

# Is this vein isolated or not? How a new advanced algorithm helps find unconventional far-field sources



Francesco Solimene, MD,\* Francesco Maddaluno, MS,<sup>†</sup> Maurizio Malacrida, MS,<sup>†</sup> Vincenzo Schillaci, MD\*

From the \*Clinica Montevergine, Mercogliano (AV), Italy, and <sup>†</sup>Boston Scientific, Milan, Italy.

## Introduction

Multielectrode mapping catheters placed within pulmonary veins (PVs) usually detect an initial far-field electrogram (EGM) and then a sharp near-field EGM, which represents the local PV activity. The PV myocardial origin of the second potential is indicated by near-field characteristics of higher voltage and slope, proximal to distal activation within the vein. However, as there is significant overlap of amplitudes and slopes, these parameters do not reliably distinguish between the 2 potentials.<sup>1</sup> For this reason, when multiple far-field components are present inside a vein, distinguishing electrically active tissue inside the vein from electrically active neighboring tissue can be challenging.

To our knowledge, the present case report is the first to describe the characterization of local PV activity by means of an ultra-high-density Rhythmia mapping system (Boston Scientific, Marlborough, MA) and the new automated Lumipoint software (Boston Scientific), which helps to find far-field sources when multiple signals are detected inside a vein.

## Case report

A 50-year-old woman presented for radiofrequency ablation of paroxysmal atrial fibrillation. The left atrium (LA) and PVs were mapped by means of the Orion multipolar basket catheter (Boston Scientific) and Rhythmia mapping system during coronary sinus pacing. After point-by-point ablation of each vein, the Orion catheter was positioned in the left superior pulmonary vein (LSPV), where 2 components were detected (Figure 1); the first one was blunt and far-field-looking, while the second was sharp and near-field-looking. Is this vein isolated? Indeed, the vein could seem to be connected, if one assumes that the far-field-looking component is coming from the left atrial appendage (LAA), which is a common far-field source for this location,

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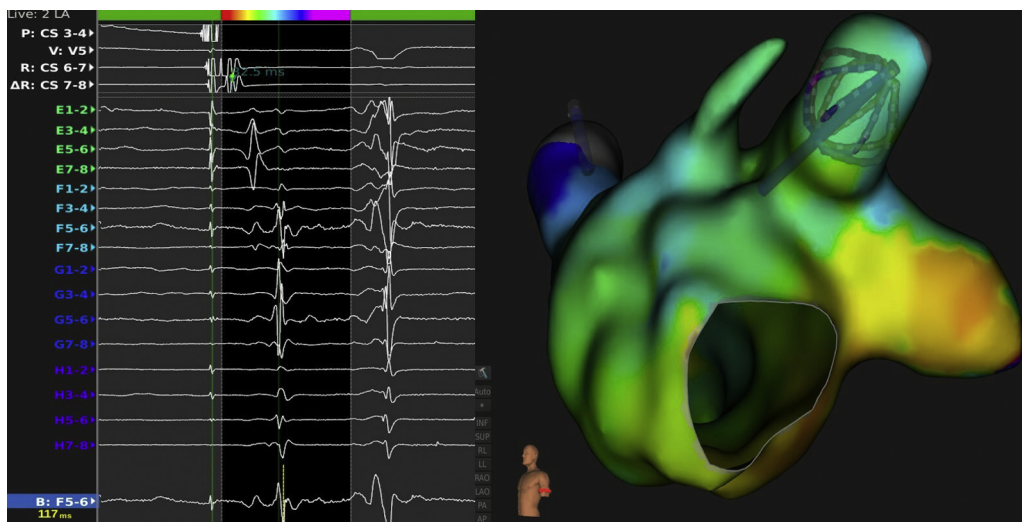
Francesco Maddaluno and Maurizio Malacrida are Boston Scientific employees. The other authors have no conflicts of interest. **Address reprint requests and correspondence:** Dr Francesco Solimene, Laboratorio di Elettrofisiologia, Clinica Montevergine, Via Mario Malzoni 5, 83013 Mercogliano (AV), Italy. E-mail address: [francescosolimene@msn.com](mailto:francescosolimene@msn.com).

