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RADIOFREQUENCY ABLATION OF THE PULMONARY VEINS USING A SINGLE-CATHETER METHOD IS AS EFFECTIVE AS THE TRADITIONAL APPROACH IN THE TREATMENT OF PAROXYSMAL ATRIAL FIBRILLATION

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Aim. To conduct a comparative analysis of the efficacy and safety of radiofrequency ablation (RFA) of pulmonary vein (PV) in patients with paroxysmal atrial fibrillation (AF) using a single-catheter method (experimental group) versus the standard technique with a multipolar diagnostic Lasso catheter (Biosense Webster, Johnson & Johnson, USA) (control group).

Methods. A single-center prospective randomized study included 206 patients with paroxysmal AF, randomized into two groups: single-catheter (n=103) and control (n=103). All procedures utilized the CARTO 3 (Biosense Webster, Johnson & Johnson, USA) 3D electroanatomical mapping system, and PV isolation was performed according to the CLOSE protocol based on the ablation index. In the experimental group, only a navigated ablation catheter was used for mapping and ablation, with verification of conduction block (entrance and exit) via stimulation from the ablation electrode. The control group underwent the standard approach with a circular diagnostic Lasso catheter. The primary endpoint was the absence of atrial arrhythmias (AF/atrial flutter) after 12 months of follow-up.

Results. Procedure efficacy after a median follow-up of 400 days was 83.5% (86/103 patients) in the single-catheter group and 78.7% (81/103) in the control group. The difference between groups was not statistically significant (OR 1.298; 95% CI 0.649-2.595; p=0.354). Kaplan-Meier analysis also revealed no significant differences (log-rank test, p=0.405). The first-pass PV isolation rate was comparable between groups (94.2% vs. 93.2%, p=0.874). The total procedure time was statistically significantly shorter in the single-catheter group (65.3±20.0 min vs. 82.2±13.0 min, p=0.011), while fluoroscopy time and RFA duration did not differ significantly. Three periprocedural complications were recorded (1 in the experimental and 2 in the control group), all of them were managed successfully.

Conclusion. Radiofrequency ablation of pulmonary veins using a single-catheter method is not inferior in efficacy to the standard approach utilizing a circular Lasso catheter in patients with paroxysmal atrial fibrillation.

Key words: atrial fibrillation; paroxysmal form atrial fibrillation; radiofrequency ablation; single-catheter method; circular catheter

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After M. Haïssaguerre and colleagues demonstrated in 1998 the key role of trigger activity from the myocardial sleeves of the pulmonary veins (PVs) in initiating atrial fibrillation (AF), catheter ablation of the PV ostia became established as the standard interventional strategy for treating this arrhythmia [1, 2].

The classical radiofrequency ablation (RFA) technique involves a double transseptal puncture and the use of a circular diagnostic Lasso catheter for realtime monitoring of PV electrical isolation. In the early stages of its application, this technique achieved clinically acceptable efficacy outcomes [3].

However, with technological advances, including the introduction of catheters with contactforce sensing and lesiondepth assessment based on calculated indices (such as ablation index - AI, contact force index - CFI), ablation efficacy has significantly improved [4]. An important milestone was the introduction in 2017 of the CLOSE protocol (Ditschaever et al.), which allows PV isolation with the first series of applications in more than 95% of cases [5].

Consequently, the use of multipolar diagnostic catheters in primary PV isolation using modern RFA technologies is no longer considered mandatory. Although these catheters retain their clinical value in treating complex atrial tachyarrhythmias and in repeat procedures, their routine use during the first PV isolation procedure may be unnecessary [6]. Avoiding a double transseptal puncture may make the procedure technically simpler and reduce its cost [7].

A number of studies demonstrate high efficacy of the singlecatheter technique in RFA in patients with various

forms of AF [6, 8]. However, the question of whether the omission of multipolar diagnostic catheters may reduce the overall procedure efficacy remains debatable.

Aim - to conduct a comparative analysis of the efficacy of RFA of the PV ostia using two approaches: the single-catheter technique (experimental group) and the standard technique with a multipolar Lasso catheter (control group) in patients with paroxysmal AF.

