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Utility and feasibility of the CartoUnivu™ system for atrial flutter ablation in patients with mechanical prosthetic valves

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ABSTRACT

Ablation of macroreentrant atrial tachycardia in patients with mechanical prosthetic valves represents a challenge for electrophysiologists, because of the complexity of the procedure and the potential complications. Moreover, the need for fluoroscopy in this type of procedure is greater, due to the risk of interference between the prosthetic valve and the ablation or mapping catheter. We present two cases of patients with mechanical prosthetic valves and atrial flutter who underwent successful ablation with no complications using the CartoUnivu™ tool, which integrates the electroanatomical map and the fluoroscopy image.

1. Introduction

Atrial flutter ablation in patients with mitral and tricuspid mechanical prosthetic valves is a more complex procedure, of longer duration and consequently more prolonged fluoroscopy time, than in patients with native valves, with a similar described short- and long-term success rate [1,2]. There are severe potential complications, such as entrapment of the ablation or mapping catheter between the leaflets of the prosthetic valve, sometimes requiring surgery to resolve them [3]. The development of the CartoUnivu™ system (Biosense Webster Inc., Irvine, CA, USA) has enabled fluoroscopy images to be integrated with the electroanatomical map (EAM), making it possible to perform an equally precise ablation and reducing the radiation dose in complex substrate ablation procedures, in both adult and pediatric patients [4,5].

To date, there is no evidence of effective and safe use of the CartoUnivu™ system in this clinical context. Our objective is to describe two cases of patients with atrial flutter and mechanical prosthetic valves in whom ablation was performed, using the CartoUnivu™ system to integrate the EAM with the fluoroscopic image.

2. Case 1

Woman aged 57 years with a history of Churg-Strauss disease and a mechanical tricuspid prosthetic valve implanted in 2001 for tricuspid stenosis secondary to eosinophilic cardiomyopathy (Image 1). The patient presented with common atrial flutter and was scheduled for cavotricuspid isthmus (CTI) ablation. The procedure was carried out under conscious sedation, through right femoral vein access, without interrupting treatment with acenocumarol. We used a duodecapolar catheter located in the right atrium and coronary sinus and performed the EAM reconstruction with a SmartTouch® ablation catheter (Biosense Webster Inc.) and CARTO® [3] navigation system, observing an activation sequence compatible with counter-clockwise common flutter; we integrated the EAM with the fluoroscopic image using the CartoUnivu™ system, which enabled us to locate the tricuspid prosthetic valve properly during the procedure. Ablation of the CTI was successfully performed (power at 35 W and irrigation at 17 mL/min with temperature limit of 42 °C), ending the flutter and bidirectional CTI block without any associated complications. The fluoroscopy time during the procedure was 11 minutes.

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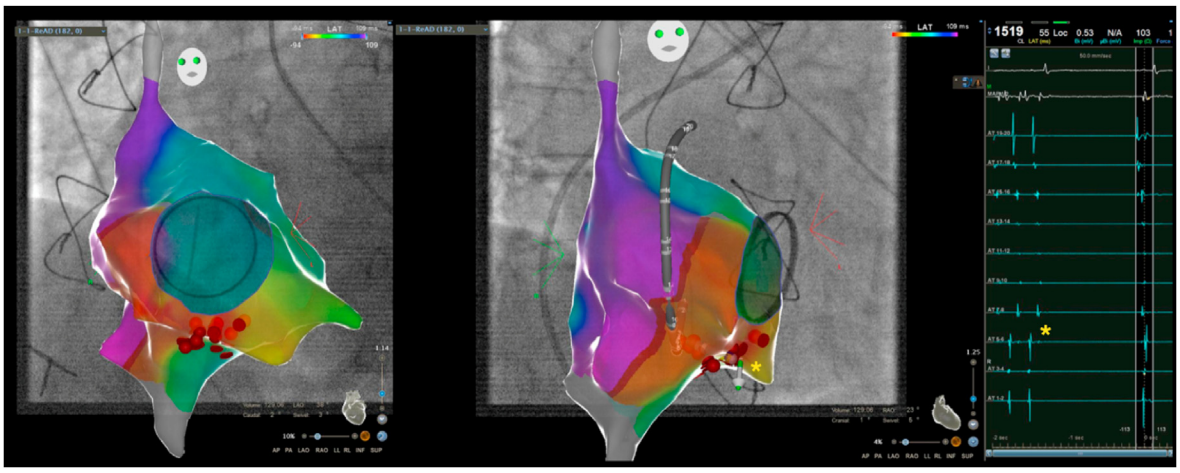

Fig. 1. *Left Panel*: Left anterior oblique (LAO) view. Activation map compatible with counterclockwise common atrial flutter. *Right Panel*: Right anterior oblique (RAO) view. Catheter position and radiofrequency delivery at the moment of flutter termination (*).

