Characterization of propagation patterns with omnipolar EGM in epicardial multi-electrode arrays

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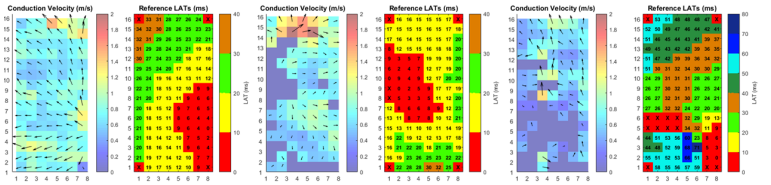
Background: Characterization of atrial propagation patterns can help understanding the mechanisms responsible for Atrial Fibrillation (AF) maintenance in a given subject and guiding appropriate therapy, as in RF ablation. Omnipolar EGM (OP-EGM) is a recently proposed technique to characterize propagation in multi-electrode catheters regardless of the relative angle between propagation direction and the electrodes. The aim of this work is to assess the accuracy of propagation parameters obtained with OP-EGM for different propagation patterns.

Materials and Methods: Epicardial EGM data recorded with a high-density multielectrode array (MEA) sensor during Sinus Rhythm (SR) and AF from a patient undergoing open-chest surgery were used. A uniform double-layer model of a planar slice of atrial tissue was used to simulate simple propagating patterns from a single focus at different positions. For both types of data, conduction velocities (CV), angles (θ) were obtained for each clique of 4 neighbor electrodes using the OP-EGM model.

Results: Analysis of simulated data showed good agreement with expected propagation patterns. With CV = 1m/s and a focus located at 30mm from the bottom of the MEA, estimated CV (mean$\pm$std) was 1.05$\pm$0.005m/s with estimated θ = 90.1$\pm$2.7; when focus was at the corner of the MEA, estimated CV was 1.1$\pm$0.25m/s; when it was at the middle of the MEA, CV was 1.1$\pm$0.32m/s. Larger errors appeared in cliques where the plane wave model does not hold. Analysis of clinical data showed good concordance with manual LAT maps, both in SR and AF.

Conclusions: OP-EGM allows to characterize atrial propagation patterns regardless of the relative direction with respect to the MEA. However, model compliance must be assessed to avoid large estimation errors in specific sites.



Maps of conduction velocity and reference LATs for three different activations during AF.