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Case report

Catheter ablation for atrial fibrillation- therapeutic dilemmas

Milan M. Marinković[1], Nebojša M. Mujović[1,2], Nebojša S. Marković[1]

[1]Cardiology Clinic, Clinical Center of Serbia, Koste Todorovića 8, Belgrade 11000, Serbia, [2]Faculty of Medicine, University of Belgrade, Dr Subotića 8, Belgrade 11000, Serbia

Atrial fibrillation (AF) is a cardiac rhythm abnormality most commonly encountered in clinical practice. The presence of AF is linked to a higher mortality and morbidity rate. Treatment for patients with AF primarily focuses on reducing the symptoms (rhythm and frequency control) and preventing thromboembolism. Numerous studies have not indicated a reduction in patient mortality in case of rhythm control strategy application, while a large number of patients in whom the frequency control strategy had been applied, displayed severe symptoms, despite adequate control of ventricular response. For patients suffering from AF three modalities of treatment are available: antiarrhythmic treatment, catheter ablation and a surgical procedure. Bearing in mind that rhythm control drugs have shown limited efficiency, a case of a patient with paroxysmal atrial fibrillation, treated with catheter ablation, has been described in this paper[1-3].

At the Cardiology Clinic of the Clinical Center of Serbia, a sixty-six-year-old man was treated for AF paroxysms occurring every two months, which were accompanied by chest discomfort, feeling of accelerated heart rhythm, labored breathing, and, on several occasions, vertigo. Prevention of arrhythmia was attempted with the application of propafenone, which proved ineffective. In fact, during treatment with this drug, an episode of typical atrial flutter (AFL) occurred, with a rapid ventricular response complicated by the development of transient tachycardiomyopathy. Consequently, prevention of AF paroxysms was continued with amiodarone. Later, amiodarone treatment was discontinued due to the fact that the patient was experiencing nightmares. Three years previously, due to an AFL episode, ablation of the cavotricuspid isthmus (CTI) had been performed.

The patient was admitted to the Cardiology Clinic with almost daily AF paroxysms, lasting from 20 minutes to 24 hours. The echocardiogram discovered an enlarged left atrium (LA), measuring 45x76x46 mm, and a preserved left ventricular systolic function. 24 hours ECG Holter Monitoring, prior to the procedure, had registered persistent atrial fibrillation, of 92/min. average frequency. Before the procedure, a CT angiography of the LA and pulmonary veins (PV) had been performed, revealing normal anatomical characteristics of these structures. For a period of at least six weeks prior to the procedure INR had been within the therapeutic range[2-3]. Upon hospital admission the patient was switched to low-molecular-weight heparin (LMWH), which was not administered on the day of the procedure. The procedure was performed under general intravenous analgosedation.

