A New Approach to Derive a Dynamic Anatomical Model of the Left Atrium from 3D Echocardiography in Atrial Fibrillation

Matteo Falanga[1], Sachal Hussain[1], Matteo Lisi[2], Corrado Tomasi[2], Claudio Fabbri[1], Cristiana Corsi[1]

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

Introduction. Real-time 3-dimensional echocardiography (RT3D echo) is a novel technique capable of instantaneous acquisition of volumetric data. We propose a new approach to derive a complete dynamic anatomical model of the left atrium during atrial fibrillation (AF) episodes by using both RT3D transthoracic echocardiogram (RT3D-TTE) and RT3D transesophageal echocardiogram (RT3D-TEE).

Methods. 3D patient-specific anatomical and motion models were derived from RT3D-TTE and RT3D-TEE. By applying a deformable region-based approach, we extracted the LA and the LA appendage models from RT3D-TTE and RT3D-TEE, respectively. A two-step registration was then applied: an iterative closest point algorithm was first applied to fuse RT3D-TEE and RT3D-TTE in the same domain; then, an affine transform followed by a B-spline registration was used to obtain the motion model in AF throughout the cardiac cycle. This approach was tested on 5 consecutive AF patients.

Results. The proposed workflow was successfully applied to all patients. An example of the registration result is shown in the Figure. Validation of the derived motion model was only qualitatively performed not being available a reference motion field during AF. However, the computed displacement of the LA model throughout the cardiac cycle was representative of the small amplitude of wall contraction in AF (mean displacement throughout the cardiac cycle +/- SD (mm): 1.5+/-0.7, displacement range (mm) [0.1- 2.7]).

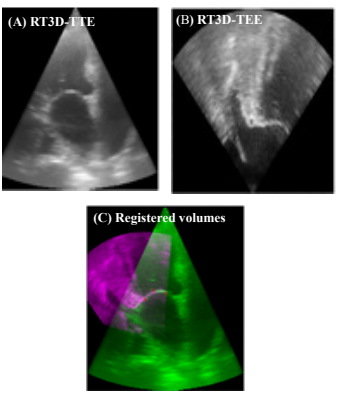

Figure: (A) plane extracted from RT3D-TTE; (B) plane extracted from RT3D-TEE; (C) registration result of the two volumes: visualization of the central plane.

Conclusions. We presented a unique approach to derive a dynamic anatomical model of the LA during AF episodes. Preliminary results are promising but further testing on a larger population is required.