Effects of Geometry in Atrial Fibrillation Markers Obtained with Electrocardiographic Imaging

R. Molero[1], A. M. Climent[2], I. Hernández-Romero[2], A. Liberos[1], F. Fernández-Avilés[2], F. Atienza[2], M.S. Guillem[1], M. Rodrigo[1]

[1]ITACA Institute, Universitat Politècnica de València, Valencia, Spain, [2]Cardiology Department, Hospital GU Gregorio Marañón, IiSGM, CIBERCV, Spain

Introduction. Electrocardiographic imaging (ECGI) can characterise cardiac pathologies such as atrial fibrillation (AF) through specific markers based on frequency or phase analysis. In this study, the effect of the geometry of patients' torso and atria in the ECGI resolution is studied.

Methods. A realistic 3D atrial geometry was located on 30 real patient torsos and ECGI signals were calculated for 30 different mathematical AF simulations in each torso. Dominant frequency (DF) and reentrant activity analysis were calculated for each scenario. Anatomical and geometrical measurements of each torso (30-80% of variability between patients) and atria were calculated and compared with the errors in the ECGI estimation versus the departing EGM maps.

Results. Results show evidences that big chest dimensions worsen the non-invasive calculation of AF markers ($p<0.05$). Also, higher number of visible electrodes from each atrial region improves ECGI characterization measured as lower DF deviations (0.64±0.26 Hz vs 0.72±0.27 Hz, $p<0.05$) and higher reentrant activity coincidence (10.1±12.2% vs 3.4±3.4%, $p<0.05$).

Conclusion. Torso and atrial geometry affect the quality of the non-invasive reconstruction of AF markers such as DF or reentrant activity. Knowing the geometrical parameters that worsen non-invasive AF maps may help to measure each detected AF driver reliability.

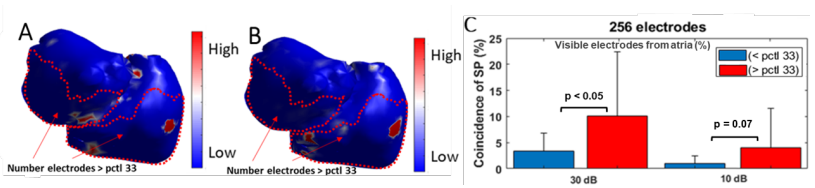

Figure. Singularity point (SP) map for departing EGM signals (A) and non-invasively reconstructed ECGI signals (B). Dashed line represents the atrial regions whose number of visible electrodes is over the percentile 33 (pctl 33). (C) Coincidence of SP detection between original EGM and ECGI maps for atrial regions with low/high number (pctl 33) of visible electrodes (N=900).