Left Atrium Fibrosis Quantification in Atrial Fibrillation Patients: an Open Issue

Vittoria Berrettini¹, Matteo Falanga¹, Corrado Tomasi², Cristiana Corsi¹

¹ DEI, University of Bologna, Campus of Cesena, Bologna, Italy
² Santa Maria delle Croci Hospital, AUSL della Romagna, Ravenna, Italy

Introduction. The extent of fibrotic tissue in the left atrium (LA) wall has been reported as an important index for AF treatment selection. Both late-gadolinium enhanced magnetic resonance imaging (LGE-MRI) acquisition and algorithm for fibrosis detection are critical issues since data acquisition require substantial expertise and no standard algorithm for data analysis is available. The aim of the study was to compare the results obtained applying different methods to quantify LA fibrosis in the 3D domain.

Methods. 157 LGE-MRI from 60 AF patients acquired at the CARMA Center (University of Utah) pre- and post-ablation, in which manual tracing of LA wall by expert radiologist was available, were analysed. Ten different approaches for fibrosis segmentation were applied: the histogram-based algorithms (H-nSD, four different versions), the image intensity ratio (IIR), the blood pool-based normalization approaches (BP, three different versions), the nulled myocardium-based reference and the full width at half maximum (FWHM). For each technique we quantified the percentage of fibrosis with respect to the entire LA wall mass.

Results. Correlation matrices between the different approaches obtained analyzing pre- and post-ablation data showed similar results within the same family, highlighting that the use of a different number of standard deviations doesn’t introduce significant differences in fibrosis quantification. Unfortunately, a wide variability was found among fibrosis percentages computed applying different methods (pre-ablation mean percentage range: from 1.5%±5% (BP) to 62.4%±24% (FWHM); post-ablation mean percentage range: from 6.1%±24% (BP) to 61.1%±23% (H-3SD). The only approach for which fibrosis quantification increased after ablation was the IIR.

Conclusions. This study confirmed that the quantification of fibrotic tissue percentage from LGE-MRI is indeed critical and strongly depends on the algorithm applied. Based on our results the IIR should be considered the most reliable approach, but further research is needed to define a satisfactory standard for fibrosis quantification.