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In-vitro investigation of the effect of variable pulsatile flow and Left Ventricular Assist Device speed on the intraventricular hemodynamics MARISSA MIRAMONTES, FANETTE CHASSAGNE, VENKAT KESHAV CHIVUKULA, JENNIFER BECKMAN, CLAUDIUS MAHR, ALBERTO ALISEDA, University of Washington, MEHCANICAL ENGINEERING AND CARDIOLOGY COLLABORATION — Left Ventricular Assist Devices (LVAD) are used to treat end-stage heart failure but induce unfavorable hemodynamics in the left ventricle (LV) that can result in thromboembolic and hemorrhagic events such as stroke. This study aims to quantify the impact of native contractility and LVAD speed on fluid mechanics inside the LV, and the associated thrombogenicity. Stereo Particle Image Velocimetry (PIV) measurements of the flow in a patient-specific LV flow phantom implanted with a real LVAD are analyzed under a wide range of clinically relevant parameters: pulsatility, preload and afterload. The combination of reduced pulsatility and LVAD speed results in highly heterogenous flow patterns, with co-existing jet-like flow and high-residence time recirculating regions. Increased pulsatile flow and higher LVAD speeds improve velocity field variability, associated with less stagnation. Pulsatility plays a greater role in reducing stagnant regions compared to increasing LVAD speed. Unfavorable hemodynamics caused by decreased contractility combined with low LVAD speed may explain the persistent incidence of thrombosis even in new generation LVADs.

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