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Radiofrequency ablation – new insights into the modern treatment of atrial flutter and fibrillation

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Abstract

Background: Atrial fibrillation (AF) is associated with a 5-fold increase in the risk of stroke and a 3-fold increase in the incidence of heart failure. The increase in AF prevalence can be attributed both to better detection of silent AF, alongside increasing age and conditions predisposing to AF. Non-pharmacological measures aimed at «healing» AF were initially tested in open surgery. Searching for an approach with a greater chance of success led to the development of radiofrequency ablation (RFA). Only recently RFA technique began to be used extensively in people with AF, not being tested in large randomized studies, with establishment of remote results.

Conclusions: Catheter ablation is used successfully in patients suffering from symptomatic paroxysmal atrial fibrillation, as an alternative to drug therapy. Performed correctly by a trained and experienced electrophysiolologist, RFA allows us to get remarkable results, being possible suspension of treatment with antiarrhythmic drugs and to avoid its so well known side's effects. RFA with catheter is superior to antiarrhythmic drug therapy in preventing recurrence in both persistent AF and in the paroxysmal AF. The success rate of RFA in experienced centers for paroxysmal AF exceeds 70% a year. RFA reintervention is necessary in the approximately 9-20% of patients with more modest results. The frequency of major complications related to RFA is less than 5%. The restored sinus rhythm with RFA in patients with heart failure may be associated with significant improvement in left ventricular ejection fraction.

Key words: atrial fibrillation, radiofrequency ablation.

Introduction

Despite good progress in the management of patients with atrial fibrillation (AF), this arrhythmia remains one of the most common sustained cardiac rhythm disorders and one of the major causes of stroke, heart failure, sudden death, and cardiovascular morbidity in the world [1]. In 2010, the estimated numbers of men and women with AF worldwide were 20.9 million and 12.6 million, respectively, with higher incidence and prevalence rates in developed countries [2,3]. By 2030, 14–17 million AF patients are anticipated in the European Union, with 120 000–215 000 newly diagnosed patients per year [3,4,5].

The age of patients with this disease increases progressively, that currently the average age is between 75 and 85 years. This arrhythmia is associated with a 5-fold increase in the risk of stroke and a 3-fold increase in the incidence of heart failure. The increase in AF prevalence can be attributed both to better detection of silent AF, alongside increasing age and conditions predisposing to AF [1].

In many patients, AF progresses from short, infrequent episodes to longer and more frequent attacks. With time, many patients will develop permanent AF. In a small proportion of patients, AF will remain paroxysmal over several decades. Based on the presentation, duration, and spontaneous termination of AF episodes, five types of AF are traditionally distinguished: first diagnosed, paroxysmal, persistent, long-standing persistent and permanent AF. If patients suffer from both paroxysmal and persistent AF episodes, the more frequent type should be used for the diagnosis [1,6].

Patients who are primary diagnosed with AF are in the category called de novo AF. Many patients with AF are often asymptomatic and are diagnosed incidentally during a routine physical examination. If the patient has more episodes of AF lasting up to seven days and that stops on its own the category changes to paroxysmal AF. If AF lasting longer than 7 days is then known as persistent AF [7]. In this case to restore sinus rhythm it is recommended to perform planned electrical cardioversion. If the electrical cardioversion is ineffective, contraindicated or not performed and AF continues year or more the patient's AF is then known as permanent [8]. In addition to the above four AF categories, which are mainly defined by episode timing and termination, the ACC/AHA/ESC guidelines describe additional AF categories in terms of other characteristics of the patient [9].

Lone atrial fibrillation – the absence of clinical signs and symptoms or echocardiographic findings of rheumatic valve disease, ischemic heart disease, hypertension, pulmonary heart, cardiomyopathy thyrotoxicosis or the left atrium enlargement in patient under 60 years old.

Secondary AF – the occurrence of arrhythmias in certain situations or directly in the acute phase of diseases, such as during myocardial infarction, acute pericarditis, pulmonary embolism, infectious diseases, brain trauma or thoracic surgery [9].

AF is a chaotic atrial depolarization at a rate of 300-600 beats per minute and ventricular rate may vary depending on atrioventricular (AV) conduction. On the electrocardiogram (ECG) we have a completely irregular ventricular rhythm and fibrillatory waves of small amplitude and different morphology.

