The Influence of Using a Static Diastolic Geometry in ECG Imaging

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Electrocardiographic imaging (ECGI) is a modality that noninvasively images electrical activation and recovery directly on the heart surface. One of the common assumptions when performing ECGI is that the cardiac geometry is in a static, diastolic state. To test the influence of this assumption, we compared ECGI reconstructions during systolic and diastolic geometries in four patients. Zero-th order Tikhonov regularization was used to reconstruct ventricular epicardial potentials. A spatiotemporal estimation method was then used to determine the activation and recovery times from the reconstructed epicardial electrograms. Geometries were segmented in a fully automated manner, to minimize the user influence. Activation times (AT), recovery times (RT) and electrogram correlation coefficients (CC) were compared for both geometries. Furthermore, CC and differences in AT/RT were correlated against the linear movement and a substitute for rotational movement (namely, distance to the apex). Overall, agreement between the inverse solution of both geometries was high (r_{AT}=0.86, r_{RT}=0.80, CC=0.98 on average) when assessed quantitatively, but regional differences may occur for qualitative interpretation (see figure). Poor correlation was found between linear or rotational movement and inverse solution differences (average r<0.09) between both geometries, suggesting that movement of the heart does not affect reconstruction accuracy. Still, while overall quantitative differences of epicardial potential maps and isochrones were low, using a constant diastolic geometry might influence clinical interpretation of ECGI, especially for areas of large repolarization heterogeneities. This first systematic investigation of the assumption of a static geometry may further help in interpreting ECGI.