MATERIAL AND METHODS

Study design: singlecentre, prospective, randomised controlled trial. Patient enrolment was conducted from January 2023 to February 2024. During this period, a total of 578 interventional AF procedures were performed. From these, 234 patients meeting the established criteria were selected for participation in the study. The work was carried out after approval from the local ethics committee (permission No. 115 dated 12.01.2023).

Inclusion and exclusion criteria

The study enrolled firstprocedure patients aged 40-75 years with symptomatic paroxysmal AF (paroxysm duration up to 7 days) who had documented inefficacy or intolerance to class IC or III antiarrhythmic drugs [9]. A mandatory requirement was the ability to undergo postoperative followup.

Exclusion criteria were: nonparoxysmal AF, combined AF and atrial flutter, haemodynamically significant valvular pathology (valvular stenosis or regurgitation > grade I), left atrial (LA) diameter >55 mm, and left ventricular ejection fraction <45%.

After signing informed consent, patients were randomised using a random number generator into two groups. In the experimental group (n=115), PV ostial isolation was performed using only an ablation catheter. In the control group (n=119), the procedure was performed with the additional use of a circular diagnostic Lasso catheter (Biosense Webster, Johnson & Johnson, USA). Due to the inability to undergo subsequent followup, 28 patients (12 and 16 from each group) were excluded from the analysis. Thus, data from 206 patients, equally divided between the groups, were available for efficacy assessment at the end of the study (Fig. 1). Baseline clinical and demographic parameters did not differ significantly between the groups (Table 1).

The procedural technique is described in detail in a previously published article [10]. Two different mapping techniques were used in the study. In the group of patients undergoing ablation with the singlecatheter technique, anatomical reconstruction of the LA was performed using the CARTO 3 threedimensional electroanatomical mapping system (Biosense Webster, Johnson & Johnson, USA). For this purpose, a navigational EZ Steer Nav SmartTouch ablation catheter (Biosense Webster, Johnson & Johnson, USA) was used. Access to the LA was achieved via a single transseptal puncture. In the second group, also after a single transseptal puncture, a 20pole navigational diagnostic Lasso catheter (Biosense Webster, Johnson & Johnson, USA) was used to construct the LA map. After mapping was completed, the Lasso catheter was exchanged for an ablation catheter, PV ostial isolation was performed, and the ablation catheter was again exchanged for the Lasso catheter to verify conduction block. Thus, in the first group, no instrument exchange was performed; in the second group, it was performed twice.

In patients who presented with AF either initially or intraoperatively, electrical cardioversion was performed after radiofrequency applications around the right and left

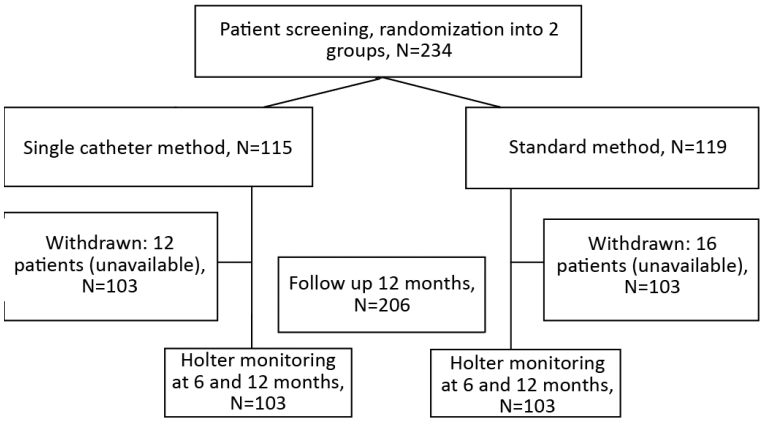

Fig. 1. Research design.

Table 1.

