Delayed Enhancement Assessment of Pulmonary Veins Using 3 Tesla Magnetic Resonance Imaging after Atrial Fibrillation Ablation

Felipe Gomes de Oliveira, Ibraim Masciarelli Pinto, Dalmo Antonio Moreira, Deise Aparecida Miyake, Bruno Pereira Valdigem, Tiago Senra

Instituto Dante Pazzanese de Cardiologia, São Paulo, SP - Brazil

Introduction

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia in clinical practice. Epidemiological data show that AF is associated with significant morbidity and mortality, resulting in high medical and hospital costs.[1] The dismay generated by the modest impact of antiarrhythmic agents in the natural history of AF motivated the development of non-pharmacological methods aimed at curative treatment of this arrhythmia. In this context, over the past decade, catheter ablation with percutaneous techniques evolved considerably and has become a therapeutic option for selected patients with AF.[2] Imaging methods, such as intracardiac echocardiography and electroanatomic mapping have been increasingly incorporated to increase the efficiency and safety of the method. The efficiency of ablation has been discussed in recent years to evidence factors that contribute to the recurrence rates of AF. Failure of the procedure is often attributed to resumed conduction between the pulmonary veins and the left atrium due to incomplete ablation of ectopic foci.[3] Cardiac magnetic resonance (CMR) with delayed enhancement technique is a noninvasive imaging modality used to view areas of fibrosis. In the context of AF, it may be adapted to identify fibrosis induced by radiofrequency waves on the left atrial wall and in the pulmonary vein ostia after ablation of AF. The fibrotic regions present increased signal intensity on delayed enhancement due to the slow gadolinium washout in the injured tissue. In this scenario, initial studies suggest that CMR with evaluation of atrial fibrosis using the delayed enhancement technique can provide important information about the radiofrequency ablation sites, potentially identifying incomplete isolations and preexisting areas of atrial fibrosis that may result in a higher AF recurrence rate after the procedure.[4]

Case Report

C.A.S., male sex, 38, under electrophysiology follow-up at Instituto Dante Pazzanese de Cardiologia due to AF. The patient had frequent symptoms despite the use of antiarrhythmic drugs. He did not have any comorbidities and denied alcoholism and smoking. A 12-lead electrocardiogram showed AF, present for more than one year, as reported by the patient. The patient was referred for AF ablation. Circumferential radiofrequency ablation was performed around the right and left pulmonary veins with reversal of arrhythmia after the procedure. There were no adverse events during the procedure.

Three months after radiofrequency ablation, the patient underwent CMR to evaluate ablation sites. The test was conducted on a 3T device (Phillips Ingenia 3T, Eindhoven, Netherlands). Cine sequences and atrial and ventricular delayed enhancement were performed. 18ml of gadoteric acid 0.5 mmol/mL was injected in peripheral vein and images of atrial and ventricular delayed enhancement were acquired after 10 minutes of administration. The parameters used for the delayed atrial enhancement were the following: FOV 400, voxel size: 1.25 x 1.25 x 1.25, 3D FFE T1 sequence, TR 5.1 ms, TE 1.72 ms, matrix 320 x 320, 2.5 mm thickness, ITI 270 ms, fat suppression, cardiac synchronization with 30 levels by cut and using the navigator. It was possible to identify those sites in which radiofrequency was applied to the pulmonary veins and their circularity (Figures 1 and 2). The patient is currently in the sixth post-ablation month remaining in sinus rhythm without further episodes of AF.

Discussion

RF catheter ablation developed rapidly and is now one of the main therapeutic options for the treatment of AF. With mounting evidence of the efficacy and safety of the procedure, in 2012, a new recommendation was suggested by the HRS/EHRA/ESC committee, placing RF catheter ablation therapy as class I, level of evidence A, for patients with paroxysmal AF, symptomatic and refractory to drug therapy.[5] The same document published a consensus on the technical aspects and on the strategies used for the treatment for AF ablation. Regardless of the technique used, complete electrical isolation of all PV should be performed as an initial objective of the procedure.[6] Based on the rate of recurrence, many patients are candidates for repeat ablation. In two systematic reviews and in a meta-analysis involving patients with paroxysmal or persistent AF and long-term persistent AF, it was shown that the success rate of a single ablation procedure was 57%, and that this rate rose to 77% when analyzed from the standpoint of multiple procedures.[7] The case illustrates the capacity of CMR with delayed enhancement technique to identify sites of application of

Keywords

Arrhythmias, Cardiac; Atrial Fibrillation; Catheter Ablation; Heart Atria; Pulmonary Veins.