## KEY TEACHING POINTS

- The present case report is the first to describe the characterization of local pulmonary vein (PV) activity by means of an ultra-high-density Rhythmia mapping system (Boston Scientific, Marlborough, MA) and the new automated Lumipoint software (Boston Scientific), which helps to find far-field sources when multiple signals are detected inside a vein.
- The software illuminates every electrogram (EGM) on the map that has a marked deflection falling within the search window, irrespective of whether or not that deflection has been chosen as the EGM annotation on the activation map.
- Using this tool sequentially on each PV component, the physician is immediately addressed to the specific left atrial site whose activation is simultaneous with the vein component under investigation.

and that the second, high-frequency signal is the local vein activity. However, a quick comparison with the Orion signals detected in the LSPV before ablation (Figure 2) immediately shows that radiofrequency ablation around this vein led to the disappearance of a third, high-frequency potential, which was the real vein activity. Consequently, the first 2 components detected inside the LSPV were both far-field potentials coming from unknown sources that needed to be identified. The Lumipoint software is a new map analysis tool with different features that can be selected in order to provide a comprehensive overview of Orion signals. Among these features, the simple activation search tool allows the operator to open a green search window inside the mapping window, so that the software will illuminate every EGM on the map that has a marked deflection falling within that search window, irrespective of whether or not that deflection has been chosen as the EGM annotation on the activation map.

By moving the Lumipoint acquisition window on each LSPV signal, the software can immediately illuminate



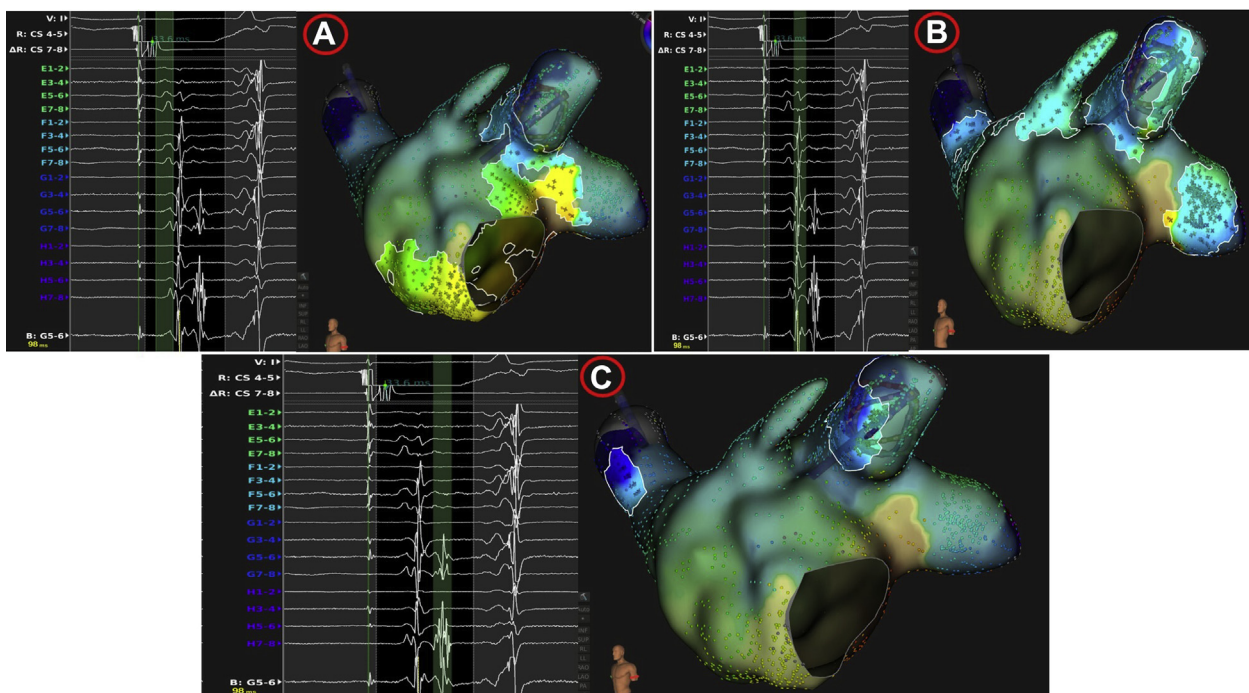
**Figure 1** Postablation remap of left superior pulmonary vein with the Orion catheter (Boston Scientific, Marlborough, MA). Two components were detected: the first one was blunt and far-field-looking, while the second was sharp and near-field-looking (“pulmonary vein–like signal”).

every neighboring tissue that has a simultaneous activation and that can potentially behave as a far-field source for the vein. In the present case, when the first LSPV component fell within the Lumipoint acquisition window, the low anterior atrium was illuminated. At this point, the green window was shifted to the second vein component and the LAA was illuminated. Pacing both from the low anterior atrium and from the LAA confirmed that the first 2

