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Manipulation of the closing transients of bileaflet mechanical heart valves using passive, surface-mounted elements HELENE SIMON, LAKSHMI DASI, AJIT YOGANATHAN, ARI GLEZER, Georgia Tech — 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. The closing transients in the absence and presence of the passive vortex generators are characterized using PIV measurements that are phase locked to the leaflet motion. The study utilizes a 25 mm St. Jude Medical valve placed in the aortic position of the Georgia Tech left heart simulator. The valve is subjected to physiological flow conditions: a heart rate of 70 bpm; a cardiac output of 5 l/min; and a mean aortic pressure of 90 mmHg. 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.

Ari Glezer
Georgia Tech

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