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Vortex and energy characteristics of flow in the left ventricle following progressive severities of aortic valve regurgitation GIUSEPPE DI LABBIO, LYES KADEM, Concordia University — During the heart's filling phase, a notorious vortex is known to develop in the left ventricle (LV). Improper development and poor energetic behavior of this vortex can be correlated with cardiac disease. In particular, during aortic valve regurgitation (leakage of blood through the aortic valve during LV filling), this vortex is forced to interact with a jet emanating from a regurgitant orifice in the valve. The ensuing flow in the left ventricle subject to this disease has yet to be fully characterized and may lead to new indices for evaluation of its severity. As such, this experimental work investigates flow in a model LV subject to aortic regurgitation on a novel double-activation left heart duplicator for six progressive grades of regurgitation (beginning from the healthy case). Double-activation (independent activation of the atrium and ventricle) is critical to the simulation of this pathology. Regurgitation is induced by restricting the closure of the aortic valve to a centralized orifice. The velocity fields for each case are acquired using 2D time-resolved particle image velocimetry. Viscous energy dissipation and vortex formation time are investigated and found to significantly increase as the pathology progresses, while a histogram of vorticity tends toward a shifted and depressed Gaussian distribution. Proper orthogonal decomposition reveals significant disruption of the dominant energetic coherent structures.

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