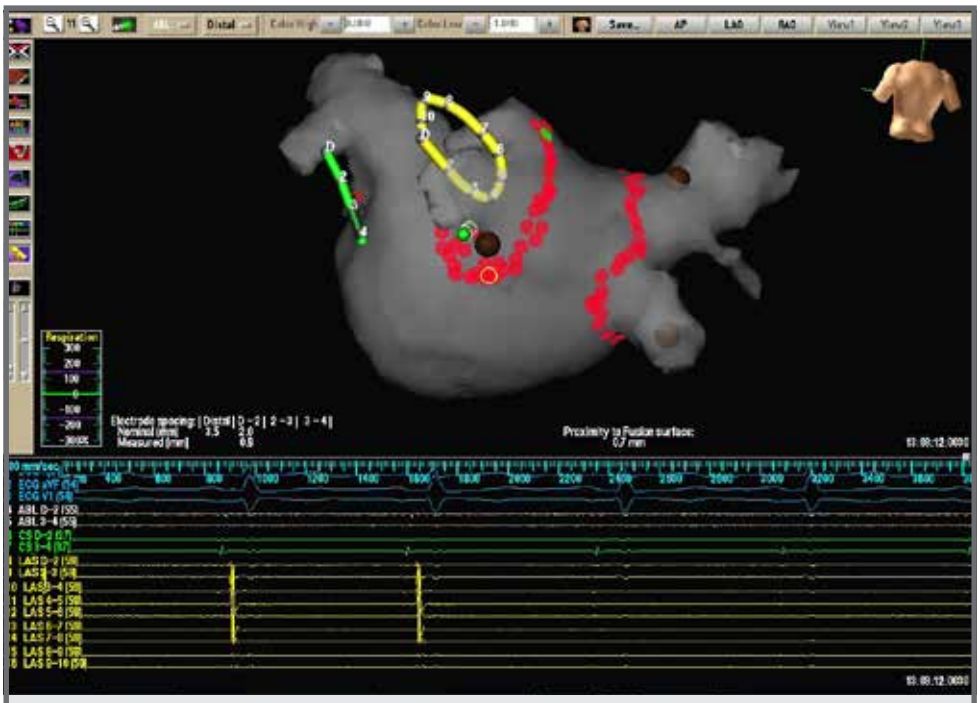

Image 1. The image shows LP reconstruction and, in red dots, places of RF ablation around the PV. The brown spot shows the site of electrical isolation of the left PVs, as visible on the intracardial electrocardiogram in the lower half of the image (disappearance of yellow signals on the circular mapping catheter).

With access via the right femoral vein, transseptal puncture was performed under control of fluoroscopy, while the ablation itself was navigated with the use of a 3D electroanatomical mapping system (Ensite NaVX, St Jude) whereby the cavities of the LA and the PV were reconstructed. The signals were registered, recorded and analyzed on the standard EP system (Work Mate, St Jude). During the entire procedure unfractionated heparin was administered, maintaining the ACT within the 300-350 seconds range. A circular catheter for mapping electrical signals within the pulmonary veins (PV) was positioned, during ablation, on the ostio-antral segment of each PV. With the application of radiofrequency (RF) energy circumferential antral ablation around paired ipsilateral veins was performed, while PV isolation was proven by absence of electrical activity in the veins, which was registered on the circular mapping catheter as well as by appropriate pacing maneuvers (Image 1). In the our EP lab at the Cardiology Clinic the endpoint of the ablation of AF lasting less than 48h is the isolation of all PVs. After an observation period lasting 30 minutes upon isolation of the last PV, it was established that electrical PV isolation was being maintained, while revision of conduction through the CTI confirmed that the bidirectional CTI block was being maintained (previous procedure). The procedure was carried out without complications, therapy with LMWH was continued the same evening, while the following day warfarin was reintroduced, overlapping with LMWH until the achievement of therapeutic INR. Propafenone was continued after the procedure in a blanking period of three months, upon which treatment with this drug was discontinued. Anticoagulant therapy (CHADS2VASc=1) was also, withdrawn three months after the procedure. During follow up period of 20 months there were no symptomatic recurrences of tachyarrhythmia, which was also confirmed with 24-hour Holter ECG Monitoring after one, three, six, twelve and eighteen months after the procedure.

Discussion and reference literature overview

Ablation of paroxysmal AF is a schematic procedure. For each patient, the basis of the procedure is to create a permanent block on the ablation line around the PVs, with the purpose of electrical isolation of the PVs, thus preventing the propagation of electrical potentials from the PV to the LA and AF initiation, since, as it has been established earlier, in these patients, arrhythmia triggers are located in the PVs[4].

The Clinical Practice Guidelines of the European Society of Cardiology and the European Heart Rhythm Association (EHRA) clearly outline the recommended AF ablation strategy, in case of either paroxysmal or persistent form of arrhythmia, this being only PV isolation. On the other hand, the guidelines of the American Heart Association (AHA), American College of Cardiology (ACC) and the American Heart Rhythm Society (HRS) have not clearly defined the strategy of RF ablation. Today, additional strategies are available, and are aimed at increasing the overall success of the procedure, both for paroxysmal AF (left atrial roof linear ablation, additional left atrial ganglionated plexi ablation, ablation of extravenous foci), as well as for persistent AF (linear left atrial ablation, additional ablation of complex fractionated atrial electrocardiograms- CFAE in the left or right atrium, posterior box lesion set, stepwise ablation approach)[1,3,5].