Baseline characteristics of the patient groups

	All patients (n=206)	Single catheter method (n=103)	Standard method (n=103)	p
Age, years	60.8±8.5	61.5±8.5	60.2±8.4	0.260
Male sex, n (%)	108 (52.4%)	48 (46.6%)	54 (52.4%)	0.406
Body mass index, kg/m²	29.6±4.1	29.4±3.7	29.8±4.5	0.419
Left ventricular ejection fraction, %	62.1±6.0	61.8±5.9	62.4±6.1	0.494
Left atrial volume, mL	70.3±16.2	70.2±15.3	70.3±17.2	0.942
Left atrial diameter, mm	39.9±3.7	39.9±3.7	39.8±3.6	0.791
Arrhythmia history duration, months	48 [24;72]	49 [23;70]	47 [24;73]	0.887
Diabetes mellitus, n (%)	25 (12.1)	12 (11.7)	13 (12.6)	0.832
Hypertension, n (%)	177 (85.9)	88 (85.4)	89 (86.4)	0.842
Coronary artery disease, n (%)	18 (8.7)	11 (10.7)	7 (6.8)	0.094

Note: p - significance of differences between single catheter and standard method groups.

PV ostia. Verification of PV electrical isolation was carried out after restoration of sinus rhythm.

In the first group, the criterion for achieving entrance block into the PV was the disappearance of spike electrical activity recorded on the ablation catheter electrograms. Exit block was confirmed by the absence of LA myocardial capture in response to stimulation from the ablation electrode (stimulation parameters: current 10 mA, pulse duration 1 ms). Stimulation was performed at eight equidistant points along the perimeter of the ablation line, provided that catheter-tissue contact force was at least 4 grams (Fig. 2, 3).

In the second group, a diagnostic 20pole navigational Lasso catheter, sequentially positioned at the ostium of each PV, was used to verify PV isolation. Entrance block was confirmed by the disappearance of PV spikes on the electrograms. Exit block was verified by stimulation from each pair of Lasso catheter electrodes using parameters identical to those in the first group. Exit block was defined as the absence of LA myocardial capture upon stimulation, or the presence of local LA myocardial captures without conduction to the atrium [10]. If PV isolation was not achieved after the first series of applications, additional RFA applications were delivered until complete electrical PV isolation was attained.

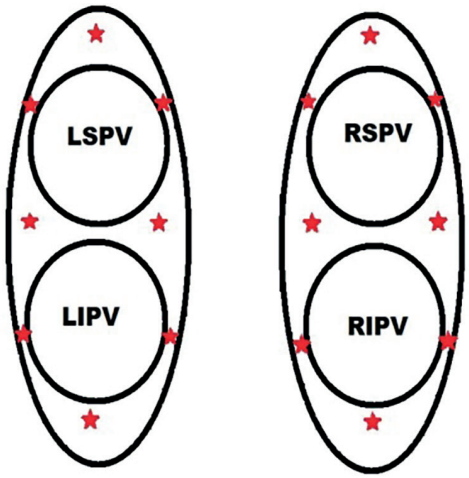

Fig. 2. Schematic representation of stimulation sites from the ablation electrode (marked with stars). RSPV - right superior pulmonary vein; RIPV - right inferior pulmonary vein; LSPV - left superior pulmonary vein; LIPV - left inferior pulmonary vein.

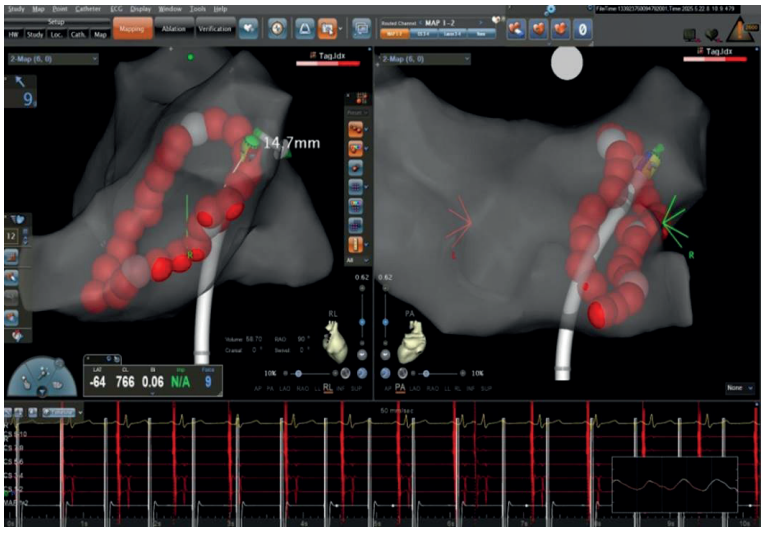

Fig. 3. Exit block verification from the right superior pulmonary vein using the ablation electrode positioned behind the ablation line. Stimulation is delivered from the distal pair of electrodes; absence of atrial myocardial capture indicates vein isolation.

