# Coupled image processing and computational hemodynamics in a patient-specific Type B Aortic Dissection: a longitudinal study

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## ABSTRACT

The progressive false lumen aneurysmal degeneration in type B aortic dissection (TBAD) is a complex process coupling mechanical and biological dynamics. Patient-specific computational fluid dynamics (CFD) simulations compute specific quantities that may facilitate the understanding of this disease progression. A complete analysis requires the coupling of CFD with image processing techniques to identify morphological changes induced by tissue regrowth. Comprehensive morphological changes can be quantified by the point set registration (PSR) method so that the correlations between hemodynamic factors and changes in the false lumen may be established. In our clinical case, we have considered a patient presented with a TBAD in 2006, who did not receive surgery according to standard protocols. The same patient in 2010 underwent surgery, as the false lumen significantly grew. After an appropriate geometrical reconstruction of the original and follow-up geometries, we performed CFD using a cost-efficient Large Eddy Simulation (LES) solver implemented in the finite element library LifeV. LES was necessary for the local high velocity in the neighborhood of the entry tears. In particular, we resorted to a deconvolution filter technique based on the so called Evolve-Filter-Relax sequence [1]. Hemodynamic quantities, including velocity field, flow rate, wall shear stress (WSS) and its gradient, time averaged wall shear stress(TAWSS), relative residence time (RRT) and oscillatory shear index (OSI) were extracted. A 3D deformation field between the initial and follow-up geometries was obtained using PSR. Correlations between hemodynamic factors and the deformation were analyzed.

After introducing all the methodological aspects of our coupled approach, we present an extensive quantitative analysis that shows that the preventive using of CFD may have a predictive role of the false lumen evolution, so to significantly support surgical planning [2].

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## REFERENCES

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