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Integrating *in-vivo* data in numerical and *in-vitro* analyses of the hemodynamic in healthy and pathologic thoracic aorta

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Hemodynamic forces play an important role in the initiation and progression of cardiovascular diseases. In the last years, the merging of Computational Fluid Dynamics (CFD) with Magnetic Resonance Imaging (MRI) has been used to provide clinical information at a patient-specific level. Nevertheless, different sources of uncertainties are present in CFD models, e.g., inflow/outflow boundary conditions, and these uncertainties may affect the accuracy of the output quantities of interest (see e.g. [1]). A framework integrating *in-vivo* data into the simulation of a healthy thoracic aorta is presented in [2]. MRI data are used to provide/calibrate inlet and outlet boundary conditions in simulations and to validate the simulation results.
Three aorta geometries are considered herein: a patient-specific healthy aorta, an aneurysmal aorta, and a coarctated aorta, both derived from the former geometry. A comparison between the results obtained integrating *in-vivo* measurements in numerical simulations and *in-vitro* experiments is presented. Hemodynamic simulations are carried out by using the open-source code *Simvascular*. *In-vitro* data are obtained by a fully controlled and sensorized circulatory mock loop for 3D-printed aortic models. This experimental setup allows a few uncertainties that are conversely present *in-vivo* data to be eliminated: the flow rate is controlled, and it is the same for each cardiac cycle, the model is fixed, and the wall model properties are known. In this way, clearer indications can be obtained to asses and possibly improve the accuracy of CFD models.
The comparison between CFD and in-vitro data is excellent for all the considered cases. The agreement with *in-vivo* data is satisfactory and consistent with the possible controlled and uncontrolled differences with the numerical and *in-vitro* set-up. The validated CFD and *in-vitro* platforms are then used to investigate in details the hemodynamics and to point out, in particular, the differences between the healthy and pathological cases.

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