AF and atrial flutter (AFL) are two forms of supraven-

tricular tachyarrhythmia that in different periods of time can coexist on the same patient. Sources of rapid electrical discharges are automatic foci localized in the left atrium near the pulmonary veins or in a variety of other locations through both the left or right atrium [10].

AFL is atrial tachyarrhythmia with frequency of 250-350 beats per minute. AFL foci are often localized in the cavotricuspidian isthmus in the right atrium [10]. The prevalence of AFL is less than one tenth of the prevalence of AF. AFL often coexists with or precedes AF [1]. In typical, isthmus-dependent flutter, P waves will often show a "saw tooth" morphology, especially in the inferior leads (II, III, aVF). The ventricular rate can be variable (usual ratio of atrial to ventricular contraction 4:1 to 2:1, in rare cases 1:1) and macro-re-entrant tachycardias may be missed in stable 2:1 conduction [11].

Non-pharmacological measures aimed at "healing" AF were tested initially in open surgery. Searching for an approach with a greater chance of success led to the development of ablation with radiofrequency (RFA) without the need for open surgery, after having determined that, in many patients, AF is initiated and / or maintained by extrasystoles with the origin in the pulmonary veins. In the form of persistent AF, pulmonary vein isolation is not sufficient to achieve acceptable success rates but are often necessary to modify the atrial substrate (discrete ablation and / or linear ablation). Reintervention by RFA applies in the case of about 9-20% of patients. The frequency of major complications related to the ablation is less than 5%. Only recently RFA catheter technique began to be used extensively in people with AF, not being tested in large randomized studies, with the establishment of remote results. However, several well-conducted randomized trials and systematic reviews have shown that both in the persistent AF and paroxysmal AF, catheter ablation is superior to antiarrhythmic drug therapy in terms of preventing recurrences [12].

According to recent guidelines, prevention of recurrence of AF using RFA is warranted in patients with symptomatic paroxysmal form, RFA catheter may be considered after failure of first line antiarrhythmic drugs. Thus, in those without structural heart disease, RFA is an alternative to treatment by antiarrhythmic drugs if they have been found to be ineffective. In cases where the medication with amiodarone is the first line therapy due to the presence of contraindications for IC antiarrhythmic class RFA may be considered if amiodarone does not work [12]. The guides are equivocal regarding persistent AF patients. RFA can be indicated for cases of recurrent AF with severe symptoms after the failure of an antiarrhythmic drug. Such a recommendation is not based on solid evidence, but is supported by small case series and randomized trials that show that, in patients with heart failure restoring sinus rhythm (SR), the ablation catheter can be associated with significant improvement in left ventricular ejection fraction [12].

Obesity may increase the rate of AF recurrence after catheter ablation, with obstructive sleep apnea as an important potential confounder. Obesity has also been linked to a higher radiation dose and complication rate during AF ablation [13,14]. Notably, the symptomatic improvement after catheter ablation of AF in obese patients seems comparable to the improvement in normal-weight patients. In view of the potential to reduce AF episodes by weight reduction, AF ablation should be indicated to obese patients in association with lifestyle modifications that lead to weight reduction [1,15].

Technique of Radiofrequency Ablation

RFA is a minimally invasive procedure, which is performed in the electrophysiological laboratory, usually under mild sedation and only in rare cases with general anesthesia. Electrophysiology physician will perform femoral vein puncture. Subsequently, under radiological control will be introduced diagnostic and ablation catheters through the femoral vein and inferior vena cava up to the heart (in right atrium). Then the physician will puncture the interatrial septum to penetrate in this way into the left atrium, the place of entrance of the four pulmonary veins, where he identifies the most common sites of occurrence of AF. Responsible sites will be identified by a special technique of cardiac "mapping". The catheter uses radiofrequency energy (RE) to create a lesion and to block the pathologic circuit that generates AF. This procedure is called pulmonary vein isolation and is the most common procedure used in radiofrequency ablation for AF [16].

Under the same procedure, the physician can apply radiofrequency energy to an area of the right atrium, which is the cause of other arrhythmias, atrial flutter, commonly found in patients with AF. The procedure usually takes a few hours [16].

The objective of curative treatment of typical atrial flutter is to discontinue the leadership in cavotricuspid isthmus by providing a complete line of ablation, by drawing point to point of some types of successive RE and obtaining sinus rhythm. The absence of relapses is provided only in case of a complete bidirectional block. RFA for typical atrial flutter has a high success rate in more than 80% and low risk of relapse. In case of atypical atrial flutter, success of the procedure depends on the location of the circuit, and recurrences are more frequent and can even require later antiarrhythmic therapy. Also, atypical atrial flutter that is secondary to AF ablation may be difficult to treat with RFA [16].

