SHORT COMMUNICATION

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Voltage analysis after multi-electrode ablation with duty-cycled bipolar and unipolar radiofrequency energy: a case report

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Pulmonary vein ablation with a single-tip catheter remains long and complex. We describe a typical case of a novel efficient technique with a decapolar ring catheter utilizing alternating unipolar/bipolar radiofrequency energy. Voltage analysis and electrical mapping demonstrate the potential for antrum ablation and pulmonary vein isolation.

Introduction

Pulmonary vein (PV) isolation remains the cornerstone of ablation for atrial fibrillation.[1] Procedures using single-tip catheters are long and require additional techniques like three dimensional (3D) mapping systems and intracardiac echo imaging.[2–4] Recently, a quick and efficient novel ablation technology has been introduced that uses multi-electrode catheters and alternating unipolar and bipolar radiofrequency (RF) energy at a maximum power of 10 W.[5] This report provides a typical example showing the potential for antrum ablation and PV isolation.

Description of the pulmonary vein ablation catheter ablation technique

Details of the ablation system have been described previously.[5] Briefly, a quadripolar catheter is placed in the coronary sinus (CS) for pacing. A 9.5F inner lumen diameter sheath (Channel, Bard or Frontier Advance) is introduced, and selective biplane PV angiography is performed. The decapolar PV ablation catheter (PVAC) is deployed in the antrum with the guidewire inside the PV (*Figure 1*). Clockwise and counter-clockwise rotation may increase or decrease the 25 mm diameter of the circle, and the tip can be extended to adapt to PV anatomy. Multiple applications (60 s, target temperature 60°C) are then performed for each vein until the local electrical activity within the antrum has disappeared. The default setting with the PVAC uses a 4 : 1 ratio RF duty-cycle resulting in 80% bipolar and 20%

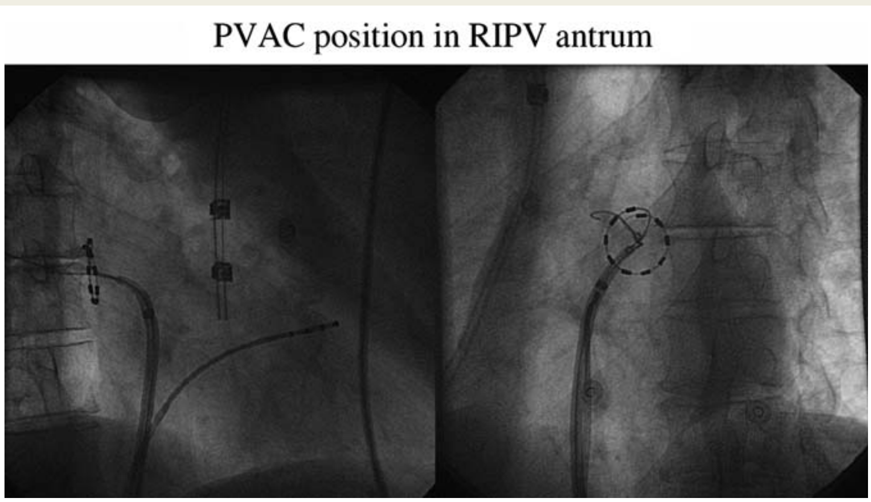

Figure 1 RAO (left) and LAO (right) 45° fluoroscopic image of the 10-polar PVAC (3 mm electrodes, 3 mm spacing) in the right inferior pulmonary vein.

unipolar energy with a maximum power of 8 W. Bipolar current flows between adjacent electrodes of all pairs that are selected for energy delivery, except for electrodes 1 and 10. After ablation, the PVAC is introduced for mapping inside the vein, and isolation can then be verified with pacing from the CS or inside the vein. In the present case, a 15 mm diameter decapolar LASSO mapping catheter (Biosense-Webster) and a 3D imaging system (Endocardial Solutions, St Jude, USA) were used to construct a complete 3D cast and voltage map of the LA (298 points) and demonstrate the effect of PVAC ablation. During SR, there is a high voltage of 2 mV and more at the anterior and posterior LA and PVs (*Figure 2*, left maps). The voltage maps on the right after PVAC ablation were obtained in the same way with special attention for the PVs (198 points) and clearly show that the LA body voltage remained unchanged, whereas the

