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Influence of transport on thrombogenic potential in cardiovascular flows[1] KIRK B. HANSEN, SHAWN C. SHADDEN, Univ of California - Berkeley — Intraluminal thrombus is a common complication inside aneurysms, as well as inside hearts with pumping or rhythmic deficiencies. The mechanisms of thrombus formation in these scenarios remain unclear. As opposed to stenotic thrombosis, where shear-induced platelet activation likely plays a major role, the shear stresses in aneurysmal flows are typically lower than in the surrounding vasculature. This suggests an alternative mechanism more akin to the stasis-driven coagulation typically seen on the venous side of the cardiovascular system. In this work, we investigate how transport properties of the complex flow features inherent to aneurysmal (or intracardiac) flows may affect the potential for thrombus formation. Patient-specific three-dimensional velocity fields are obtained using image-based computational fluid dynamics. These velocity fields are then coupled to a computational thrombosis model based on a system of reaction-advection-diffusion equations. This continuum-based model accounts for the transport and activation of platelets, as well as the transport and reaction of other chemical species involved in the coagulation cascade. Near-wall values of thrombin concentration are used as a metric for localized thrombogenic potential.

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