Three complications were recorded during the study. In the first group, intraoperative haemopericardium developed and was successfully managed by pericardial drainage. In the second group, in the early postoperative period, hydropericardium with pericardial separation of up to 6 mm, which resolved with conservative therapy, and an arteriovenous fistula between the superficial femoral artery and common femoral vein located 20 mm from the common femoral artery bifurcation (as detected by computed tomography), which was also managed conservatively (by compression), were identified.

For 4 weeks after the RFA procedure, all patients continued antiarrhythmic therapy. The decision to discontinue it was made by the attending physician at the place of residence. Anticoagulant therapy was continued in all patients, regardless of the procedure's efficacy.

Postprocedural followup was organised using a combined scheme that included both inperson and remote visits. Local patients underwent scheduled inperson examinations at the outpatient department, which included clinical assessment and 24hour Holter ECG monitoring. For patients residing in remote regions, remote followup was used: at 6 and 12 months after the procedure, they provided medical documentation with a description of symptoms and Holter ECG results.

Arrhythmia recurrence was defined as any documented episode of AF or atrial tachycardia lasting >30 seconds on ECG or Holter monitoring. When recurrence was detected, the possibility of a repeat intervention was considered. The primary endpoint of the study was the absence of atrial arrhythmias at the end of the followup period.

Statistical analysis

Sample size calculation was performed for the primary endpoint. The noninferiority margin (Δ) was set at 15%. The calculation was based on the assumption that the true efficacy in both groups was identical and approximately 80%. With a twosided significance level (α) of 5% and power (1β) of 85%, to confirm that the singlecatheter method was noninferior to the standard method, the required number of patients in each group was 105. To account for possible dropout (~10%), the total sample size was increased to 236 patients.

Normality of distribution of quantitative variables was assessed using the Kolmogorov-Smirnov test. Variables with normal distribution are presented as mean and standard deviation (M±SD) with 95% confidence intervals (95% CI). Nonnormally distributed data are presented as median and interquartile range Me [Q1; Q3].

Comparison of two independent groups with normal distribution was performed using Student's ttest. For nonnormally distributed variables, the nonparametric Mann-Whitney

Utest was used. Cumulative probability of freedom from arrhythmia recurrence during followup was assessed using Kaplan-Meier curves. Survival curves were compared using the twosided logrank test. The critical level of statistical significance was set at 0.05.

RESULTS

The proportion of procedures performed in sinus rhythm was comparable between the groups. In the singlecatheter group, 86.4% (n=89) of patients were operated on in sinus rhythm and 13.6% (n=14) in AF. In the standard group, the corresponding proportions were 83.5% (n=86) and 16.5% (n=17). The difference was not statistically significant (p=0.453).

The proportion of patients with successful firstpass PV isolation also did not differ between groups: 94.2% (n=97) in the experimental group vs. 93.2% (n=96) in the control group (p=0.874). Complete electrical isolation of all PV ostia was achieved by the end of the procedure in 100% of patients in both groups.

Total procedure time was significantly longer in the standard group than in the singlecatheter group (82.2±13.0 min vs. 65.3±20.0 min, p=0.011). Meanwhile, fluoroscopy time and RFA duration did not differ significantly between the groups (Table 2).

The median followup duration was 400 [209.8; 400.0] days. During the study, inperson followup was conducted for 112 patients (54.4%), and remote followup for 94 patients (45.6%). Treatment efficacy did not differ statistically between the inperson and remote groups (79.5% vs. 82.3%, p=0.621).

