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Fluid Dynamics of Thrombosis in Transcatheter Aortic Valves[1]
JUNG HEE SEO, CHI ZHU, ZHONGWANG DOU, JON RESAR, RAJAT MITTAL, Johns Hopkins University — Transcatheter aortic valve replacement (TAVR) with bioprosthetic valves (BPV) has become highly prevalent in recent years. While one advantage of BPVs over mechanical ones is the lower incidence of valve thrombosis, recent clinical studies have suggested a higher than expected incidence of subclinical bioprosthetic valve thrombosis (BVT). Many factors that might affect the transvalvular hemodynamics including the valve position, orientation, stent, and interaction with the coronary flow, have been suggested, but the casual mechanisms of valve thrombosis are still unknown. In the present study, the hemodynamics associated with the formation of BVT is investigated using a novel, coupled flow-structure-biochemical computational modeling. A reduced degree of freedom, fluid-structure-interaction model is proposed for the efficient simulation of the hemodynamics and leaflet dynamics in the BPVs. Simple models to take into account the effects of the stent and coronary flows have also been developed. Simulations are performed for canonical models of BPVs in the aorta in various configurations and the results are examined to provide insights into the mechanisms for valve thrombosis.

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