Another procedure of RFA is circumferential ablating of left atrium, which consist in making some confluent ablative lesions around the orifice of the pulmonary veins entrance, usually grouped two by two, these two circles can be joined together or with other anatomical structures (e.g.: mitral valve ring) with additional ablation lines. These additional lines have as a purpose left atrial flutter prevention (which may occur especially if the ablation lines are incomplete). The optimal ablation procedure varies from patient to patient [16].

There is a consensus that administration of oral anticoagulation (OAC) in peri-procedural ablation is effective in preventing thromboembolic complications. This applies both to patients who have an indication for long-term OAC and in

patients with risk factors for stroke, stressing that somehow ablation increases stroke risk in peri-procedural period [17].

According to the recommendations of the 2010 Guidelines, OAC long-term therapy post-ablation is recommended in patients with a score CHA2DS2-VASc ≥2, regardless of the apparent procedural success [17]. Anticoagulation should be maintained for at least 8 weeks after ablation for all patients. The true incidence of thromboembolic events after catheter ablation has never been systematically studied and the expected stroke risk has been adopted from nonablation AF cohorts. Although observational studies suggest a relatively low stroke rate in the first few years after catheter ablation of AF, the long-term risk of recurrent AF and the safety profile of anticoagulation in ablated patients need to be considered. In the absence of controlled trial data, OAC after catheter ablation should follow general anticoagulation recommendations, regardless of the presumed rhythm outcome [1].

It is not uncommon to reappear arrhythmia after ablation in the first 2-4 weeks. It may take 1-3 months for healing of postablation scars in order to check the success of the procedure. In this interval antiarrhythmic therapy may be required. Surveillance to detect recurrent AF after RFA is important, so it is recommended that the first visit to electrophysiology physician will be 3 months post-ablation, then every 6 months during the first two years [12].

Outcome of catheter ablation for atrial fibrillation

After several procedures for catheter ablation of AF was observed that better results are obtained in young patients with short episodes of AF and in the absence of structural heart disease. Sinus rhythm is found in up to 70% of patients with paroxysmal AF and in 50% of patients with persistent AF. Many patients require more than one ablation procedure to obtain rhythm control. RFA reintervention is necessary in the approximately 9-20% of patients with more modest results. It is important that before ablation procedure the patient to be well informed about the benefits and the risks.The decision to continue treatment of AF with antiarrhythmic drugs or with RFA always belongs to patient [1].

Complications of catheter ablation for atrial fibrillation

EURObservational Research Programme (EORP) determined that the average length of hospital stay of patients after RFA is 3 days [18,19]. The frequency of major complications related to RFA is less than 5%-7 % [20]. Intraprocedural death has been reported, but is rare (0.2%) [1].

Possible complications post-RFA:

- Injury to vessels, nerves, organs and surrounding tissues by manipulating instruments
- Renal damage or allergies
- Infection or bleeding at injection site
- Arterio-venous fistula on puncture site
- Complete AV block requiring pacemaker implantation (under 1%);
- Pericardial effusion, cardiac tamponade
- Stroke; pulmonary vein stenosis
- Acute coronary syndrome
- Atrio-esophageal fistula especially in circumferential atrial ablation
- Pyloric spasm and gastric hypomotility by affecting the vagus nerve during ablation [12, 21].

Conclusions

Catheter ablation is successfully used in patients suffering from symptomatic paroxysmal AF, as an alternative to drug therapy. Performed correctly by a trained and experienced electrophysiolologist, RFA allows us to get remarkable results, being possible suspension of treatment with antiarrhythmic drugs such as: amiodarone, dronedarone, flecainide, propafenone,sotalol etc. and to avoid its so well known side effects. RFA is superior to antiarrhythmic drug therapy in preventing recurrence in both persistent AF and in the paroxysmal AF.

All patients should receive oral anticoagulation for at least 8 weeks after catheter ablation. The success rate of RFA in experienced centers for paroxysmal AF exceeds 70% a year. RFA reintervention is necessary in the approximately 9-20% of patients with more modest results. The frequency of major complications related to RFA is less than 5%. The restored sinus rhythm with RFA in patients with heart failure may be associated with significant improvement in left ventricular ejection fraction.

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