Overall treatment efficacy in the entire cohort was 81.1% (167 of 206 patients). In the first group, sinus rhythm was maintained at the end of followup in 83.5% of patients (86 of 103), and in the second group in 78.7% (81 of 103). The difference between groups did not reach statistical significance (OR 1.298; 95% CI 0.649-2.595; p=0.354). Kaplan-Meier survival analysis also showed no statistically significant differences between groups (logrank test, p=0.405) (Fig. 4).

Among patients with documented arrhythmia recurrence (n=39), repeat catheter ablation was performed in 11 patients from the first group and 14 from the second. Refusal of reintervention due to mild symptoms was recorded in 4 and 5 patients, respectively. Medical contraindications to repeat procedure were identified in 2 patients in the first group (erosive gastritis and manifestation of thyrotoxicosis) and 3 patients in the second group (thyrotoxicosis in two cases and exacerbation of gastric ulcer in one). In all cases of thyrotoxicosis, patients were not taking amiodarone.

During repeat procedures, conduction recovery was documented in at least one PV in all patients. The total number of veins with recovered conduction was 19 in the first group and 23 in the second, which did not differ statistically (p=0.612).

DISCUSSION

The results of this prospective randomised study are consistent with published data emphasising the feasibility and efficacy of simplified catheter ablation protocols.

One of the first studies to directly compare the efficacy of standard and singlecatheter RFA techniques in paroxysmal AF was that by Sebag et al. [7]. That study included 100 patients divided into two groups of 50. Safety and efficacy, as well as procedure cost, were compared between the standard and singlecatheter approaches. At oneyear followup, sinus rhythm was maintained in 86% of patients in the experimental group and 84% in the control group. The difference was not statistically significant. At the same time, the cost of the singlecatheter procedure was 31% lower than the standard technique. Thus, avoidance of the diagnostic circular Lasso catheter allowed a significant reduction in procedure cost without compromising efficacy.

Another study comparing singlecatheter and standard RFA techniques for PV isolation was that by Xhaet et al. [11]. The retrospective analysis included a cohort of 477 patients who underwent PV RFA for paroxysmal AF. Patients were divided into a standardtechnique group (n=226) and a singlecatheter group (n=251). Primary endpoints were success of PV isolation, AF recurrence rate at oneyear followup, total procedure duration, and fluoroscopy time. No statistically significant differences were found between groups in the number of isolated PVs, AF recurrence rate, or need for antiarrhythmic therapy at one year. However, the singlecatheter group showed a significant reduction in total procedure time (106±33 min vs. 125±32 min, p<0.0001) and fluoroscopy time (2.2±1.9 min vs. 2.7±2.3 min, p=0.0002).

Thus, an important practical conclusion of that study is the confirmation that the singlecatheter technique significantly reduces procedure duration and radiation exposure, suggesting a potential reduction in radiation burden

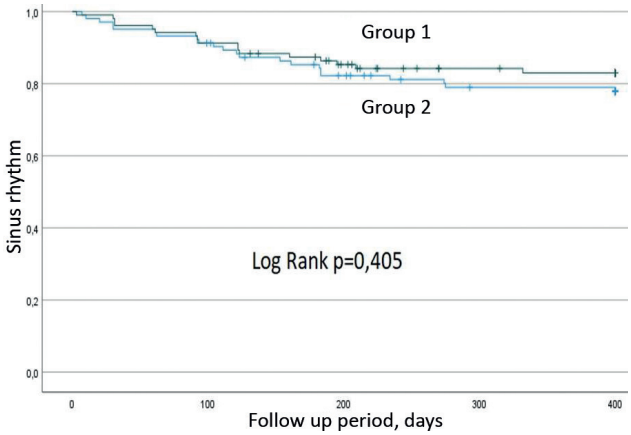

Fig. 4. Treatment efficacy in the first (single catheter method) and second (standard technique) patient groups.

Table 2.

Procedural characteristics (n=206)

	Single catheter method (n=103)	Standard method (n=103)	p
Total procedure time, min	65,3±20,0	82,2±13,0	0,011
Fluoroscopy time, s	93,1±34,3	112,5±28,6	0,083
RFA duration, min	14,9±4,0	15,7±4,9	0,271

Note: RFA - radiofrequency ablation.

for both patient and operator, as well as more efficient use of operating room resources. Despite differences in study design, their results are highly consistent with our data.

