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Intra-Ventricular Flow Dynamics Post-Implantation of a Bileaflet Mechanical Heart Valve

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Surgical replacement of a dysfunctional valve with heart valve prosthesis is a viable option for patients suffering from severe heart valve disease. Among various prosthetic heart valves, bileaflet mechanical heart valves (BMHVs) have widely been implanted, owing to their long life span and durability. However, the non-physiological flow phenomena (e.g., hinge jet, squeeze flow, and regurgitation jet) make BMHVs vulnerable to calcification and thromboembolism. Computational methods have extensively been utilized to understand and optimize the hemodynamic performance of BMHVs. Due in part to the difficulty of modeling the beating left ventricle, the numerical studies of BMHV at mitral position are quite limited. Hence, in this study, intra-ventricular flow after implantation of a 25 mm BMHV at mitral position has been numerically simulated, utilizing fluid-structure interaction analysis, in order to accurately predict leaflet dynamics. The numerically predicted intra-ventricular flow was comparable to earlier numerical and experimental results available in the literature.

Keywords: Computational Simulation, Fluid-Structure Interaction (FSI), Hemodynamics, Mitral Valve