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EDITORIAL COMMENT

Noninvasive Estimation of LV Filling Pressures in Heart Failure and Reduced Ejection Fraction: Revisited and Verified*

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Echocardiography plays a key role in the evaluation of patients presenting with congestive heart failure (CHF). This includes diagnosis, prognosis, and guiding treatment decisions. Aside from the important measurements of left ventricular (LV) volumes and ejection fraction (EF), Doppler can be successfully applied to assess LV and right ventricular hemodynamic status. Several studies have shown the accuracy of these techniques against the invasive gold standard (1–12). In fact, Doppler echocardiography provides data that are comparable to that obtained by a pulmonary artery (PA) catheter (13).

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More importantly, several echocardiography laboratories routinely report such measurements as LV stroke volume, cardiac index, PA pressures, and estimates of left atrial (LA) and right atrial pressures. Likewise, several heart failure groups use the hemodynamic data obtained by Doppler to select and adjust therapy for CHF patients and in clinical trials in lieu of invasive hemodynamic measurements (14).

Recently, the accuracy of the Doppler approach for estimating LA pressure has been questioned, with 1 study reporting weak to no significant correlation between Doppler velocities and mean wedge pressure measured by a PA catheter (15) in patients with acute decompensated heart failure. However, there are a number of limitations to the latter study that have been noted by several groups, including the American Society of Echocardiography/European Association of Echocardiography Diastolic Function Writing Group (16). The study by Ritzema et al. (17) in this issue of *iJACC* presents important results that are helpful in addressing the accuracy of tissue Doppler (TD) imaging in patients with CHF and reduced EF. The study design has the strengths of using a direct measurement of LA pressure (as opposed to pulmonary capillary wedge pressure) and of including ambulatory patients in various grades of diastolic dysfunction and receiving medical therapy. The characteristics of these patients led to a study sample that is very similar to most CHF patients who are seen in the ambulatory setting. The authors noted that the ratio of mitral peak velocity of early filling to early diastolic mitral annular velocity was the most accurate parameter in identifying patients with increased LA pressure. Of note, the overall correlations were not as strong when adjusted for multiple comparisons, because patients were imaged at several time points, but the ratio was highly accurate as judged by receiver-operator characteristic analysis. Interestingly, in a finding similar to previous studies (12), the authors show in Figure 4 of their report that for most repeat studies, changes in the ratio of mitral peak velocity of early filling to early diastolic mitral annular velocity tracked well the changes in left atrial pressure. The study has the major limitation of including few patients, which precluded the authors from drawing reliable conclusions about the accuracy of Doppler techniques in certain subsets, as those with cardiac resynchronization therapy and in patients with mitral regurgitation (although they note no differences in accuracy in these subsets).

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In general, the results of Ritzema et al. (17) are confirmatory of several previous studies and in general supportive of the recent American Society of Echocardiography/European Association of Echocardiography guidelines for the estimation of LV filling pressures (18). The guidelines emphasize a comprehensive approach that includes mitral Doppler and TD velocities but also recommend paying close attention to both technical and functional factors when the different velocities and time intervals are applied. For example, mitral inflow velocities can have lower accuracy in patients with mitral valve disease; pulmonary vein velocities have limitations in patients with atrioventricular block and arrhythmias; and TD velocities are not reliable for assessment of LV relaxation in normal subjects, patients with primary mitral valve disease and normal EF, patients with left bundle branch block/paced rhythms, and patients with constrictive pericarditis (18).

It is also important to note that Doppler velocities, including TD early diastolic velocity, provide independent prognostic information that is incremental to clinical and other echocardiographic measurements, such as LV volumes and EF. This has been shown in several patient populations, including heart failure patients with reduced EF and those with normal EF; patients with hypertension; and patients with secondary mitral regurgitation in the setting of LV systolic dysfunction, end-stage renal disease, hypertrophic cardiomyopathy, and atrial fibrillation (for a summary of these studies please refer to the reference list of Nagueh et al. [18]). Furthermore, a small randomized study has shown the promise of Doppler echocardiography in guiding medical therapy in an outpatient setting, which led to a significant reduction in hospital admissions (19).

Finally, with respect to the specific question about the application of Doppler/TD in patients with CHF and depressed EF, one can conclude—on the basis of the existing published data—that the technique with careful attention to acquisition and analysis provides an accurate assessment of LV filling pressures in most patients. This conclusion is applicable to those in acute decompensated heart failure as well as stable ambulatory patients, whether patients are receiving oral therapy or intravenous drips, and those with and those without secondary pulmonary hypertension and normal or abnormal right ventricular systolic function (1–12,17).

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