Mailing Address: Felipe Gomes de Oliveira •
Instituto Dante Pazzanese de Cardiologia. Av. Dante Pazzanese, 500. Postal Code 04012-909, Vila Mariana, São Paulo, SP - Brazil
E-mail: Lipejf@hotmail.com/ Felipe_gomes@usp.br/ Lipejf10@gmail.com
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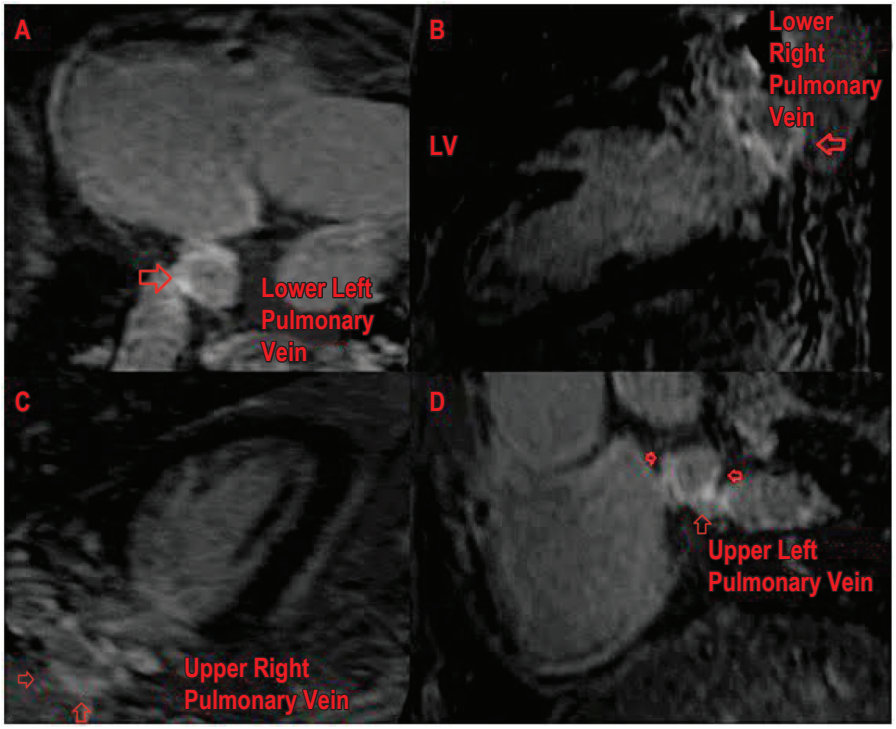

Figure 1 - *Red arrows indicating points with hyperintensity corresponding to the sites of radiofrequency ablation.*

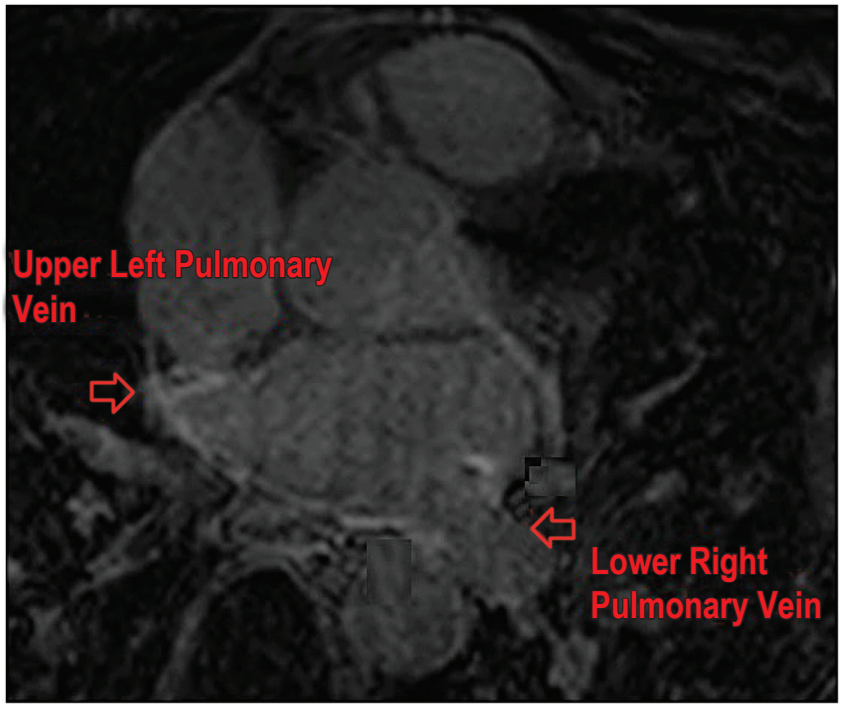

Figure 2 - *Red arrows indicating points with hyperintensity corresponding to the sites of radiofrequency ablation in the lower right pulmonary vein and upper left pulmonary vein.*

radiofrequency in the pulmonary veins and demonstrate the degree of circularity of fibrosis, a potential marker of success of the procedure.

Conclusion

CMR using delayed enhancement to evaluate the left atrium and pulmonary veins can noninvasively demonstrate fibrosis promoted by radiofrequency ablation in patients with AF and is a potential predictor of success for the procedure.

Authors' contributions

Research creation and design: Oliveira FG, Pinto IM, Moreira DA, Valdigem BP; Data acquisition: Oliveira FG, Miyake DA; Data analysis and interpretation: Oliveira FG, Pinto IM, Miyake DA, Senra T; Manuscript drafting: Oliveira FG, Senra T; Critical revision of the manuscript for important intellectual content: Oliveira FG, Pinto IM, Moreira DA, Valdigem BP, Senra T.

Potential Conflicts of Interest

There are no relevant conflicts of interest.

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Academic Association

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