Catheter ablation is efficient both in short and long-term AF control. However, the differences in ablation techniques and technologies, the different definitions of success and recurrence of arrhythmia, as well as the differences and limitations of clinical follow-up upon the procedure, make it difficult to establish the real result, which is why the significant differences in reported outcomes come as no surprise[3,4,6-11].

The success of catheter ablation of paroxysmal AF is within the 60% - 80% range. Early recurrences of atrial tachyarrhythmia in the first three months (so called blanking period) are frequent (30 – 50%) and can be the result of transient inflammation of the atrial tissue and the immaturity of the ablative lesion, and can therefore be prevented with antiarrhythmic and anti-inflammatory drugs and can gradually spontaneously disappear in 40% – 60% of patients, which is why the final outcome of the procedure is assessed only after this early postoperative period has elapsed. Late recurrences occur in 10% of patients, between the first and the second year of follow-up. Data on long-term outcome after AF ablation are still scarce and limited to the follow-up period of between three and five years[3,4,6-13].

Randomized controlled studies have not succeeded in demonstrating the benefit of a sinus rhythm maintained with antiarrhythmic medication. Namely, both pharmacological strategies, rhythm control and frequency control, have demonstrated a comparable mortality rate and stroke in patients with AF. Subsequent subanalysis has, however, shown that the maintenance of the sinus rhythm is connected with an increase in survival by 47% in comparison with AF, and that the application of antiarrhythmic drugs increases mortality by 49%, whereby the advantage of sinus rhythm maintenance over AF is annulled by the adverse effects of antiarrhythmic drugs. Catheter ablation of AF provides the possibility of maintaining sinus rhythm without the application of medication therapy in a significant proportion of the selected patients with AF[14-17].

Randomized studies have shown that catheter ablation for AF is more efficient in maintaining sinus rhythm in comparison with antiarrhythmic therapy (Table 1). Seven studies analyzed the efficiency of ablation and antiarrhythmic therapy in patients with AF, refractory to at least one class Ic or class III antiarrhythmic drug[18-24]. Prevention of atrial tachyarrhythmia episodes was registered more frequently in groups of patients subjected to catheter ablation than in the groups of patients undergoing medication therapy (74% vs. 25%). These studies mostly included patients with paroxysmal AF. The success of ablation was 63% - 85%, after the first procedure, and 85% - 89%, after repeated procedures. On the other hand, in patients with paroxysmal AF, already refractory to pharmacological therapy, success in

Table 1. Randomized studies comparing antiarrhythmic drugs and catheter ablation in treatment of atrial fibrillation.

