Received: 26 May 2020 | Revised: 8 July 2020 | Accepted: 10 July 2020
DOI: 10.1002/joa3.12413

CARDIAC ARRHYTHMIA SPOT LIGHT

Journal of Arrhythmia WILEY

Is signal resolution of linear cryocatheters appropriate to map superoparaseptal accessory pathways? A comparison with Orion high-resolution mapping

Valentino Ducceschi MD[1] | Francesco Maddaluno BS[2] | Giuseppe Del Giorno MD[3] | Angelo Catalano MD[3] | Angelo Carbone MD[3]

[1]Pellegrini Hospital, Napoli, Italy
[2]Boston Scientific, Milan, Italy
[3]Maria Santissima Addolorata Hospital, Eboli (SA), Italy

Correspondence
Valentino Ducceschi, Laboratorio di Elettrofisiologia, Ospedale Pellegrini, Via Portamedina alla Pignasecca 41, 80134 Naples, Italy.
Email valducceschi@gmail.com

Funding information
No external funding was obtained for this project.

KEYWORDS
accessory pathway, cryoablation, high-resolution mapping, signal resolution, superoparaseptal

1 | CASE PRESENTATION

A 28-year-old male patient was referred to our electrophysiology lab with a previously diagnosed anteroseptal accessory pathway (AP) and unsuccessful ablation attempt.

Detailed Rhythmia electroanatomical activation mapping was performed using the 64 pole Orion catheter (Boston Scientific, Marlborough, MA) whose printed electrodes have low surface area (0.4 mm^2) and 2.5 mm interelectrode distance. The activation map was carried out during atrial pacing from the proximal bipole of the decapolar catheter positioned into the coronary sinus (12 lead ECG with pre-excitation is shown in Figure S1) and the earliest antegrade ventricular activity during preexcitation was identified as a red spot on the map. In this region, the ventricular electrogram (EGM) preceded the delta wave onset of 46 ms (Video S1) and was fused with the atrial EGM identifying an outstanding target site for ablation.

A 6 mm tip linear cryocatheter (Freezor Xtra, Medtronic CryoCath, Kirkland Quebec, Canada) was advanced into the right atrium and positioned at the region with the earliest preexcited ventricular activity previously recorded by the Orion catheter, but impressively, the signals detected by the linear catheter (Video S1 and Figure S1) were not suggestive of a good ablation target at all.

Figure 1 represents a snapshot of this moment of the procedure: the white halo on the activation map indicates the real time Freezor catheter tip location (that was exactly on the red spot with earliest ventricular activation previously identified with the Orion catheter) and the white signals on the left panel of the figure are the real time bipolar and unipolar traces recorded by the linear cryocatheter in that position. The distal bipolar signal (Freezor 1-2) shows a late ventricular activity with a clear isoelectric line between atrial and ventricular EGMs, suggesting that the catheter tip was far from the AP ventricular insertion site. Using the roving probe tool on a Rhythmia map, a review graph can be opened in the right part of the screen to review previously acquired signals with the Orion catheter at the probe position during a single acquired beat: the lower part of this review graph shows the EGMs detected by the Orion bipole that was exactly beneath the roving probe location during map acquisition, while the upper part of the graph shows the remaining Orion signals recorded during the same beat. The analysis of this review graph in the right panel of Figure 1 confirms that the roving probe

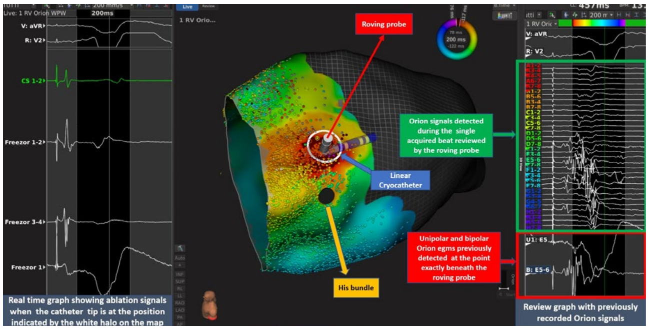

FIGURE 1 Linear cryocatheter positioned on the earliest preexcited ventricular activity, previously mapped with the Orion catheter that is represented as a red area on the activation map. The white halo on the map indicates the current position of the cryocatheter distal tip, while the roving probe is placed in the red area to allow reviewing of Orion signals previously recorded in that position for a single acquired beat. The graph on the left part of the picture shows real time ablation signals when the cryocatheter tip is at the position indicated by the white halo on the map. The graph on the right part of the picture allows reviewing of previously recorded Orion signals: the lower part of the graph shows unipolar and bipolar Orion EGMs previously detected at the point exactly beneath the roving probe, while the upper part of the graph shows all Orion signals detected during the single acquired beat reviewed by the roving probe

