SHORT COMMUNICATION

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Cryoballoon ablation of paroxysmal atrial fibrillation within the dilated coronary sinus in a case of persistent left superior vena cava

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Trigger sources of paroxysmal atrial fibrillation (PAF) are not limited to a pulmonary vein origin and may be achievable by cardiac vascular structures like the coronary sinus (CS), the vena cava superior and in some rare cases by a persistent left superior vena cava (LSVC). Cryoballoon ablation has been shown to be effective in pulmonary vein isolation. We report an unusual case of using this technique in the dilated CS in case of a persistent LSVC. A 64 year old patient presented PAF recurrences after cryo pulmonary vein isolation 4 months before. A maintaining pulmonary vein isolation could be demonstrated by transseptal mapping. Further bi-atrial mapping localized repetitive atrial trigger activity in a dilated CS proceeding to a LSVC. A cryoballoon was deployed in the CS target area and during cryoablation the triggered activity suspended. Ablation side effects were excluded by coronary angiography. During a follow up time of 8 months the patient has remained free of PAF recurrences. The current report underlines the importance of a patient-tailored ablation approach. Cryothermic balloon technology may be more applicable in delicate cardiac structures by developing new anatomically adapted balloon shapes and sizes.

Introduction

Ablation strategies of atrial fibrillation are still under discussion owing to the complexity of arrhythmogenesis. Trigger and driver sources are not limited to a pulmonary vein origin but may be linked to other vascular structures like the coronary sinus (CS), the vena cava superior, and, in some rare cases, a persistent left superior vena cava (LSVC).[1]

In addition to radiofrequency (RF) application, cryoballoon ablation demonstrated comparable results in pulmonary vein isolation for paroxysmal atrial fibrillation (PAF).[2] The use of this technique has not been yet described in the further cardiac anatomy.

Case

We report a patient (male, 64 years old, no structural heart disease) with prior successful cryoballoon pulmonary vein isolation who presented again recurrences of PAF. Four months after the initial intervention, we were able to demonstrate maintaining pulmonary vein isolation by a repeated transseptal spiral multielectrode mapping (Spiral 7F duo-decapolar catheter, SJM, Minnetonka, MN, USA). A consecutive left and right atrial mapping of repetitive atrial trigger activity focused our interest on a dilated CS proceeding to a persistent LSVC.

We depicted the earliest exit of repetitive atrial premature beats within the CS (*Figures 1A* and *2*) by performing an encircling mapping manoeuvre with the spiral catheter and a quadripolar cryoablation catheter (8F, 6 mm tip, Cryocath, Quebec, Canada). However, a focal cryoablation remained unsuccessful. Thus, we deployed a 28 mm cryoballoon (ArcticFront, Cryocath) at the target area and applied three cryoablations (6 min; minimum temperature -68°C). During ablation, the triggered activity suspended. Even by burst stimulation, we were not able to re-induce any atrial arrhythmias. Ablation side effects on the circumflex artery were excluded by coronary angiography (*Figure 1C*).

During a follow-up time of 8 months after re-ablation, the patient has remained free of PAF recurrences.

Discussion

The current report underlines the importance of a patient-tailored ablation approach, especially in the case of PAF recurrence.[3] After pulmonary vein isolation, other cardiac vascular structures, also unusual, may play an important part in arrhythmogenesis.

The CS is directly related to the epicardial space, and its musculature structures may play a role in generating arrhythmogenic foci.[4] An effective ablation within the CS could be demonstrated in selected patients burdened with atrial fibrillation.[5]

In those delicate vascular structures, the amount of applied energy should be limited to avoid harm.[5] On the other hand, limited RF applications may result in an increased number of procedures to achieve a final electrical isolation.[1] Concerning vascular side effects (e.g. pulmonary vein stenosis), cryoablation is considered a safe technique.[2] However, focal cryothermic treatment remains time

