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Simulations of pulsatile suspension flow through bileaflet mechanical heart valves to quantify platelet damage BRIAN YUN, CYRUS AIDUN, AJIT YOGANATHAN, Georgia Institute of Technology — Studies have shown that high shear stress and long exposure times on platelets have a strong impact on thromboembolic complications in bileaflet mechanical heart valves (BMHVs). This numerical study quantifies the platelet damage incurred in pulsatile flow through various BMHV designs. The lattice-Boltzmann method with external boundary force (LBM-EBF) was implemented to simulate pulsatile flow and capture the dynamics and surface shear stresses of modeled platelets with realistic geometry. The platelets are released in key regions of interest in the geometry as well as at various times of the cardiac cycle. The platelet damage is quantified using a linear shear stress-exposure time blood damage index (BDI) model. The multiscale computational method used to quantitatively measure the BDI during the pulsatile flow has been validated as being able to accurately capture bulk BMHV fluid flow and for accurately quantifying platelet damage in BMHV flows. These simulations will further knowledge of the geometric features and cardiac cycle times that most affect platelet damage. This study will ultimately lead to optimization of BMHV design in order to minimize thromboembolic complications.

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