patient selection, RFA of the pulmonary vein ostia has the potential to improve CHF FC, which may positively influence long-term survival.

ADDITIONAL INFORMATION

Author's contribution. V.A. Marinin, concept and design of the study, conducting the practical part of the study, collecting data; A.V. Sotnikov, concept and design of the study, collection and processing of materials, writing the text; V.V. Stepanova, conducting the practical part of the study, collecting materials; M.A. Savelyeva, writing the text, analyzing the data obtained; I.L. Urazovskaya, analysis of the data obtained, literature review. Thereby, all authors confirm that their authorship complies with the international ICMJE criteria (all authors have made a significant contribution to the development of the concept, research, and preparation of the article, as well as read and approved the final version before its publication).
Ethics approval. All patients signed an informed voluntary consent to participate in the study. The approval of the ethics committee for the study was not received due to the lack of additional interventions for patients other than those required under the treatment plan in accordance with clinical recommendations.
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ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. В.А. Маринин — концепция и дизайн исследования, проведение практической части исследования, сбор данных; А.В. Сотников — концепция и дизайн исследования, сбор и обработка материалов, написание текста; В.В. Степанова — проведение практической части исследования, сбор материалов; М.А. Савельева — написание текста, анализ полученных данных; И.Л. Уразовская — анализ полученных данных, обзор литературы. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.
Этическая экспертиза. Все пациенты подписали информированное добровольное согласие на участие в исследовании. Одобрение этического комитета на проведение исследования не получали в связи с отсутствием дополнительных вмешательств в отношении пациентов, помимо необходимых в рамках плана лечения в соответствии с клиническими рекомендациями.
Конфликт интересов. Авторы заявляют об отсутствии потенциального конфликта интересов, требующего раскрытия в данной статье.
Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при написании статьи.

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