Ultra-fast, high-density 3D mapping system for catheter ablation of atypical atrial flutter

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Abstract

Atypical atrial flutter is a rare supraventricular tachyarrhythmia which is extremely challenging to visualize using well-known mapping systems. A new approach using ultra-fast, high-resolution 3D mapping systems could be a step forward in understanding and treatment of this arrhythmia. We report a case of a 54-year-old man with paroxysmal, atypical atrial flutter who was admitted to a tertiary cardiology center. The patient had undergone pulmonary vein isolation due to atrial fibrillation and as a result of the intervention he developed atypical atrial flutter. The arrhythmia had previously been treated with electrical cardioversion but without any success. An ultra-fast, high-density 3D mapping system (Rhythmia, Boston Scientific) was used to determine the arrhythmia localization. Ablation was done with a 8.5F basket mapping catheter equipped with 64 low-noise electrodes. This system allowed for precise and adequate mapping, thus enabling the patient's arrhythmia to convert to sinus rhythm.

Introduction

Atrial flutter (AFl) is classified as a supraventricular tachyarrhythmia with an atrial rate at the level of at least 240 bmp (240-350 bmp). In the literature, the most commonly described type of AFl is cavotricuspid isthmus flutter (known as a typical AFl) with the macroreentry mechanism of activation. The definition of atypical AFl is wider and includes a broad spectrum of other macroreentrant tachycardias which are not related to tricuspid annulus and are called cavotricuspid isthmus dependent flutter[1]. Ablation of this type of AFl is more challenging than typical AFl, mainly due to mapping difficulties. The mechanism of atypical AFl can often be triggered by the presence of scars which are a consequence of cardiac surgical procedures or other cardiological interventions such as pulmonary vein isolation[2,3]. A new approach of dealing with this tachyarrhythmia is needed, and using the novel mapping system Rhythmia HDx could be a feasible solution. The Rhythmia HDx Mapping System (RMS, Boston Scientific, Cambridge, MA, USA) is a modern, ultra-fast, high-density 3D mapping system which uses a 64-electrode Orion mini-basket catheter instead of multielectrode and is capable of delivering 25 times more data than other known systems[4]. We report a case of successful ablation of atypical AFl using ultra-fast, high-density 3D mapping (Rhythmia Mapping system).

Case report

A 54-year-old man with paroxysmal, atypical AFl was admitted to the tertiary cardiology center for ablation of atypical AFl. Previously atrial fibrillation (AF) and typical AFl were observed, and the patient had undergone two procedures. Pulmonary vein isolation was performed in September 2014 due to persistent AF and then typical AFl was diagnosed; thus in January 2015, the patient underwent a second procedure – ablation of the cavotricuspid isthmus. The patient remained asymptomatic for a period of 6 months, and after that time intense fatigue occurred. Electrophysiologists diagnosed atypical AFl, and ablation of this arrhythmia was recommended. On admission to hospital in October 2016, 12-lead ECG showed atypical AFl with a rapid ventricular response (Figure 1). The

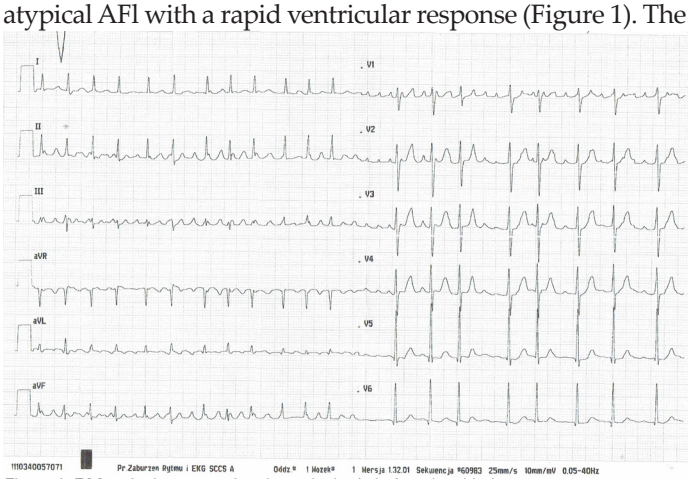

Figure 1. ECG strip demonstrating the arrhythmia before the ablation.

echocardiography showed normal size and slightly decreased ejection fraction (50%) of the left ventricle. The left atrium (LA) was enlarged with the dimension of 45 mm. The patient was treated with bisoprolol and atorvastatin.

Due to the patient's prior medical history (AF and typical AFl) and expected difficulties in locating the arrhythmia, the electrophysiologists decided to use the high-density (Rhythmia) 3D mapping system. Transesophageal echocardiography was performed to exclude intra-atrial thrombus prior to ablation. Slight sedation and local anesthesia were used during the procedure. The operators obtained vascular access via the right femoral vein and the right internal jugular vein. A 9-F vascular sheath was used to place a 8.5F Orion multielectrode catheter using femoral access. Through the jugular vein access, the operators introduced a 6-F CS electrode. The mapping multielectrode was placed in the LA using transseptal access. The INTELLAMAP Orion Mapping Catheter was used to create an ultra high-density electro-anatomical model of LA. The catheter is equipped with 64 deployable electrodes (range 3-22 mm) arranged in 8 splines[5]. The number and density of points were sufficient to draw an activation map of LA (Figure 2) and located the place where the arrhythmia originated. The areas were located in the middle of the line connecting the mitral valve and the left superior pulmonary vein (Figure 2A) and on the posterior wall of the LA (Figure 2B). The RF