Fig. 2. *Panel A*: LAO view of left atrium. Note the mitral prosthetic valve position. Mapping catheter (*) inside the left atrium. Absence of right superior pulmonary vein (arrow). *Panel B*: Posterior view of left atrium. The prosthetic mitral valve can be seen (*). Activation map showing roof atrial flutter with two early-meets-late sequences, one between the left inferior pulmonary vein and infero-posterior scarring (white arrow) and the other between the right inferior pulmonary vein and inferior posterior scarring (blue arrow). Catheter ablation showing fractionated and mid-diastolic electrograms (+).
Panel C: Start of ablation at that catheter position (+) and termination of flutter 10 seconds later.

3. Case 2

Man aged 26 years of Senegalese origin with complex congenital heart disease (incomplete Shone's syndrome) treated surgically on 2 occasions: initially, in 2004, he was operated on for aortic and mitral valve disease with a Ross procedure, together with mitral valvuloplasty; subsequently, in 2011, a bileaflet mechanical mitral valve was implanted for severe double mitral lesion, complicated by hematoma and occlusion of the right superior pulmonary vein. In 2018, he presented with common flutter and CTI ablation was successfully performed. In 2019, he had several episodes of atypical flutter, which was scheduled for electrophysiological evaluation and ablation. The procedure was carried out under general anesthetic through triple femoral vein access, without interrupting treatment with acenocumarol. A decapolar catheter was positioned in the coronary sinus and activation compatible with left flutter was observed, with a cycle length of 380 ms. Transseptal puncture was performed guided by transesophageal echocardiography and EAM reconstruction of the left atrium with a PentaRay® catheter (off-label use in the presence of a mechanical heart valve) (Biosense Webster Inc.) and CARTO® [3] system; the fluoroscopy was then integrated with the CartoUnivu™ to locate the mitral prosthetic valve during the procedure (Image 2, Panel A). The activation map showed roof atrial flutter, and on the voltage map there was a notable area of scarring on inferior level on the posterior wall (Image 2, Panel B). Ablation was performed with a SmartTouch® catheter (power at 30 W and irrigation at 17 mL/min with temperature limit of 42 °C) between the right inferior pulmonary vein and the low voltage area on the posterior wall, with interruption of the flutter (Image 2, Panels B and C). Finally, bidirectional block was confirmed after completing the ablation line. No complications were observed during the procedure. The fluoroscopy time was 27

minutes.

4. Discussion

Currently we have different tools available for monitoring catheter movement to avoid complications and to reduce the need of fluoroscopy in complex ablation scenarios, including the intracardiac echocardiography (ICE) and the CartoUnivu™ System, which are compatible techniques.

We present 2 cases which illustrate the utility of the CartoUnivu™ system in patients with macroreentrant atrial tachycardia and mechanical prosthetic valves, both for reducing the fluoroscopy time during the procedure and for monitoring the movement and position of the catheter, ensuring that it does not interfere with the prosthetic valve. As far as we know, this is the first description of the use of this technique in this clinical context.

Dr. Kella et al. [2] have recently published a series of 16 patients with congenital heart disease and tricuspid valve surgery, 14 with tricuspid prosthetic valves and 2 with annuloplasty, and common atrial flutter who underwent CTI ablation; in this series, despite the use of the CARTO® navigation system, the mean fluoroscopy time in each procedure was 33.2 ± 19.8 minutes. In our 2 cases fluoroscopy time was shorter, although the small number of patient of our series is a limitation to make any interpretation. The 2 largest series published in patients with mitral prosthetic valves and left flutter by Dr. Mountantonakis et al. [1] and Dr. Enriquez et al. [6] do not provide data on the mean radiation doses used.

On the other hand, there is a published description of entrapment of the mapping catheter between the leaflets of the mechanical prosthetic valve, with potential severe complications [3]. Despite we made an off-label use of PentaRay® catheter, actually entrapment may occurr with any other kind of catheter in the presence of a mechanical heart valve. Better determining the location of the prosthetic valve by integrating the fluoroscopic image and the EAM makes it possible to avoid positions of close proximity and reduce the risk of catheter entrapment.

Given that atrial flutter ablation procedures in patients with prosthetic valves are complex and require a higher dose of radiation than in patients with native valves, the CartoUnivu™ system represents a useful and safe tool for reducing the need for fluoroscopy in these patients, as the 2 presented cases show. It would be interesting to have a large series of patients with these characteristics in whom the CartoUnivu™ system is used and compare the data with patients in whom the procedure is performed in the conventional way.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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