Pseudo-reentry due to automatic annotation of dissociated activity unmasked by the new Lumipoint™ algorithm

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Abstract
The new Lumipoint™ algorithm based on map analysis with several features is a valuable aid to understanding complex circuits, particularly as it can unmask areas with dissociated activity misleadingly annotated by an automatic mapping system.

KEYWORDS
atypical atrial flutter, high-density mapping system, Lumipoint, reentrant activity, RF ablation

1 | CASE REPORT

In patients undergoing repeat ablation procedures for left atrial flutter (LAF) or atrial fibrillation, multiple lines of block may be created, potentially giving rise to extensive atrial regions that are entirely confined by two previous ablation lines and are electrically dissociated from the rest of the atrial chamber.1 When these islands of atrial myocardium are automatically activated at a slower cycle length than the clinical tachycardia, automatic annotation of these dissociated electrograms might lead to an inaccurate interpretation of the whole circuit. Here, we provide the first report of a particular use of the new automated Lumipoint™ software tool to unveil areas with dissociated activity misleadingly annotated by an automatic mapping system.

We report the case of a 59-year-old woman presented for RF ablation of an atypical atrial flutter after she had already undergone pulmonary vein (PV) isolation and ablation of two separate anterior lines (from the right superior pulmonary vein to the mitral valve) for the treatment of both paroxysmal AF and perimitral LAF at another institution. The left atrium (LA) was mapped by means of the Orion™ multipolar basket catheter and Rhythmia™ mapping system (Boston Scientific). The propagation map (Video S1) of the flutter was quite complex, showing a collision of wavefronts at the posterior wall and two visually reentrant patterns: at the anterior wall and atrial septum. The Lumipoint™ software is a new map analysis tool with several features, which can be selected to provide a comprehensive overview of multielectrode signals and potentially help in the interpretation of complex circuits. One of these features, the simple activation search tool, allows the operator to open a green search window inside the mapping window; the software then illuminates every EGM on the map that has a spatio-temporally consistent deflection falling within that search window, irrespective of whether or not that deflection has been chosen as the EGM annotation in the activation map.

By scanning the Lumipoint™ search window throughout the full cycle length, we noticed that the area of presumed reentry at the anterior wall was not highlighted by the software. Indeed, on looking at each signal in that area, we noticed dissociated activity that had been automatically annotated the standard algorithm; this excluded by the Lumipoint™ software, owing to lack of temporal consistency (Figure 1).

After ruling out the false reentrant activity at the anterior wall, the septum was easily identified as the region containing the critical isthmus of the tachycardia (Video S2). The same conclusion was drawn by the analysis of another Lumipoint™ tool, called Skyline. This is a histogram showing the relative surface area of map that displays activation at...
any given time within the mapping window, where the x-axis is the tachycardia cycle length, and the y-axis is the amount of surface area activating. The valley of this graph represents a minimum amount of cardiac tissue that is activating at that specific time, which is likely to be a narrow isthmus. On placing the Lumipoint™ green window at the timing of the Skyline valley, the posterior septum was illuminated (Figure 2). After entrainment at this location had confirmed the site to be the critical isthmus, ablation in this area terminated the arrhythmia.

2 | DISCUSSION

In this new era of high-density mapping, activation maps contain thousands of points that are automatically accepted and annotated by the 3D mapping system according to specific criteria. Sometimes, however, a “wrong” beat may be accepted and therefore included in the resulting activation map. In most cases, the acceptance of a few wrong beats in a map containing thousands of correct beats does not alter the understanding of the circuit, but when the acceptance of wrong beats creates a pseudo-reentry pattern that does not exist, the physician can be misled in interpreting the map.

In the present case, the automatic acceptance of beats with dissociated activity created a false reentrant pattern at the anterior wall, complicating the interpretation of an already complex map. The new Lumipoint™ software is able to illuminate every area with a consistent spatial and temporal signal, regardless of its amplitude and annotation in the activation map. In our case, scanning with the Lumipoint™ green search window throughout the full cycle length immediately directed us to a large surface of
the atrium with dissociated activity in the anterior wall, which was not highlighted by the software. This area was confined by two previous ablation lines and showed slow automatic activity that should not have been included in the activation map. This case shows that the new Lumipoint™ software is a valuable aid to understanding complex circuits, particularly as it can unmask areas with dissociated activity, which, if automatically annotated by the 3D mapping system, can confound the interpretation of the propagation map by showing a false pseudo-reentrant pattern.

CONFLICT OF INTEREST

No external funding was obtained for this project. Francesco Maddaluno and Maurizio Malacrida are Boston Scientific employees, no other conflicts of interest exist.

AUTHOR CONTRIBUTIONS

FS: contributed to concept/design, drafting article, data analysis, and approval of article; FM: contributed to data analysis/interpretation, critical revision of article, and approval of article; MM: contributed to data analysis/interpretation, critical revision of article, and approval of article; VS: contributed to data collection, data analysis/interpretation, critical revision of article, and approval of article.

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SUPPORTING INFORMATION

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

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