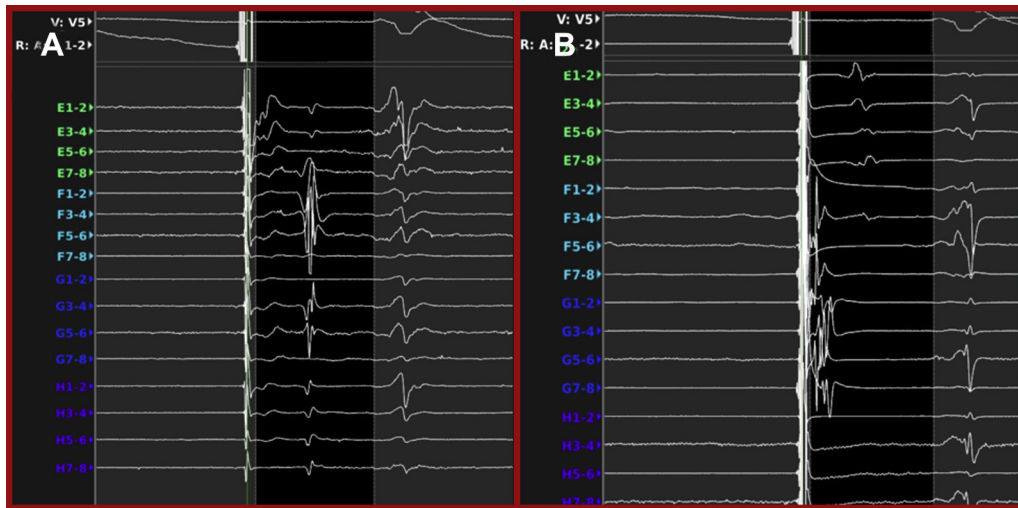
LSPV components were far-field signals coming from those regions (Figure 3).

## Discussion

The use of the Orion catheter, in comparison with conventional circular catheters, has been shown to improve recordings of PV potentials after incomplete ablation, owing to its



**Figure 2** Before ablation, the Orion catheter (Boston Scientific, Marlborough, MA) in the left superior pulmonary vein shows 3 signals displayed in the left part of each panel. Going from panel A to panel C, the Lumipoint (Boston Scientific) acquisition window is sequentially placed on each component of the pulmonary vein (PV) signal. **A:** The Lumipoint algorithm illuminates the left atrium, which activates simultaneously with the first vein component. **B:** The Lumipoint algorithm illuminates the left atrial appendage, which activates simultaneously with the second vein component. Pacing maneuvers confirmed those signals to be far-field activities from those regions. **C:** The Lumipoint algorithm illuminates the PV, confirming the last rapid activity to be the local vein depolarization.



**Figure 3** **A:** Pacing with the ablation catheter from the left atrium (LA) pulls the low-frequency component detected by the Orion catheter (Boston Scientific, Marlborough, MA) into the pacing stimulus, confirming the far-field origin from the LA. **B:** Pacing with the ablation catheter from the left atrial appendage (LAA) pulls the high-frequency component detected by the Orion catheter into the pacing stimulus, confirming the far field origin from the LAA.

small, closely spaced electrodes, which allow better discrimination of near-field PV potentials.<sup>2</sup>

Despite this improved mapping resolution, multiple far-field activities originating from neighboring anatomical structures can still be detected inside the vein, leading the electrophysiologist to use pacing maneuvers to avoid unnecessary ablation.

However, when far-field EGMs are “PV-like signals” or originate from an unconventional far-field source (like the LA), the differential diagnosis can be time-consuming, requiring multiple pacing maneuvers to find the specific atrial site likely to be responsible for the far-field component of the PV EGM.

The new Lumipoint acquisition window tool illuminates every area of the LA that has a marked activity falling within it. Using this tool sequentially on each PV component, the physician is immediately addressed to the specific left atrial site whose activation is simultaneous

with the vein component under investigation. Pacing from this region can quickly confirm the diagnosis of far-field origin of the vein signal.

In our case, this workflow pinpointed and accelerated the search for the far-field source responsible for the first far-field vein component, which unexpectedly turned out to be the LA; this is not a common far-field source for the LSPV.<sup>3</sup> With the same approach, the second, high-frequency vein component was quickly identified as far-field activity from the LAA.

## References

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