Left atrial strain: a new window on left ventricular filling pressure?

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In a paper published in the current issue of this Journal, Henein et al. 1 demonstrated that pulmonary capillary wedge pressure (PCWP) correlated strongly with global left atrial (LA) systolic strain rate, which was the most accurate echocardiographic variable in identifying abnormally raised pressures. These findings suggest the potential role of LA strain rate in heart failure for identifying patients with raised LA pressure.

Left atrial strain

Speckle-tracking echocardiography allows direct and angle independent analysis of myocardial deformation, thus providing sensitive and reproducible indexes of myocardial fiber dysfunction that overcome most of the limitations of Doppler-derived strain measure. Although this new technique was introduced for analysis of LV function, several studies have recently extended its applicability to LA.2-6 The longitudinal strain curves reflect the pathophysiology of LA function: during the reservoir phase, the LA fills up and the atrial strain increases [peak atrial longitudinal strain (PALS)]; after the opening of the mitral valve, LA empties, and the strain decreases, up to a plateau corresponding to diastasis, followed by a second positive peak, which corresponds to atrial contraction [peak atrial contraction strain (PACS)], and finally a negative peak after the atrial contraction (Figure 1). Thus, PALS and PACS can be calculated by averaging values (global PALS and PACS), and/or by separate values observed in four- and two-chamber views.

This new technique presents intrinsic limitations, including strict frame rate dependency, potential errors in border tracing in subjects with suboptimal image quality, and need for an appropriate learning curve in using analysis software. Speckle tracking is not fundamentally a different modality of imaging but rather a modality of post-processing, and this is the second phenomenon that is potentially very different among vendors and may influence strain 2,7.

Despite these limitations the LA strain has a increasingly important clinical, diagnostic and prognostic role; in fact, abnormalities in LA strain have been shown in some pathophysiologic conditions, including dilated cardiomyopathy 4, hypertrophic cardiomyopathy 5, as predictor of new-onset atrial fibrillation and maintenance of sinus rhythm after cardioversion 6.

Left atrial strain and LV filling pressure

Accurate assessment of left-sided intracardiac filling pressures is crucial for the management of chronic heart failure, in which congestion causes most disabling symptoms, rehospitalizations and death. Various methods have been proposed to translate the presence of high left-sided filling pressures as standard Doppler assessments and Tissue Doppler. Because mitral inflow velocity (E wave) is directly related to both LA pressure and LV relaxation, dividing this measure by annular relaxation velocity (e'), itself a measure of LV relaxation, can theoretically yield an estimate of LA pressure and, by extension, LV filling pressure: in fact, a tight relationship between E/e' and LV filling pressures (PCWP) has been shown. The current European Consensus Statement on the Diagnosis of Heart Failure 3 include measurement of E/e' prominently in the assessment of diastolic function and suggest that these measures can be used as a way to both diagnose and manage patients with a wide variety of heart diseases.

Figure 1: Peak atrial longitudinal strain (PALS) and peak atrial contraction strain (PACS) in a representative subject. From Cameli et al (6) modified.
However, Mullen et al. 10 demonstrated that in patients with severe cardiac dysfunction, mitral E/e’ ratio may not be as reliable in predicting intracardiac filling pressures: greater LV remodeling, low ejection fraction and significant mitral regurgitation might alter the relationship between E/e’ and PCWP. Henein et al. 1 showed that PCWP was strongly correlated with LA global strain rate during atrial systole irrespective of LVEF, and had the highest areas under the curve for identifying patients with elevated PCWP. These results aid in the search for new non-invasive methods for assessing PCWP. However, before the adoption of novel and potentially useful methodologies, we need to more fully understand their utility and limitations across the full spectrum of patients in whom they might provide clinical value.

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