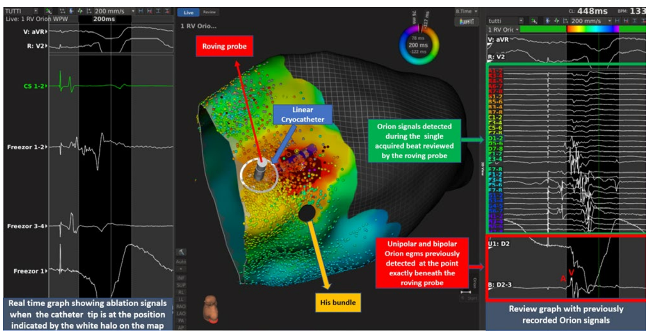

FIGURE 2 Linear cryocatheter positioned anterior and distal to the earliest preexcited ventricular activity, previously mapped with the Orion catheter that is represented as a red area on the activation map. The white halo on the map indicates the current position of the cryocatheter distal tip, while the roving probe is placed in the same corresponding area to allow reviewing of Orion signals previously recorded in that position for a single acquired beat. The graph on the left part of the picture shows real time ablation signals when the cryocatheter tip is at the position indicated by the white halo on the map. The graph on the right part of the picture allows reviewing of previously recorded Orion signals: the lower part of the graph shows unipolar and bipolar Orion EGMs previously detected at the point exactly beneath the roving probe, while the upper part of the graph shows all Orion signals detected during the single acquired beat reviewed by the roving probe

identifies an optimal ablation target in disagreement with the real time information provided by the ablation catheter. Furthermore, mapping revealed that the earliest preexcited ventricular activity

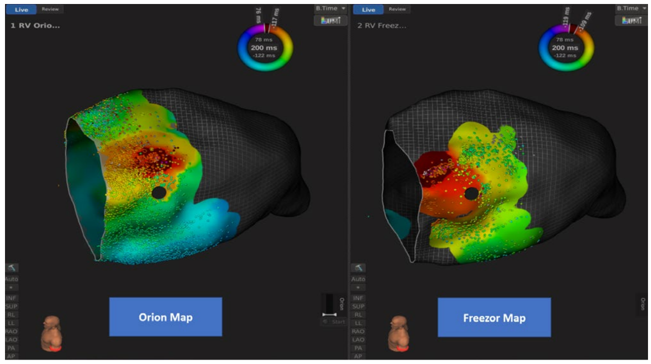

FIGURE 3 Activation maps acquired with the Orion catheter (left panel) and with the Freezor catheter (right panel). In both maps, the ablation target representing the earliest preexcited ventricular activity, is shown as a red region.

identified by the Freezor catheter was more anterior and distal than the ablation target found with the Orion catheter. The optimal ablation target area, based on cryocatheter signals, is indicated by the white halo (real time Freezor catheter tip position) in Figure 2: the real time graph on the left panel of the picture shows a very early ventricular EGM fused with a well-represented atrial EGM, suggesting a very good ablation target. However, putting the roving probe in the same position to review Orion signals previously recorded in that spot revealed that the atrial EGM was not well-represented (low amplitude and low frequency content) and that the ventricular EGM was later than the one detected in the red spot (Video S2).

Due to these discrepancies, we decided to carry out a second activation map with the Freezor catheter. As expected, the Freezor activation map was completely different from the Orion map and suggested a more anterior and distal ablation spot (Figure 3), revealing its worse signal resolution.

A test application (−30°C for 30 seconds) was delivered at the earliest spot of the Orion map interrupting conduction over the AP with no modification of normal conduction, then direct transition to −75°C up to 480 seconds was performed.

2 | DISCUSSION

Cryoablation is considered a safer alternative due to two main advantages: the potential for reversing an induced AV block and the adherence of the catheter tip to the endocardium with freezing.

Despite the high safety profile of cryoablation, the long-term efficacy is still lower than RF ablation. Some variables have been considered to explain the reasons for higher rate of recurrences, like the avoidance of a bonus application, the size of the freezing electrode and a longer time to success. Our case shows that another important reason that could potentially explain the lower long-term success rate of cryoablation is the poor resolution of the linear cryocatheter during mapping, that can guide the physician to target a region that is close to the AP location but not exactly on it. Considering the 6 mm length of the distal tip and the 2 mm interelectrode space to the first proximal ring, the distal ablation signal of the linear cryocatheter is recorded over a length of 8 mm which can displace the geometric center point of the measuring bipole and greatly decrease precision. By comparing Freezor and Orion EGMs in our case, it was clear that in Freezor recordings the more proximal tissue (closer to the first ring electrode) always made a great contribution to the overall signal. In addition to this, since this was a redo case, it was common to detect fractionated signals (likely due to the RF applications of the first procedure)with the Orion catheter in the superoparaseptal and parahissian region, but we could not detect the same amount of fractionation in the same area with the cryocatheter, because the Freezor distal ablation bipole likely filtered out some of the lowest amplitude fractionated components.

The use of 4 mm tip cryocatheters should improve EGM resolution, but it is less effective than the 6 mm and 8 mm tip cryocatheter, so we suggest to combine the use of the cryoablation technology with high-density electroanatomical mapping to further increase the precision and safety of the procedure, especially in redo cases.

CONFLICT OF INTEREST

Valentino Ducceschi has received speaker's fees from Boston Scientific Corporation, F. M. is a Boston Scientific employee, and no other conflicts of interest exist

ORCID

Valentino Ducceschi https://orcid.org/0000-0003-3730-5871

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Ducceschi V, Maddaluno F, Del Giorno G, Catalano A, Carbone A. Is signal resolution of linear cryocatheters appropriate to map superoparaseptal accessory pathways? A comparison with Orion high-resolution mapping. *J Arrhythmia*. 2020;36:942–944. https://doi.org/10.1002/joa3.12413