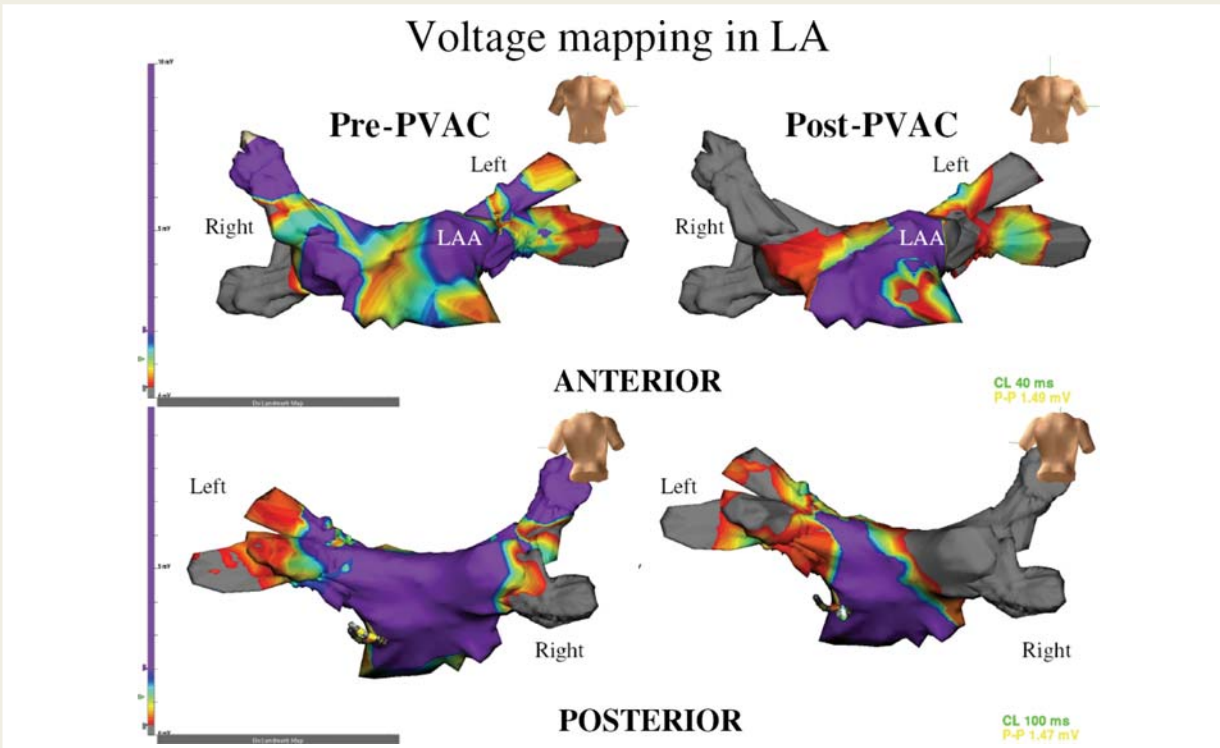

Figure 2 Voltage map of the pulmonary veins and left atrium before (left) and after (right) ablation with the PVAC. A and C show the posterior LA wall, whereas B and D show the anterior aspect.

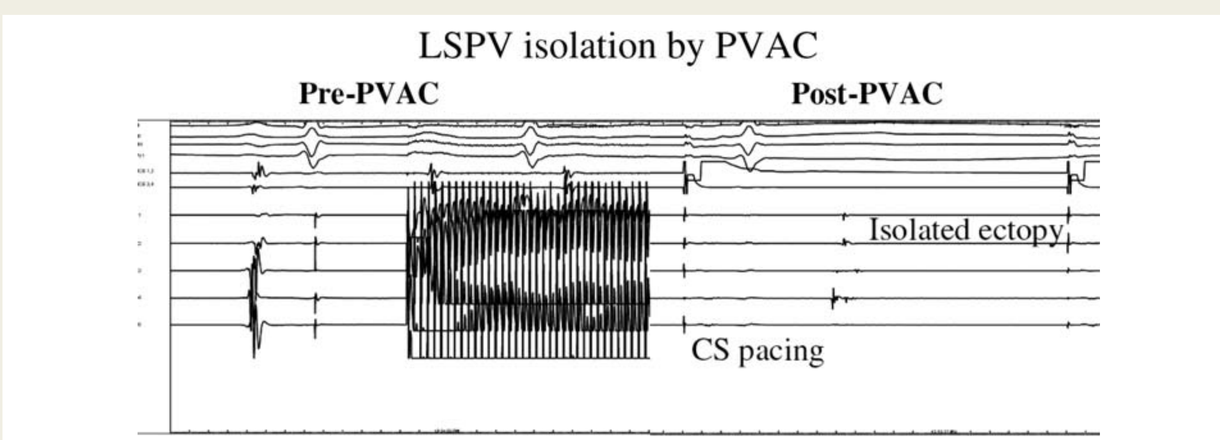

Figure 3 ECG leads I–III and V1 electrogram recordings from the CS and PVAC. Pre-PVAC shows the five bipolar PVAC recordings with local potentials in the LSPV before ablation is switched on. Post-PVAC shows the same PVAC recordings after ablation, demonstrating absence of PV capture during CS pacing, and electrical isolation with inability of ectopy inside the LSPV to capture the atrium.

PVs are completely devoid of electrical activity with a sharp demarcation. The electrical silence clearly extends very far into the antrum, especially for the right-sided PVs. The PVAC was also used to map the local PV and antrum potentials to verify isolation. *Figure 3* shows the electrograms before (pre-PVAC) and after (post-PVAC) ablation in the LSPV. After PVAC ablation, there is only a far-field component during CS pacing, and isolated ectopy inside the vein. The complete isolation was also confirmed by LASSO recording in all veins. The total procedure time including 3D imaging and LASSO mapping was 89 min with fluoroscopy time of 21 min.

Discussion

The present case demonstrates that PV isolation with multi-electrode PVAC ablation is feasible and efficient. The use of 3D imaging and LASSO mapping in this case, elegantly shows that the ablation effect of the PVAC extends far away from the ostium into the PV antrum. Although voltage analysis can never be 100% accurate, the reduction after ablation is striking, and the LASSO mapping confirmed isolation in all veins. This seems very similar to the endpoint of single-tip wide area circumferential ablation and is not merely a segmental, ostial isolation. More elaborate studies are needed to quantify and compare this effect in larger patient groups. The technique will need more validation in challenging variations of PV anatomy and may depend on patient selection. Together with long-term follow-up of clinical efficacy such factors will determine the value of this new ablation system.

Acknowledgements

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Conflict of interest: L.B. was a former stockholder and consultant of Ablation Frontiers Inc., and is on the speaker bureau and a clinical trainer for Medtronic. L.B. and M.W. have received grant money for performing research for Ablation Frontiers Inc.

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