Identification of mechanisms of maintenance of atrial fibrillation by signal processing

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Introduction Identification of mechanisms of maintenance of atrial fibrillation (AF) is challenging, no matter which technology is used for the characterization of the electrophysiological state of the atria. Patient-specific identification of those mechanisms is required to personalize the therapeutic approach to each AF patient.

Methods Current approaches are based on in silico models, animal experiments, and human data. Electrical mapping set-ups include either dense epicardial mapping or body surface recording systems, or a combination of both. High density epicardial mapping allows a spatially detailed analysis of the electrical activation patterns, but with a limited coverage of the entire atria. In contrast, body surface mapping allows a panoramic view of both atria with a poor spatial resolution.

Results We have found that by merging repetitive patterns detected in sequential recordings on the epicardium we could reconstruct composite conduction maps with increased coverage. This approach could enable composite sequential electro-anatomical mapping to detect stable mechanisms sustaining AF. Improvements on inverse problem resolution, including a combination of discretization, regularization and activation reconstruction allows to detect ectopic foci. Post-processing of inverse problem electrical maps allows detecting rotational activity that can be linked to the termination of the arrhythmia in AF patients.

Conclusion Joint efforts on signal processing and combination of different mapping techniques appear to be key in understanding driving mechanisms of AF, and should influence next developments in management of AF patients.