Year	№ pts	Age (years)	Study design	AF type	SHD	LA (mm)	Ablation strategy	AAD strategy	Follow-up (months)	Ablation results			AAD results		
										Freedom of AF	Cross-over to AADs	Adverse events	Freedom of AF	Cross-over to ablation	Adverse events
2006 [18]	137	62	AF refractory to ≥1 AAD: ablation+AAD vs. „new" AAD	67% PAF	63%	≈45	RF, 8 mm or irrigated-tip, EAM-CPVA (± lines)	62% amiodarone 26% flecainide 10% propafenone 6% sotalol 1% disopyramide	12	56%	-	4% (1 CVI, 1 tamponade, 1 phrenic nerve palsy)	9%	57%	3% (1 SCD, 1 TIA)
2006 [19]	146	57	PeAF>6 m: amiodarone vs. ablation	100% PeAF	8%	45	RF, 8 mm, EAM-CPVA (± lines)	100% amiodarone (first 3 months)	12	74%	1%	-	4%	77%	-
2008 [20]	112	51	PAF refractory to ≥1 AAD: ablation vs. „new" AAD	100% PAF	26%	40	RF, irrigated-tip, PVI (± non PV triggers)	83% Class I 76% Class III (59% amiodarone)	12	89% (1.8 procedures/ pt.)	9%	3% (155 procedures: 2 tamponades, 2 hematomas, 1 PV stenosis)	23%	63%	2% (1 hypothyreosis) + 2 unrelated deaths
2009 [21]	70	≈64	AF refractory to ≥AAD: ablation vs. „new" AAD	41% PAF	50%	45	RF, irrigated-tip, EAM-PVAI (± lines)	77% Class IC 63% amiodarone 9% sotalol	12	80%	-	3% (1 hematoma)	43%	-	17% (5 bradycardias, 1 AFL)
2010 [22]	167	56	PAF refractory to ≥1 AAD: ablation+AAD vs. „new" AAD	100% PAF	11%	40	RF, irrigated-tip EAM-PVAI (± lines or CFAE)	41% propafenone 36% flecainide 20% sotalol 4% dofetilide	9	63%	7%	5% (2 CHF, 1 pericardial effusion, 1 vascular complications, 1 pneumonia)	17%	76%	9% (2 proarrhythmia, 3 intolerance)
2006 [23]	198	56	PAF refractory to ≥1 AAD: ablation vs. „new" AAD	100% PAF	≈6%	≈39	RF, 8 mm or irrigated-tip, EAM-CPVA (± lines)	33% flecainide 33% sotalol 33% amiodarone	48	72%	-	5% (3 AT, 1 pericardial effusion, 1 TIA)	12%	88%	68% (19 hyperthyreosis, 15 bradycardia, 11 sexual dysfunction, 10 wide QRS, 2 visual and dermatological events, 1 hepatitis)
2013 [24]	146	55	PeAF (<1 year) refractory to ≥1 AAD: ablation vs. AAD	100% PeAF	≈3%	≈42	RF, irrigated-tip, EAM-PVAI (± lines or CFAE)	44% Class IC (flecainide) 56% Class III (amiodarone)	12	60% (8% redo)	36%	6% (2 pericarditis, 1 pericardial effusion, 3 vascular complications)	29%	0% (48%)	2% (1 intoxication with flecainide)

Abbreviations:
AAD – antiarrhythmic drug, PAF – paroxysmal atrial fibrillation, PeAF – persistent atrial fibrillation, EAM – electroanatomical mapping, CPVA=circumferential pulmonary vein ablation; SCD=sudden cardiac death; TIA=transitory ischemic attack; CHF=congestive heart failure; AT=atrial tachycardia; AFL=atrial flutter.

maintaining sinus rhythm by change in antiarrhythmic therapy was only 9% – 21%[18,20,22,23]. Therefore, the superiority of catheter ablation of AF in comparison with pharmacological treatment is most evident in patients with paroxysmal AF and previous failure of antiarrhythmic therapy.

AF is linked to a higher mortality and risk of stroke. It is, therefore, expected that the superiority of a non-pharmacological method offering a possibility of AF cure, in comparison with potentially dangerous medication therapy, may reflect a reduction in the mortality rate and systemic thromboembolism. However, meta-analysis of 8 randomized studies has not yielded significant differences either in the mortality rate or the rate of adverse cerebrovascular events between patients treated with catheter ablation (486 patients) and those treated with antiarrhythmic medication (444 patients). The average age of the patients was 51 to 64 years, with a low prevalence of structural heart diseases (4% - 24%). A low mortality rate and a low rate of adverse cerebrovascular events in both observed subgroups of patients in these studies was the result of the selection of a low risk AF population with a high prevalence of lone AF and a short follow-up period after the procedure[25]. On the other hand, several non-randomized studies analyzing mostly a „sicker", more at risk and/or older AF population, have demonstrated a beneficial effect of ablation on the survival of AF patients. In one study, where the prevalence of cardiovascular and pulmonary disease was 58%, and the average age of patients 65 years, over the monitoring period of 2.5 years, the mortality rate was significantly lower (6% vs. 14%) as was the rate of adverse cerebrovascular events (2% vs. 8%) amongst patients treated with ablation as opposed to patients treated with antiarrhythmic medication [26]. Therefore, a positive effect of ablation on survival and systemic thromboembolism (in comparison to medication therapy) could be expected in a basically high-risk population of older AF patients with structural heart disease and increased risk of thromboembolism.

