Novel Echocardiographic Parameter in Heart Failure Is Born

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The number of hospitalized patients has been increasing every year with >10,000 new cases of heart failure (HF) reported in the past 5 years in Japan. It has been estimated that the incidence of left ventricular (LV) dysfunction will increase to a peak of 1.3 million patients by 2035.1 This situation has been termed the “HF pandemic.” The etiology of HF is variable.2–5 One-third of HF cases are reported to be due to ischemic heart disease.2–4 Secondary prevention and treatment of HF is important, especially for acute coronary syndrome survivors with reduced ejection fraction (EF). Hypertensive heart disease is also one of the most common causes of HF in Japan. First, LV diastolic dysfunction occurs in hypertensive patients. If the pressure overload is sustained, HF with preserved EF (HFpEF) occurs. Conversely, if the volume overload is sustained, HF with reduced EF (HFrEF) occurs.6 Valvular disease, especially in patients with aortic valve stenosis and/or mitral valve regurgitation, is the next big issue in HF.

Echocardiography is the most important imaging modality in patients with HF, and it is also useful for the serial assessment of cardiac function and hemodynamics over a period of time. Various echocardiographic parameters for the assessment of cardiac function are recommended (Figure).7,8

According to a report from the JASPER Registry, Japanese patients with HFpEF had a higher prevalence of atrial fibrillation (AF).9 In patients with AF, however, the use of echocardiography to assess LV diastolic function is limited. The dual Doppler system has been introduced with unique features that allows simultaneous recording of Doppler waveforms at 2 different sites with a single beat. Thus, conventional echocardiographic Doppler parameters using this system could be measured more accurately for patients with AF. The simultaneous measurement of E/e’ and Tei with a single beat has been shown to provide improved accuracy in the estimation of LV filling pressure.10,11

Other investigators applied the dual Doppler system for the measurement of Tei index.12 The Tei index (myocardial performance index) is an indicator of combined ventricular systolic and diastolic function. This system allows assessment of the isovolumic contraction time, isovolumic relaxation time, and ejection time during a single cardiac cycle.

In this issue of the Journal, Sugahara et al proposed a novel echocardiographic parameter using the dual Doppler system with a focus on the interaction between the right ventricular (RV) and LV functions.13 In addition to LV systolic and diastolic function, assessment with a combination of RV function is challenging.

The authors showed that the corrected time interval

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**Figure.** Assessment of left ventricular (LV) and right ventricular (RV) systolic and diastolic function using 2-D echocardiography. A, end-diastolic ventricular inflow velocity; DT, deceleration time; E, early-diastolic ventricular inflow velocity; e’, mitral annular peak early diastolic velocity of tissue Doppler imaging; EF, ejection fraction; FAC, fractional area change; GLS, global longitudinal strain; LA, left atrium; MPI, myocardial performance index; S’, tricuspid lateral annular systolic velocity wave; TAPSE, tricuspid annular plane systolic excursion; TR, tricuspid regurgitation.

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between the mitral and tricuspid valve opening (MO–TO time) using a dual Doppler system was correlated with pulmonary artery wedge pressure (PAWP) and the mean pulmonary artery pressure (mPAP) in 60 patients with HF in sinus rhythm. This suggested that the MO–TO time was an integrated parameter that reflects the elevation of the LV filling pressure.

Moreover, the present patients were categorized into the following 2 groups based on MO–TO time: mitral valve opening (MOP) precedence to tricuspid opening and tricuspid valve opening (TOP) precedence to mitral opening. It was easy to detect whether it was MOP or TOP using the dual Doppler system. MOP was superior in evaluating pulmonary hypertension due to left heart disease (PAWP ≥15 mmHg; mPAP ≥25 mmHg) as compared with the conventional echocardiographic parameters (E/e’ ≥15 and TRPG ≥34 mmHg). It is not surprising because tricuspid valve opening usually precedes the mitral opening in healthy subjects. If LV filling pressure was elevated, the mitral valve opening shifts forward due to the elevated left atrial pressure, and the tricuspid valve opening shifts backward due to delayed RV relaxation. The MO–TO time reflects the LV and RV hemodynamic conditions.

Sugahara et al. also followed up the adverse events (cardiovascular death and hospitalization due to HF) for 1 year. The probability of an adverse cardiovascular outcome was higher in the MOP than the TOP group. The addition of MOP improved the predictive power of univariate predictors (mitral E/A ratio and brain natriuretic peptide [BNP]) in the bivariate Cox analysis. BNP is a well-known biomarker of cardiac adverse outcome. The combination of MO–TO time (MOP) and BNP would be extremely valuable clinically.

Unfortunately, selection bias in patient enrollment may affect the results of this study because two-thirds of the patients had hypertensive heart disease. Moreover, the number of patients in the present study was relatively small for the survival analysis.

Further studies (including patients with AF) are expected to confirm the usefulness of this novel echocardiographic parameter using the dual Doppler system.

Disclosures

The author declares no conflicts of interest.

References


