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Effect of vortex generators on the closing transient flow of bileaflet mechanical heart valves DAVID MURPHY, LAKSHMI DAS, AJIT YOGANATHAN, ARI GLEZER — The time-periodic closing of bileaflet mechanical heart valves is accompanied by a strong flow transient that is associated with the formation of a counter-rotating vortex pair near the b-datum line of leaflet edges. The strong transitory shear that is generated by these vortices may be damaging to blood elements and may result in platelet activation. In the present work, these flow transients are mitigated using miniature vortex generator arrays that are embedded on the surface of the leaflets. Two vortex generator designs were investigated: one design comprised staggered rectangular fins and the other one staggered hemispheres. The closing transients in the absence and presence of the passive vortex generators are characterized using phase locked PIV measurements. The study utilizes a 25 mm St. Jude Medical valve placed in the aortic position of the Georgia Tech left heart simulator. Measurements of the velocity field in the center plane of the leaflets demonstrate that the dynamics of the transient vortices that precede the formation of the leakage jets can be significantly altered and controlled by relatively simple passive modifications of existing valve designs. Human blood experiments validated the effectiveness of miniature vortex generators in reducing thrombus formation by over 42 percent.

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