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Further classification of the cardiac vortex: On the scaling of core vorticity with heart rate GIUSEPPE DI LABBIO, LYES KADEM, Concordia University Montreal — The generation and persistence of a diastolic vortex ring within the healthy left ventricle has gained significant interest over the past two decades. This cardiac vortex has been shown to ease the transport of blood from inflow to outflow, preserving inflowing kinetic energy in a near-optimal manner while also promoting low blood residence time. Nonetheless, despite its practical interest and the multitude of associated diagnostic indices developed over the years, there has been no attempt at modeling the behavior of the cardiac vortex core. In this work, the flow in a healthy left ventricle was simulated in vitro in a double-activation left heart duplicator. The ensuing flow was captured using two-dimensional time-resolved particle image velocimetry in a clinically-relevant plane. Three heart rates were examined (50, 70 and 90 bpm). By comparison to the Lamb-Oseen-Hamel vortex, a one-parameter physics-based empirical fit is developed for the temporal evolution of the vorticity of the cardiac vortex core. The fitting constant is shown to be related to the circulation of the core by the end of the E wave of filling. With a suitable choice of scaling (dependent on the heart rate and ventricle width), the core vorticity at different heart rates appear to collapse onto a single curve.

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