Functional significance of intra-left ventricular vortices on energy efficiency in normal, dilated, and hypertrophied hearts

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Abstract

Purpose: To investigate the influence of changes in intra left ventricular (LV) vortices on LV energy efficiency (EE) in normal and diseased hearts. Methods: Vector flow mapping echocardiography was performed in 36 normal subjects (N), 36 patients with dilated cardiomyopathy (D), and 36 patients with LV hypertrophy (H). The circulation of main anterior vortex was measured as a parameter of vortex strength and EE was calculated as energy loss divided by LV stroke work. Results: Circulation increased in the order of N, H, and D (N: 15±4, D: 19±8, H: 17±6 10-3m^2/s; analysis of variance [ANOVA], P<0.01). Conversely, EE increased in the order of N, D, and H (N: 0.22±0.07, D: 0.26±0.16, H: 0.30±0.16 10^{-5}J/mmHg·mL·m·s; ANOVA, P=0.04), suggesting worst EE in group H. We found a positive correlation between circulation and stroke work only in group N and positive correlation between circulation and EE only in diseased groups (D: R=0.55, P<0.01; H: R=0.44, P<0.01). Multivariable analyses revealed that circulation was the independent determinant of EE in both of groups D and H. Conclusions: Enhanced vortices could work effectively to increase LV external work without loss of EE in normal hearts, while in failing hearts only to worse EE, regardless of the LV morphology.