In a retrospective study by Badertscher et al., the efficacy of the singlecatheter method was evaluated using both standard ablation protocols and highpower, shortduration protocols [8]. All RFA procedures were performed through a single transseptal access using only an ablation catheter; multipolar diagnostic catheters were not used. In a cohort of 91 patients undergoing ablation for paroxysmal AF, high efficacy was demonstrated, with a success rate of 87% at 12month followup. Importantly, that study, like ours, used intraoperative criteria for conduction block verification (stimulation for exit block testing), which enhances the comparability of results. The similar efficacy rates (87% vs. 81.1% in our study) indicate the reproducibility and reliability of the singlecatheter approach when using modern technologies such as contactforce sensing and ablation index.

Another important aspect addressed in the study by Badertscher et al. is safety. In our study, three periprocedural complications were recorded: one in the singlecatheter group (haemopericardium) and two in the standard group (hydropericardium and arteriovenous fistula). Although the number of events is insufficient for statistical inference, the overall trend is consistent with the literature suggesting that procedural simplification may reduce risks. Badertscher et al. reported no serious procedurerelated complications in their cohort, also supporting the safety of the technique. Reducing the number of transseptal accesses from two to one lowers the risks of complications such as puncturerelated pericardial effusion and vascular accesssite complications.

In the study by Pedro Silva Cunha et al., the efficacy and safety of PV isolation using a single transseptal puncture and the standard technique were compared [12]. A retrospective analysis of a relatively large cohort of patients undergoing RFA PV isolation for paroxysmal AF was performed. From July 2015 to March 2020, 285 patients with a mean age of 59.5±11.6 years (36.5% women, 67.7%) underwent RFA of PV ostia. The mean CHA_2DS_2VASc score was 1.7±1.3. In 115 patients (40.3%), the procedure was performed using a single transseptal puncture; in 170 (59.6%), the standard technique was used. Operator experience (5 years of AF ablation procedures) was evenly distributed between the two groups. A significant reduction in fluoroscopy time was noted (13±6.3 min vs. 19±9.1 min for single vs. double transseptal puncture, respectively; $p<0.001$). The rate of acute major complications was similar in both groups (2.6% vs. 2.3%, p=0.799). At 2 years, the rate of sinus rhythm maintenance was similar (76.5% vs. 78.8%, p=0.646). Thus, the authors concluded that the simplified PV isolation technique using a single transseptal access is a safe and highly effective AF ablation method. This approach significantly reduced fluoroscopy time compared with the traditional technique, with a comparable safety profile.

Furthermore, the use of only one catheter in the LA cavity potentially reduces the risk of cerebral embolism by eliminating instrument exchanges during the procedure [13].

In our study, exit block verification in the singlecatheter group was performed using stimulation from the ablation electrode. This method proved reliable, as confirmed by comparable efficacy in the control and experimental groups and the absence of differences in the number of reconnections at repeat procedures. Nevertheless, it should be acknowledged that the use of a specialised diagnostic catheter may be appropriate in cases with complex anatomy. However, as our results and data from other studies show, for most patients with paroxysmal AF, the use of an ablation catheter alone is sufficient to achieve favourable longterm outcomes.

One practical advantage of the singlecatheter technique was a statistically significant reduction in total procedure time (65.3±20.0 min vs. 82.2±13.0 min, p=0.011). This has important clinical and economic implications. Shorter procedure time potentially reduces the risk of infectious complications, decreases the burden on the operating team, and enables more efficient use of operating room resources. At the same time, fluoroscopy time and actual ablation time did not differ significantly between groups, indicating comparable technical complexity of the isolation line creation and no compromise in the thoroughness of ablation.

Several limitations of our study should be noted. First, it is a singlecentre design. Second, part of the followup was conducted remotely based on submitted medical documentation, which may have led to underdetection of asymptomatic recurrences. However, the proportion of patients with remote followup and the recurrence rate in this subgroup did not differ between groups, minimising potential systematic bias. Third, the study included patients with relatively preserved atrial anatomy (no significant LA dilatation); therefore, extrapolation of the results to patients with more complex AF forms and altered anatomy requires caution.