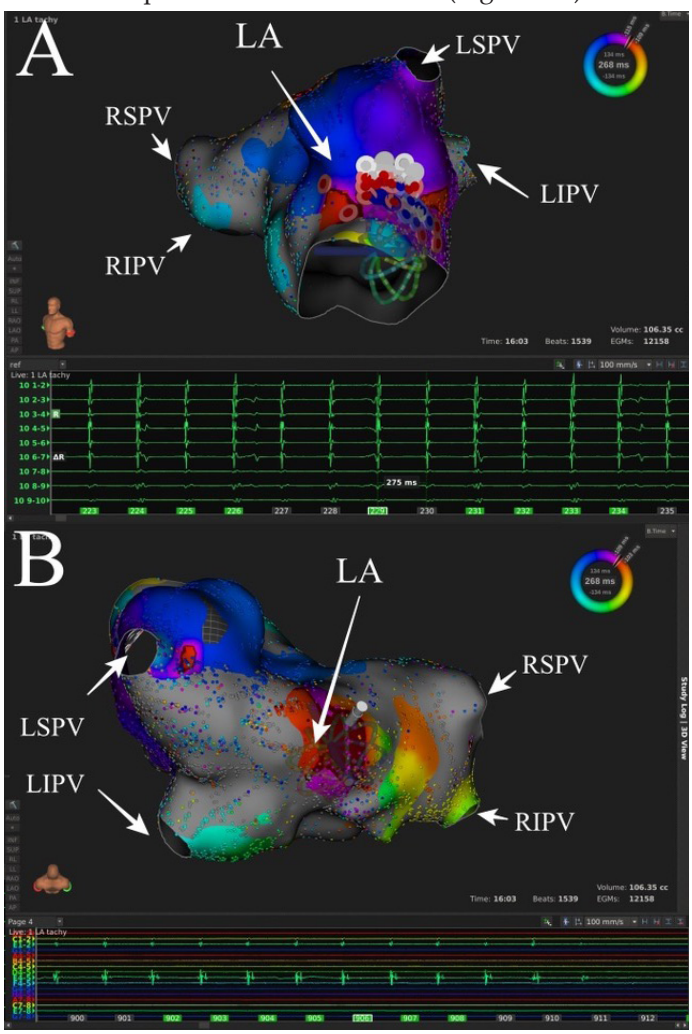

Figure 2. Left atrial activation map acquired using Rhythmia Mapping System. Two potentially arrhythmogenic areas have been mapped via Orion mini-basket catheter. Points of RF application are marked as red dots. (A) antero-posterior view and (B) postero-anterior view. LA – left atrium; LSPV – left superior pulmonary vein; LIPV – left inferior pulmonary vein; RSPV – right superior pulmonary vein; RIPV – right inferior pulmonary vein.

ablation of the first area was unsuccessful, whereas ablation of the second area was performed and released the patient from the arrhythmia. The mapping revealed the fragmented low-voltage potentials on the posterior wall of the LA. The applications were done on the posterior wall of LA between the lines connecting the left inferior and the right inferior pulmonary veins and the left superior and the left inferior pulmonary veins using an INTELLATIP MIFI XP temperature ablation catheter. The application caused the atypical AFl to revert to sinus rhythm. The duration of the procedure (skin-to-skin) was 150 minutes. The radiation exposure was 80 mGy, 825.3 DAP. The patient became free of the procedural and post-procedural complications and was discharged home the day after the procedure with recommendations to take a class IC antiarrhythmic drug (propafenone) and an anticoagulation drug (warfarin). During the short-term follow-up (30 days), one atypical AFl episode occurred, but it was self-limited, and during the long-term follow-up (360 days), the patient remained free of arrhythmia.

Discussion

This case illustrates the advantages of 3D high-density mapping in dealing with difficult to map, and treat arrhythmias. This system has made it possible to obtain an accurate electro-anatomical map of the examined structure. Rhythmia HDx is capable of gathering much more information in a shorter time than other known systems, thus enabling an adequate and detailed map to be created. Constructing a high-resolution map allowed for precise location of arrhythmia, and thus establishing the detailed area from where it has originated. There are no clinical data comparing Rhythmia with other mapping systems or single-center experiences showing that other systems could also be efficient in the ablation of atypical AFl[5]. Speeding up the process of gathering a lot of information in a short time using the Rhythmia system can be crucial in hemodynamically unstable patients or in those who have potentially life-threatening arrhythmias such as the electrical storm[6]. The Rhythmia HDx has proven that it is able to manage different supraventricular arrhythmias such as AF, typical AFl, and atrioventricular nodal re-entry (AVNRT)[7-10]. There are a few articles concerning the feasibility and efficiency of treating scar-related atrial tachycardia (AT) which occurred mainly after the pulmonary vein isolation procedure. Latcu et al. reported that ablations using Rhythmia enable one to terminate 97% of arrhythmias and allow 84% of patients' arrhythmias to convert to sinus rhythm during 11 months' follow-up[8]. However, the data about the ablation of atypical AFl with Rhythmia are limited[11]. This new 3D mapping system could be a step forward to reduce the duration of fluoroscopy, radiation dosage and time spent under anesthetic drugs, although further observations are required.

Conclusions

The Rhythmia HDx Mapping System (RMS, Boston Scientific, Cambridge, MA, USA) is a novel, effective and feasible tool to deal with a variety of difficult to ablate arrhythmias such as atypical atrial flutter. The conclusions were drawn considering one-year follow-up of a single patient, which is why our findings can be considered as hypothesis-generating only, and further studies are required to determine the possible advantages of using this system.

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