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Left ventricular flow energetics predicts worsening heart failure in dilated cardiomyopathy

Takahashi L.[1]; Uejima T.[2]; Hayama H.[3]; Cho J.[2]; Chikamori T.[1]; Yamashita T.[2]

[1]Tokyo Medical University Hospital, The Department of Cardiology, Tokyo, Japan
[2]Cardiovascular Institute, The Department of Cardiology, Tokyo, Japan
[3]National Center for Global Health and Medicine, The Department of Cardiology, Tokyo, Japan

Background: Blood flows through healthy hearts form optimal flow structures; they store flow kinetic energy (KE) that can be used for ejection. In contrast, in failing hearts, intracardiac flows become disorganized so that they may be energetically inefficient. However, it remained unknown whether left ventricular (LV) flow energetics prognosticates in heart failure.

Methods: This study included 61 patients with dilated cardiomyopathy (DCM). The temporal change in KE during early diastole (ED), atrial contraction (AC) and isovolumic contraction (IVC) was measured using Vector Flow Mapping particle tracking (Hitachi, figure top). LV inflow (total flow) were divided, based on whether they were ejected (direct flow, DF) or stayed in LV (retained flow, RF) in the following systole. KE of DF can be made use of for ejection, whereas KE of RF is supposed to be wasted. Diastolic function was graded, according to current EACVI/ASE guidelines. The patients were followed up for three years. Primary endpoint was hospitalization for worsening heart failure (WHF).

Results: 12 patients had hospitalizations for WHF in the follow-up period. KE of total flow did not show any significant difference through the cardiac cycle between patients with and without WHF. KE of DF was slightly, but not significantly, smaller (ED: p = 0.252, AC: p = 0.119, IVC: p = 0.122), and KE of RF was slightly, but not significantly, larger (ED: p = 0.971, AC: p = 0.085, IVC: p = 0.134) in patients with WHF than those without events. The ratio of DF and RF (DF/RF ratio) showed significant differences between these two groups, especially from AC through IVC (figure, bottom-left). Cox proportional hazard analyses demonstrated that DF/RF ratio during IVC showed a significant correlation with clinical outcomes (p = 0.033, hazard ratio = 0.067). It remained significant even after adjusted for diastolic function grade (p = 0.046, hazard ratio = 0.074). Kaplan-Meier analysis confirmed the above results (figure, bottom-right). Conclusion: Efficiency of KE recruitment for LV ejection during IVC is associated with clinical outcomes in DCM.

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