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Resolving Low-Density Lipoprotein (LDL) on the Human Aortic Surface Using Large Eddy Simulation JONAS LANTZ, MATTS KARLSSON, Linköping University, Sweden — The prediction and understanding of the genesis of vascular diseases is one of the grand challenges in biofluid engineering. The progression of atherosclerosis is correlated to the build- up of LDL on the arterial surface, which is affected by the blood flow. A multi-physics simulation of LDL mass transport in the blood and through the arterial wall of a subject specific human aorta was performed, employing a LES turbulence model to resolve the turbulent flow. Geometry and velocity measurements from magnetic resonance imaging (MRI) were incorporated to assure physiological relevance of the simulation. Due to the turbulent nature of the flow, consecutive cardiac cycles are not identical, neither in vivo nor in the simulations. A phase average based on a large number of cardiac cycles is therefore computed, which is the proper way to get reliable statistical results from a LES simulation. In total, 50 cardiac cycles were simulated, yielding over 2.5 Billion data points to be post-processed. An inverse relation between LDL and WSS was found; LDL accumulated on locations where WSS was low and vice-versa. Large temporal differences were present, with the concentration level decreasing during systolic acceleration and increasing during the deceleration phase. This method makes it possible to resolve the localization of LDL accumulation in the normal human aorta with its complex transitional flow.

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