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Mitigation of Shear-Induced Blood Damage of Mechanical Bileaflet Heart Valves using Embedded Vortex Generators[1] PABLO HIDALGO, SIVAKKUMAR ARJUNON, NEELAKANTAN SAIKRISHNAN, AJIT YOGANATHAN, ARI GLEZER, Georgia Institute of Technology — The strong transitory shear stress generated during the time-periodic closing of the mechanical prosthetic bileaflet aortic heart valve, is considered to be one of the main factors responsible for complications, associated with thrombosis and thromboembolism. These flow transients are investigated using phase and time-averaged PIV in a low-volume (about 150 ml) test setup that simulates the pulsatile physiological conditions associated with a 23 mm St. Jude Medical valve. The PIV measurements are accompanied by continuous monitoring of the ventricular and aortic pressures and valve flow rate. Following the valve closure, the leakage flow between the valve leaflets is caused by the pressure buildup across the leaflets, leading to the formation of a regurgitation jet starting from the BMHV B-datum line. As in a typical starting jet, a counter-rotating vortex pair is formed along each leaflet edge and the vorticity sheet is associated with high shear stress that may be result in blood platelet activation. The present investigation demonstrates that the placement of arrays of mm-scale vortex generators near the edges of the leaflets diffuses the vortex sheet and suppresses the formation of these vortices, weakening the local velocity gradients and small-scale vortical structures.

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