CONCLUSION

This study demonstrates that radiofrequency ablation of the PVs using a singlecatheter method is noninferior to the traditional approach in terms of efficacy in patients with paroxysmal AF.

REFERENCES

1. Haïssaguerre M, Jaïs P, Shah DC, et al. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. *N Engl J Med.* 1998;339(10): 659-66. https://doi.org/10.1056/NEJM199809033391003.

2. Van Gelder IC, Rienstra M, Bunting KV, et al. 2024 ESC Guidelines for the management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J.* 2024;45(36): 3314-3414. https://doi.org/10.1093/eurheartj/ehae176.

3. Oral H, Knight BP, Tada H, et al. Pulmonary vein isolation for paroxysmal and persistent atrial fibrillation. *Circulation.* 2002;105(9): 1077-81. https://doi.org/10.1161/hc0902.104712.

4. Shurrab M, Di Biase L, Briceno DF, et al. Impact of Contact Force Technology on Atrial Fibrillation Ablation:

A Meta-Analysis. *J Am Heart Assoc.* 2015;4(9): e002476. https://doi.org/10.1161/JAHA.115.002476.
5. Phlips T, Taghji P, El Haddad M, et al. Improving procedural and one-year outcome after contact force-guided pulmonary vein isolation: the role of interlesion distance, ablation index, and contact force variability in the 'CLOSE'-protocol. *Europace.* 2018;20(FI_3): f419-27. https://doi.org/10.1093/europace/eux376.
6. Chin SH, O'Brien J, Epicoco G, et al. The feasibility and effectiveness of a streamlined single-catheter approach for radiofrequency atrial fibrillation ablation. *J Arrhythm.* 2020;36(4): 685-91. https://doi.org/10.1002/joa3.12390.
7. Sebag FA, Simeon E, Miled M, et al. Contact-force guided single-catheter approach for pulmonary vein isolation: Feasibility, outcomes, and cost-effectiveness. *Heart Rhythm.* 2017;14(3): 331-8. https://doi.org/10.1016/j.hrthm.2016.12.008.
8. Badertscher P, Knecht S, Spies F, et al. High-power short-duration ablation index-guided pulmonary vein isolation protocol using a single catheter. *J Interv Card Electrophysiol.* 2022;65(3): 633-42. https://doi.org/10.1007/s10840-022-01226-9.
9. Tzeis S, Gerstenfeld EP, Kalman JM, et al. 2024 European Heart Rhythm Association/Heart Rhythm Society/Asia Pacific Heart Rhythm Society/Latin American Heart Rhythm Society expert consensus statement on catheter and surgical ablation of atrial fibrillation. *Europace.* 2024;26(4): euae043. https://doi.org/10.1093/europace/euae043.
10. Bazylev VV, Kozlov AV, Durmanov SS. The presence of local captures of the myocardium of the pulmonary veins after radiofrequency isolation improves the outcome of treatment in patients with paroxysmal atrial fibrillation. *Journal of Arrhythmology*. 2023;30(4): 5-12. (In Russ.). https://doi.org/10.35336/VA-1186.
11. Xhaet O, Deceuninck O, Robaye B, et al. A circular mapping catheter is not mandatory for isolating pulmonary veins during paroxysmal atrial fibrillation ablation with radiofrequency. *J Interv Card Electrophysiol.* 2021 Nov 1;62: 1-8. https://doi.org/ 10.1007/s10840-020-00895-8.
12. Silva Cunha P, Lacerda Teixeira B, Laranjo S, et al. A simplified single transseptal puncture approach using high-density 3D voltage mapping for atrial fibrillation ablation: acute complications and long-term results. *Front Cardiovasc Med.* 2023;10: 1309900. https://doi.org/10.3389/fcvm.2023.1309900.
13. Deneke T, Nentwich K, Schmitt R, et al. Exchanging Catheters Over a Single Transseptal Sheath During Left Atrial Ablation is Associated with a Higher Risk for Silent Cerebral Events. *Indian Pacing Electrophysiol J.* 2014;14(5): 240-9. https://doi.org/10.1016/S0972-6292(16)30795-1.