Regionalization of left atrium in atrial fibrillation patients

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Introduction. Differently from the left ventricle, the regional segmentation of the left atrium (LA) is still a matter of investigation having the LA attracted the interest of the scientific community only recently. In this study, a new automatic approach for LA regional segmentation was proposed.

Methods. 3D patient-specific anatomical models were derived from CT through an active contour segmentation algorithm. These models represented the domain for the regional segmentation. First, the left atrial appendage (LAA) was detected applying a thresholding approach based on the shape diameter function. Then, the algorithm automatically calculated the weighted barycenter of the four pulmonary veins (PVs) by considering their area. These points were used to detect the roof and the posterior wall. The line connecting the weighted barycenter of the PVs and the center of the mitral valve (MV) was defined as the long axis of the LA. The annulus of the MV was divided into four equal parts allowing to extract four points. The boundaries of the anterior, inferior, lateral, septal regions were detected considering the position of these four points, of the long axis and of the centers of the PVs. An expert electrophysiologist graded the result of regional segmentation as: unacceptable, poor, fair and good.

Results. We considered 10 atrial fibrillation patients in which the size and the location of PVs and LAA varied, but still the algorithm ran on all cases and successfully divided the LA into seven regions. An example is shown in the figure. The grading of the expert was fair and good in 3 and 7 patients, respectively.

Conclusions. The proposed approach was effective in dividing the LA into seven standard regions. It successfully faced the variability in LA anatomy, but further testing is required to confirm these results. It represents a first step towards the quantification of regional functional and contraction indices of the LA.