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Mass Transport and Shear Stress as Mediators of Flow Effects on Atherosclerotic Plaque Origin and Growth RILEY GORDER, ALBERTO ALISEDA, University of Washington — The carotid artery bifurcation (CAB) is one of the leading site for atherosclerosis, a major cause of mortality and morbidity in the developed world. The specific mechanisms by which perturbed flow at the bifurcation and in the carotid bulge promotes plaque formation and growth are not fully understood. Shear stress, mass transport, and flow residence times are considered dominant factors. Shear stress causes restructuring of endothelial cells at the arterial wall which changes the wall's permeability. Long residence times are associated with enhanced mass transport through increased diffusion of lipids and white blood cells into the arterial wall. Although momentum and mass transfer are traditionally coupled by correlations similar to Reynolds Analogy, the complex flow patterns present in this region due to the pulsatile, transitional, detached flow associated with the complex geometry makes the validity of commonly accepted assumptions uncertain. We create solid models of the CAB from MRI or ultrasound medical images, build flow phantoms on clear polyester resin and use an IOR matching, blood mimicking, working fluid. Using PIV and dye injection techniques the shear stress and scalar transport are experimentally investigated. Our goal is to establish a quantitative relationship between momentum and mass transfer under a wide range of physiologically normal and pathological conditions.

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