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Figure 1

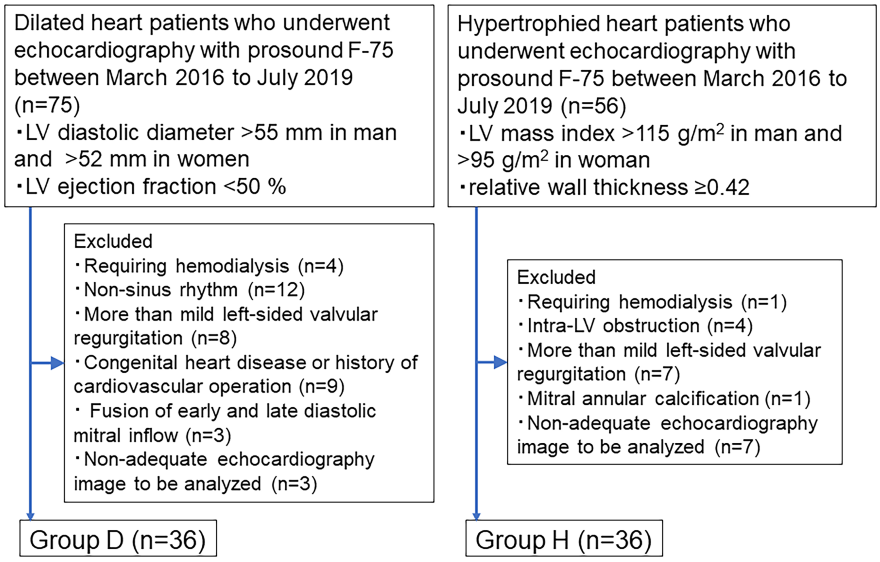

Figure 2

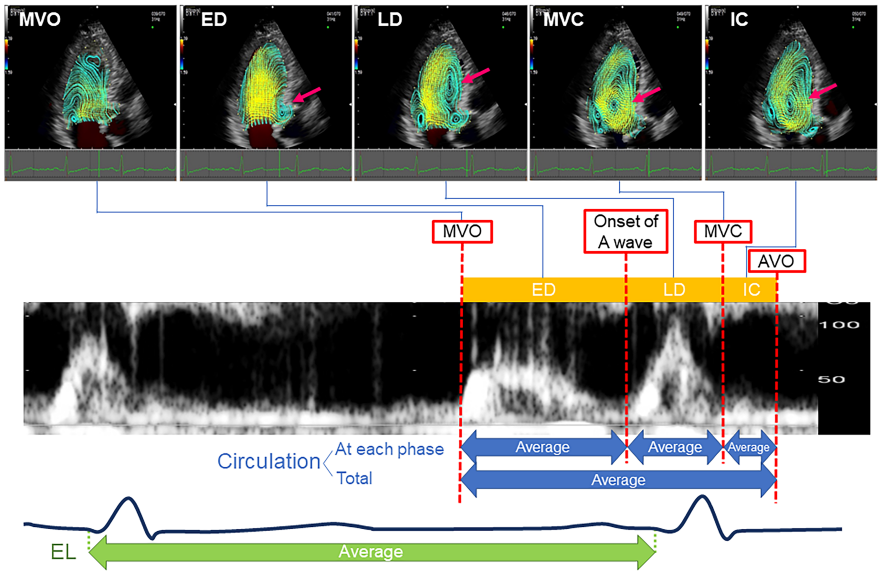

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Figure 3

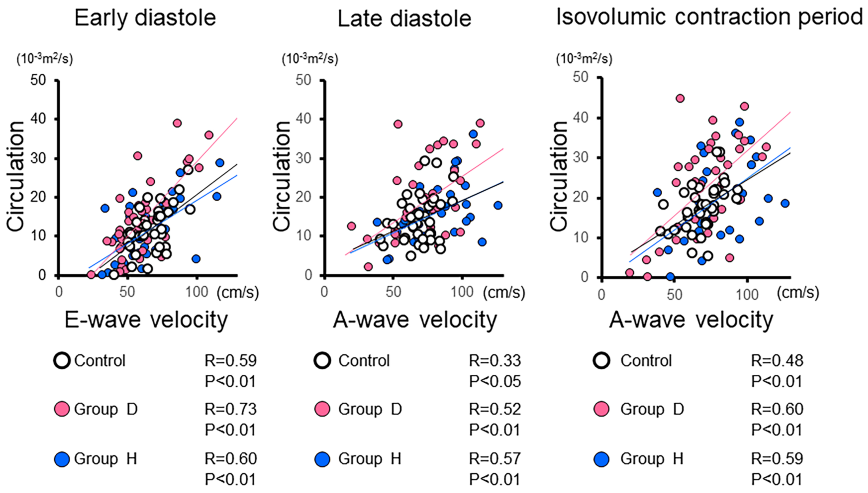
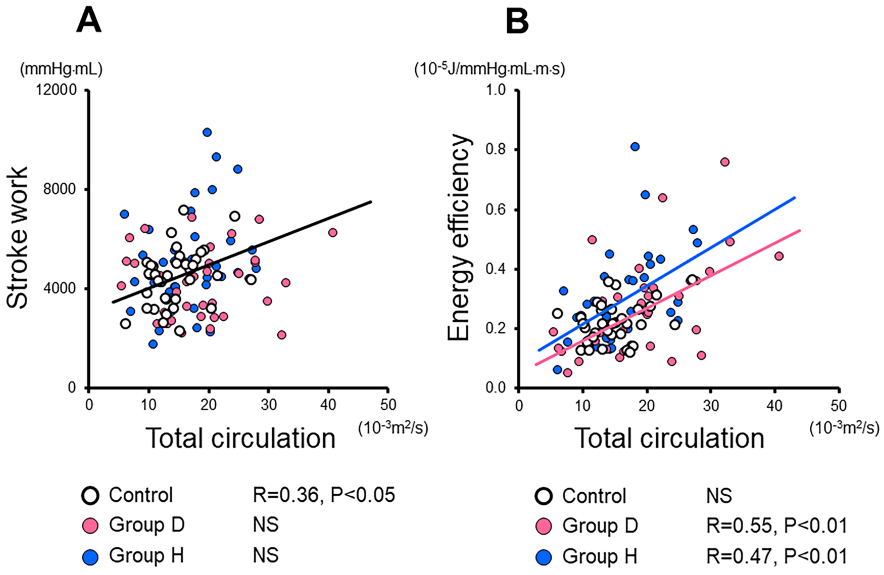


Figure 4



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