

Fibrosis Reduces the Coincidence of Repetitive Activations Patterns between the Coronary Sinus and Atrial Regions in Simulated Atrial Fibrillation

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Aims Repetitive Atrial Activation Patterns (RAAPs) detected in the coronary sinus (CS) during atrial fibrillation (AF) may represent a reference to construct composite maps of coincidental local RAAPs elsewhere in the atria, potentially improving the identification of AF drivers. However, structural remodelling associated with AF progression may affect RAAP (co)incidence. Using computer simulations, we investigated coincidence of RAAPs in the CS and other regions in the atria, in the absence and presence of fibrosis.

Methods Unipolar electrograms from simulated AF episodes (n=18, 30s) were obtained from the CS (10-pole catheter) and 16 regions located in the left and right atria (4x4 grid, 3mm spacing) using a volumetric 3D model of the atria with either no or severe (70%) fibrosis. Incidence and prevalence of RAAPs were computed using recurrence plots. For each atrial location we determined the coincidence of RAAPs with CS RAAPs.

Results Fibrosis did not affect CS RAAP prevalence (median recurrence rate (RR) no fibrosis: 78%[Q25:73;Q75:94] vs. severe fibrosis: 84%[77;89], p=0.93), but decreased prevalence in atrial regions compared to CS (median Δ RR -15%[-4;-23] vs. -43%[-27;-53], p<0.01). Similarly, fibrosis reduced coincidence of RAAPs in atrial regions with CS (median coincidence 85%[83;89] vs. 63%[55;70], p<0.01). Especially left atrial regions (posterior and septum) and the superior right atrium exhibited a significant overall lower coincidence with the CS.

Conclusion During simulated AF in models with or without fibrosis the CS displayed highly repetitive behaviour. RAAP coincidence of other regions in the atria with the CS was high in the absence of fibrosis, but significantly decreased in the presence of fibrosis, most notably in the left atrium. In coincidental RAAPs in the CS and atrial regions, quantification of the degree of RAAP coupling is required to provide further confirmation of the validity of employing CS electrograms as a reference for composite RAAPs maps.

