

Conduction from the arrhythmogenic right upper pulmonary vein to superior vena cava can induce atrial fibrillation

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A 65-year-old man with a history of multiple unsuccessful cardioversions presented with long-standing persistent atrial fibrillation (AF). Following creation of a left atrial (LA) shell (CARTO[®]3, Biosense Webster Inc., Diamond Bar, California, United States), encircling isolation of the ipsilateral pulmonary veins (PVs) with a Thermocool[®]SmartTouch[™] catheter (Biosense Webster) guided by ablation index was performed. Clear LA–PV entry block was achieved with frequent dissociated PV potentials recorded from a Pentaray[®] catheter located within the right upper PV (RUPV) during ongoing AF. Consecutive cardioversions were able to restore the sinus rhythm (SR), but AF immediately recurred afterwards. Finally, an initiating trigger located within the RUPV was detected, which might indicate LA–PV reconnection or an absence of the PV–LA exit block. A careful assessment of the electrograms along the right-sided encirclement with the ablation catheter showed no local potentials; therefore, incomplete isolation was considered unlikely. It was presumed that communication with the superior vena cava (SVC) adjacent to the RUPV conducting PV activity into the right atrium was the offending mechanism resulting in AF. The very close anatomical relationship between both veins was detected on a 3-dimensional map. The anterior part of the RUPV was adhered to the posterior part of the SVC, 29 mm away from the PV antrum. Following another cardioversion, an activation mapping of both veins revealed conduction from the SVC (Map d: posterior wall) to the RUPV (Duo 5.6: anterior wall) during the SR and showed the firing activity starting from the RUPV conducted to the SVC, which offered a clear support of the hypothesis (FIGURE 1A).

Moreover, at some point, the RUPV started to present dissociated potentials, while the SVC remained in AF (FIGURE 1B), suggesting an intermittent conduction between both structures and confirmed the LA–PV entry block. Therefore, we proceeded to encircle SVC isolation placed away from the SVC–RUPV tangent area and without any touch-up lesions within the LA (FIGURE 1C). A bidirectional block within all PVs and the SVC with dissociated electrical activity limited to the RUPV and SVC was confirmed in SR restored with cardioversion. This ablation strategy resulted in no AF recurrence in long-term follow-up.

Superior vena cava isolation in addition to PV isolation has been reported to improve ablation outcomes due to elimination of non-PV AF triggers. However, when the SVC isolation was limited to patients with triggers mapped to the SVC, no reduction in AF recurrence was detected.¹ We can speculate that the presence of venous or muscular bundle connections bridging between the SVC and arrhythmogenic RUPV was the offending mechanism. In such a situation, the isolation of the one vein may not result in the compartmentalization of abnormal activities within the vein.² Our report supports this assumption and clearly illustrates that SVC isolation could be essential to complete RUPV isolation.

