

# Simulation of the Hemodynamic effects of the Left Atrial Appendage Occlusion in Atrial Fibrillation: preliminary results

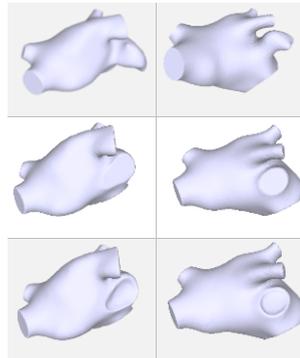
Nadia D'Alessandro<sup>1</sup>, Alessandro Masci<sup>1</sup>, Alice Andalò<sup>1</sup>, Luca Dedè<sup>2</sup>, Corrado Tomasi<sup>3</sup>, Alfio Quarteroni<sup>2</sup>, Cristiana Corsi<sup>1</sup>

<sup>1</sup>DEI, Campus of Cesena, University of Bologna, Cesena, Italy

<sup>2</sup>MOX, Polytechnic University of Milan, Milan, Italy

<sup>3</sup>Santa Maria delle Croci Hospital, AUSL della Romagna, Ravenna, Italy

In atrial fibrillation (AF) patients, stroke risk, secondary to thrombus formation in the left atrial appendage (LAA), is the most life-threatening condition. LAA occlusion (LAAO) is a novel strategy for cardioembolic stroke prophylaxis. Several devices have been developed for LAAO. Unfortunately, this procedure is associated with major adverse events and careful attention should be paid to balance benefits and risks linked to this procedure. The aim of this study was the simulation of the fluid dynamics effects of the LAAO to predict patient-specific hemodynamic changes due to LAAO, applying two different devices (Amulet<sup>TM</sup> and Watchman<sup>TM</sup>). 3D anatomical models of the LA were obtained from CT data in 2 patients. The shape diameter function was applied in order to automatically detect and remove the LAA. LAAO was reproduced at the ostium (see Figure). For each patient, three fluid dynamics simulations were performed. AF was simulated by employing a random displacement model of small amplitude. Simulations with the LAA showed different spatial distribution and higher velocities throughout the entire cardiac cycle compared to LAAO. Importantly, at the mitral valve and at the LAA ostium velocities were higher after LAAO. Similar hemodynamic patterns were observed in both patients with the two devices. However, some differences were noted especially in the number of fluid particles inside the LA after five cardiac cycles, that was higher for the first LAAO device. During atrial systole, a more chaotic fluid pattern was observed for the second LAAO device, probably due to its concave shape that causes variations in the fluid streamlines direction. Our preliminary results suggest (1) a more effective blood washout after LAAO and, consequently a lower risk of blood clot formation; (2) a slightly improved washout effect when the Watchman<sup>TM</sup> device is implanted. These results need confirmation in a larger



*LA models in two patients (columns), with the LAA (upper panels) and after LAAO (Amulet<sup>TM</sup> and Watchman<sup>TM</sup>, mid and bottom panels).*