Conclusion

Triggers and rotors in the PV and on the posterior wall of the LA have a crucial role in the initiation and persistence of AF, which is why the concept of catheter ablation of AF entails electrical isolation of the pulmonary veins in case of paroxysmal AF, while patients with persistent AF most probably require an additional modification of the substrate in the LA. The superiority of catheter ablation over pharmacological treatment can mostly be detected in patients with the paroxysmal form of the disease and after unsuccessful prevention via minimum one class Ic or class III antiarrhythmic drug. At this point there is no conclusive evidence that catheter ablation of AF can reduce mortality or the risk of thromboembolism. However, successful rhythm control by means of catheter ablation can in some patients contribute to the restoration of systolic function in the LVs, especially in patients with tachycardiomyopathy. In addition, catheter ablation improves the quality of life in these patients. Due to a limited success of the procedure (60% – 80%) and potential complications occurring in 1% - 4% of interventions (cardiac tamponade, PV stenosis, atrio-esophageal fistula, stroke) the procedure is still reserved for carefully selected patients (**Fig 1.**). Younger patients with symptomatic paroxysmal AF are amongst the best candidates for RF ablation.

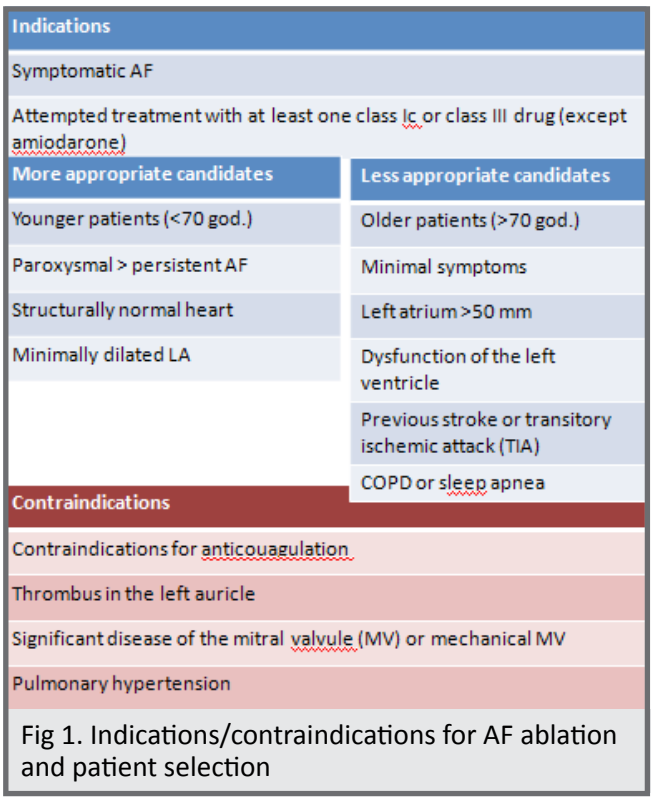

Fig 1. Indications/contraindications for AF ablation and patient selection

For now, ablation is indicated in symptomatic patients in whom AAD therapy has proven unsuccessful. However, catheter ablation can be the first therapeutic option for selected patients with lone AF, in whom ablation results are better; the rate of redo procedures is lower as is the rate of recurrence. One should bear in mind that it may be advisable to perform the procedure at an earlier stage of the disease when the result is better.

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