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Simulations of blood flow in patient-specific aortic dissections with a deformable wall model KATHRIN BAEUMLER, VIJAY VEDULA, ANNA SAILER KARMANN, ALISON MARSDEN, DOMINIK FLEISCHMANN, Stanford University — Aortic dissection is a life-threatening condition in which blood penetrates into the vessel wall, creating a second flow channel, often requiring emergency surgical repair. Up to 50% of patients who survive the acute event face late complications like aortic dilatation and eventual rupture. Prediction of late complications, however, remains challenging. We therefore aim to perform accurate and reliable patient-specific simulations of blood flow in aortic dissections, validated by 4D-Flow MRI. Among other factors, this is a computational challenge due to the compliance of the vessel walls and the large degree of membrane deformation between the two flow channels. We construct an anatomic patient-specific model from CT data including both flow channels and the membrane between them. We then run fluid structure interaction simulations using an arbitrary Lagrangian-Eulerian (ALE) formulation within a multiscale variational framework, employing stabilized finite element methods. We compare hemodynamics between a rigid and a deformable wall model and examine membrane dynamics and pressure differences between the two flow channels. The study focuses on the computational and modeling challenges emphasizing the importance of employing a deformable wall model for aortic dissections.

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