A Novel Mapping Strategy of Repetitive Patterns in Consecutive Recordings to Localize Atrial Fibrillation Sources: an In-Silico Study

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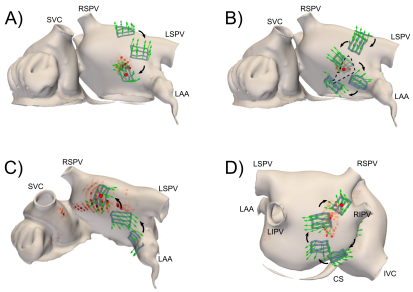
Aim: In some patients with persistent atrial fibrillation (AF), localized functional mechanisms may sustain AF and thus represent ablation targets. We propose a novel mapping strategy to locate sources of AF by combining repetitive patterns from consecutive high-density mapping recordings.
Methods: Unipolar endocardial electrograms recorded with a high-density mapping catheter are used as input to a source localization and detection algorithm. Starting from a given initial location, the algorithm attempts to identify an AF source either by directly classifying local activation patterns or by encircling the region in which a source is present.
Until a source is localized, the catheter is moved upstream from the main conduction direction of repetitive activations patterns, and the procedure is repeated. We tested the performance and robustness of this approach in two groups of detailed AF simulations, without and with severe structural remodeling (N=20 per group, 20 starting positions per simulation), using a 4x4 grid mapping catheter (3mm spacing).



Examples of mapping procedures. Sources were locally detected (A, C, D) or encircled (B)

Results: Structural remodeling was associated with more simultaneous sources (2 [1; 3] vs 3 [2; 5], $p < 0.001$) that meandered in larger areas (127.5 [82.0; 216.0] vs 188.0 [121.2; 305.5] mm^2, $p < 0.05$). The higher degree of complexity did not impair the mapping approach, which needed 6 [4; 9] vs 5 [3; 8] steps ($p < 0.001$) to localize a source within 11 [7; 16] vs 9 [6; 14] mm ($p = 0.046$) of the actual position. Sources were localized by encircling in 62.6% vs. 41.4% of the detection in both groups, respectively.
Conclusion: The proposed mapping strategy detected AF sources accurately within a few steps, even in complex AF substrates, with a substantial contribution of encircling to detect sources.