Left Atrial Appendage Contraction Analysis: A Preliminary Test on Atrial Fibrillation Patients

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Introduction: In atrial fibrillation (AF), about 80% of the thrombi originates in left atrial appendage (LAA). However, it is still unclear how and to what extent LAA mechanical contraction and its wash-out correlations affect thrombogenesis. In this study, we proposed a method to evaluate the contraction of the LAA on a patient-specific regional basis.

Methods: Patient-specific dynamic anatomical models of the left atrium were derived from CT imaging applying an active contour segmentation algorithm in 5 normal subjects (NL) and 5 AF patients. The LAAs were manually detached from the LA chamber (Figure 1(A)). For each LAA the centerline was extracted (Figure 1(B)). The planes orthogonal to the centerline and passing through the two detected points obtained by dividing the centerline in three equal parts, allowed to define the proximal, middle, and distal 3D LAA regions (Figure 1(C) – top panel). Considering the position of the posterior wall and mitral valve with respect to the centerline, the medial and lateral regions were also defined (Figure 1(C) – bottom panel). To evaluate the LAA contraction, we computed ostium diameter variation, changes in centerline length as well as several contraction indices of the volumetric regions.

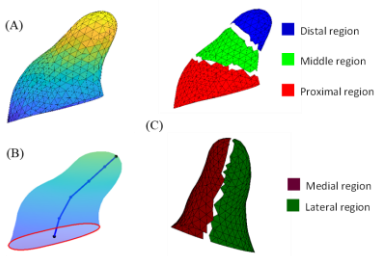

Figure 1: Example of the division of LAA into regions. (A) detached LAA; (B) centerline extraction; (C) automatic detection of the 5 volumetric regions.

Results: Ostium area percentage variation presented a significant difference in NL and AF: the mean percentage ostium area variation was 58.9%+/-10.6% in NL compared to 35.1%+/-8.8% in AF ($p<0.05$). Proximal region showed significant differences in percentage variation in regional radial dimension which was 33.2%+/-10.2% in NL and 18.1%+/-6.3% in AF ($p<0.05$).

Conclusions: In this study we proposed a regional segmentation of the LAA; several contraction parameters were computed to quantify the regional contraction of the LAA showing differences in normal subjects and in AF patients. Such preliminary results provide the basis for a more comprehensive assessment of LAA contraction which might be also very useful to run computational fluid dynamic simulations with realistic boundary conditions.