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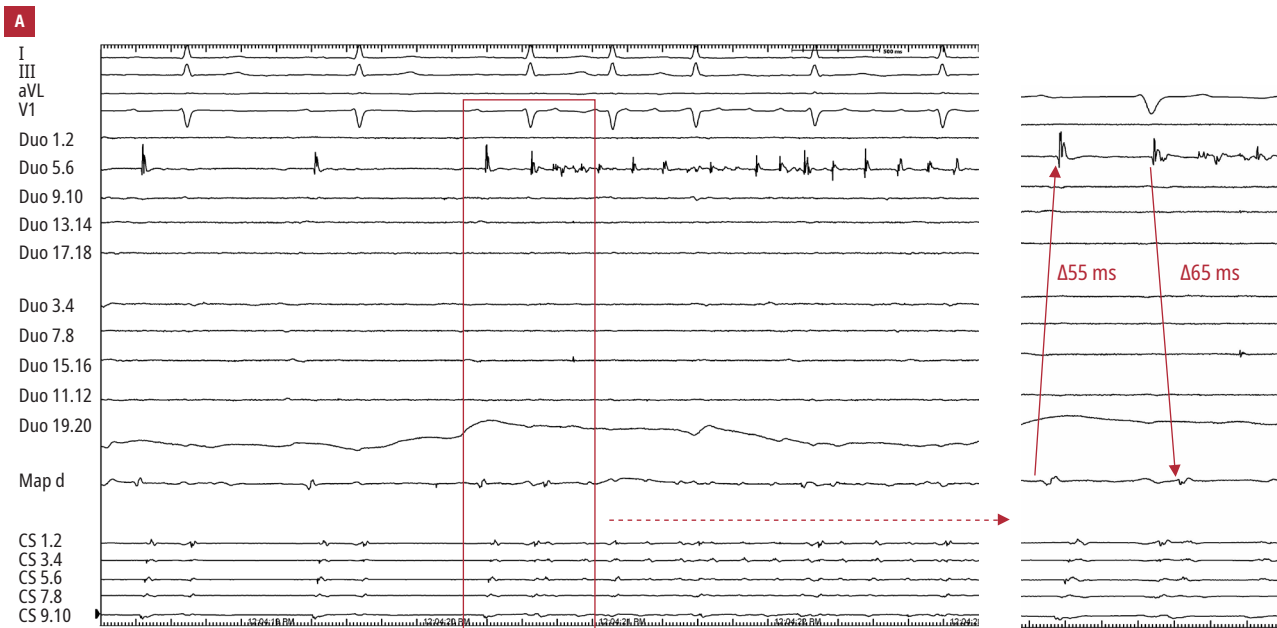
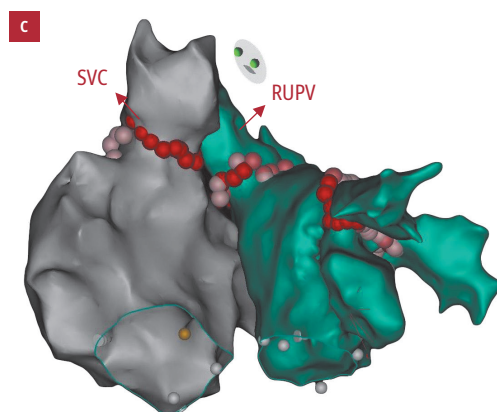
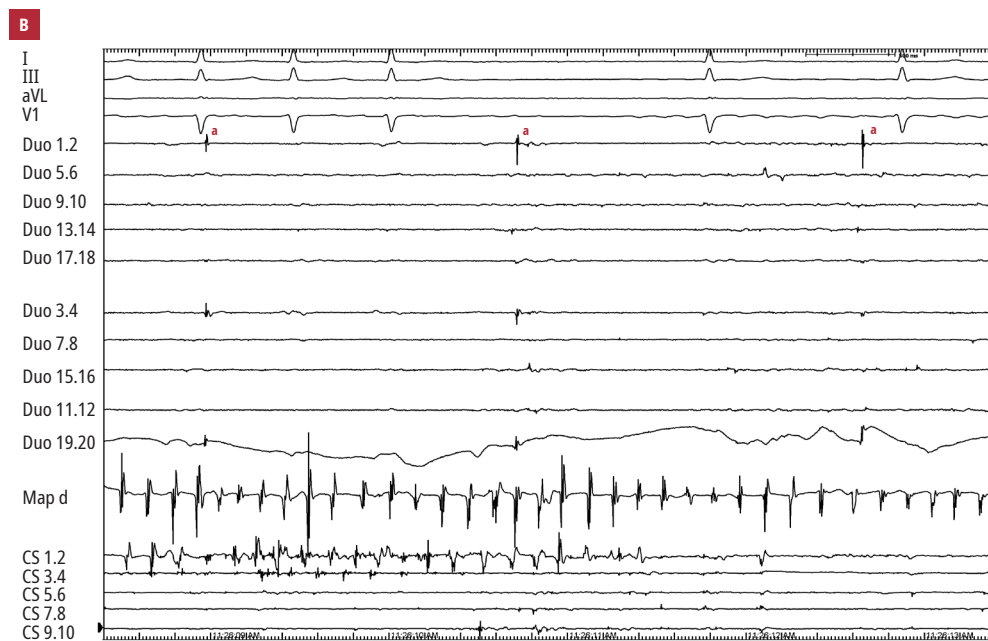


FIGURE 1 A – activation mapping in sinus rhythm, following isolation of the right-sided pulmonary veins (PVs), with an ablation catheter positioned at the posterior aspect of the superior vena cava (SVC) (Map d) and a Pentaray® catheter in the right upper PV (RUPV) (Duo 1.2–19.20), with Duo 5.6 positioned at the anterior wall. The arrow shows conduction from the SVC to the later-timed potential in the RUPV during sinus beat and reverse conduction during AF-initiating beat; **B** – dissociated PV activity (a) recorded from a Pentaray® catheter located within the RUPV during ongoing atrial fibrillation, clearly visible on the ablation catheter (Map d) positioned within the SVC; **C** – left and right atrial CARTO®3 shells with an encircling lesion set around the ipsilateral PVs and SVC. Note that the anterior part of the RUPV, located a couple of millimetres away from the antrum, is closely related to the posterior aspect of the SVC, allowing conduction between both structures



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