Does Mapping Catheter Geometry and Location Affect AF Driver Detection? A Simulation Study

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Ablation is the standard therapy to remove drivers triggering or sustaining atrial fibrillation (AF), including rotors. Therefore, the correct identification of both presence and location of rotors during the ablation procedure could support a more precise targets' tracking. Since rotor detection by multi-electrode catheters may be influenced by several parameters, in this study we developed a tool which allows testing the capability of detecting AF drivers with different catheter shapes and in different conditions. A 7.75s simulated spiral wave propagation in 2D tissue (50mm x 50mm) was obtained using a monodomain implementation and a modified Courtemanche model that considers an electrical remodeling. Two high-density multipolar catheters were simulated (Advisor™ HD Grid and Pentaray®) and placed in a region in which the simulated spiral persists longer. The inter-electrode distance, the coverage (number of electrodes) and the endocardium-catheter distance were changed. Our framework allowed the acquisition of the signal in unipolar mode at 2KHz. In contact with the wall and within 1mm distance from the real core all the configurations allowed a correct detection of the rotor, irrespective of geometry, coverage and inter-electrode distance. In the HD Grid-like geometry increasing the inter-electrode distance causes the incapability of rotor detection at a closer distance from the LA wall (inter-electrode distance 3/6mm up to 2/1mm endocardium-catheter distance). In the Pentaray-like configuration, independently from the inter-electrode distance, the rotor detection failed at 3mm endocardium-catheter distance. The asymmetry of this catheter resulted in rotation-dependence in the rotor detection. The tool was effective in assessing how catheter geometry and specific parameters affect its capability to detect rotors. In the future, other catheter morphologies and different parameters/conditions will be investigated.