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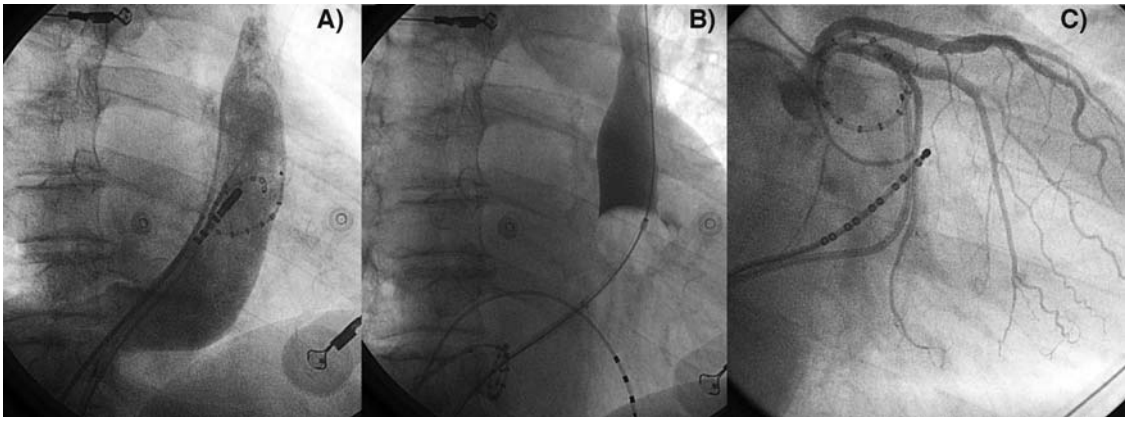

Figure 1 (*A*) AP 0°: mapping of atrial trigger activity in the enlarged coronary sinus using a spiral decapolar catheter and a quadripolar ablation catheter. Coronary sinus and left superior vena cava course is demonstrated by angiography (6F multipurpose catheter in left superior vena cava). (*B*) AP 0°: deployment of a 28 mm cryoballoon in coronary sinus and verification of fitting by angiography through the catheter's lumen. A formerly introduced 23 mm balloon was not able to fill in the coronary sinus diameter. The spiral catheter is pulled back to the coronary sinus ostium. (*C*) Post-ablation multielectrode mapping using a spiral and a further decapolar catheter (Bard, Lowell, MA, USA). Coronary angiography (LAO 40°, caudal 20°) shows the anatomical vicinity of the unaffected circumflex artery and the coronary sinus marked by the mapping catheters.

consuming. With regard to the muscular CS architecture, a broader application area offered by a cryoballoon technique may be of advantage in PAF treatment,[4] especially in the case of a massive dilatation and connected LSVC.

Care should be taken to a potential deficiency of a right SVC to avoid haemodynamic side effects while blocking the CS and LSVC over a time of 6 min.

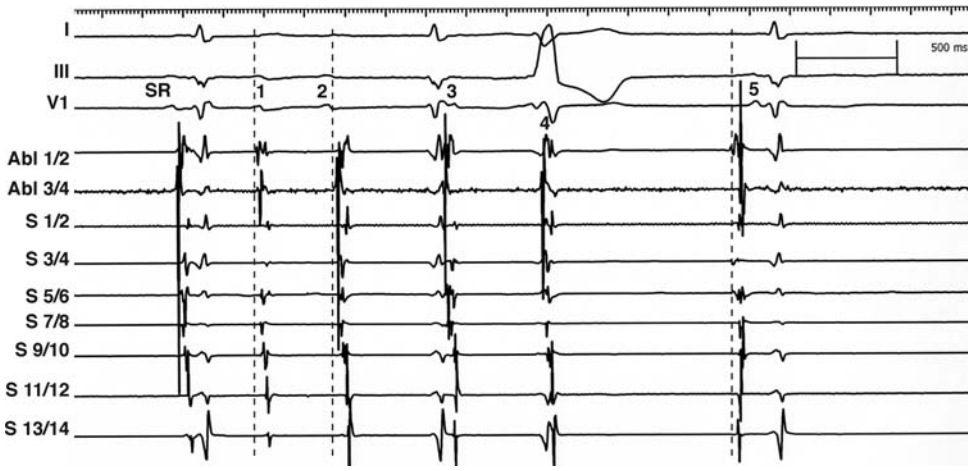

Figure 2 Documentation of atrial ectopy recorded in the coronary sinus before cryoballoon ablation. Surface ECG I, III, V1; intracardiac recordings of a quadripolar ablation catheter (bipolar distal: Abl 1/2; proximal: Abl 3/4) and recordings of the spiral catheter (S 1/2–13/14). Both catheters are located in positions comparable to *Figure 1C*. The first beat shows activation during sinus rhythm (SR). In the first ectopic beat (1), a local split potential is preceding in Abl 1/2. During the second premature activity (2), the endocardial activation appears similar to SR. In the third ectopic beat, the activation of Abl 3/4 and spiral 5/6 seems to precede; however, signals are partially overlaid by ventricular depolarization. The last beat (5) shows an early sharp deflection preceding the surface P-wave. Coronary sinus activation enters directly the septum expressed by a shortened PQ time. An accessory pathway had been excluded.

It is the first time that cryothermic balloon technology has been reported in this context. The approach may be more widely applicable in delicate cardiac vessel structures like CS or LSVC by developing new anatomically adapted balloon shapes and sizes.

Conflict of interest: none declared.

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