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Theoretical and Experimental Evidence for the Role of Vorticity in Ventricular Flow ALEJANDRO ROLDN-ALZATE, RYAN PEWOWARUK, University of Wisconsin - Madison — In the ventricular flow literature, vorticity is a frequently reported parameter that is credited for being a key marker of blood flow dynamics and particularly flow efficiency. However, the exact role of vorticity in ventricular flow efficiency has yet to be explained. We apply the concept of enstrophy from turbulence and geophysical fluid dynamics to ventricular flow to explain the relationship between vorticity and viscous energy dissipation. Theoretically, enstrophy predicts a quadratic relationship between vorticity and viscous energy dissipation. Magnetic resonance velocimetry is performed in pigs using a high spatial resolution, radial acquisition (PC-VIPR). Velocity derived vorticity and viscous energy dissipation in both the left and right ventricle of pigs show strong agreement with the theoretical quadratic relationship (R^2 =0.94). This work is the first rigorous explanation of the importance of vorticity in ventricular flow and we hope the concept of enstrophy is further applied in cardiovascular research. Additionally, experimental evidence shows strong agreement with theory, highlighting the ability of magnetic resonance velocimetry to quantify key aspects of cardiovascular fluid dynamics in living subjects.

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