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EDITORIAL COMMENT

Three-dimensional speckle tracking echocardiography: The future is now

Ecocardiografia tridimensional de *speckle tracking*: o futuro é agora

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Cardiac ultrasound is an imaging modality that enables dynamic imaging of the heart and great vessels. The past decade has seen the development of two-dimensional speckle tracking echocardiography (2D-STE), a semi-automated technique based on frame-by-frame tracking of tiny echo-dense speckles within the myocardium that reveals the extent of lengthening and shortening relative to the baseline (Lagrangian strain).[1] It enables assessment of motion and deformation parameters such as velocity, displacement, strain, and strain rate in the left ventricular longitudinal, radial, or circumferential axis.[1] This non-Doppler methodology is therefore able to provide information on segmental and global myocardial deformation. Myocardial 2D-STE has been validated by comparison with sonomicrometry[2] and tagged magnetic resonance imaging (MRI).[3]

With respect to left ventricular (LV) mechanics, global longitudinal strain (GLS) is the most-studied 2D-STE parameter and is part of routine assessment in many echocardiographic laboratories. This is in contrast to analysis of radial and circumferential LV mechanics, which are probably not sufficiently reproducible.[4] By convention, GLS is presented as negative values representing shortening in the longitudinal LV axis. In a meta-analysis of 24 studies which included 2597 healthy subjects, GLS varied from -15.9% to -22.1%.[5] The American Society of Echocardiography suggests a value above -20% with a standard deviation of ±2% as likely to be normal.[6]

To date, most strain data have come from non-randomized, retrospective studies. GLS has been proposed for the detection of myocardial ischemia,[7] to differentiate among various hypertrophy etiologies,[8] to monitor therapy, and as a tool to detect heart disease in the preclinical stage.[9] A recent 2017 review identifies four settings in which GLS can provide additional (if not potentially incremental) clinical utility: undifferentiated left ventricular hypertrophy; assessment of cardiotoxicity; aortic stenosis; and ischemic heart disease.[4]

The use of 2D-ST has been expanded and validated for the other cardiac chambers (right ventricle and left and right atrium)[1] as well as the aortic wall.[10]

Ultrasound systems are now capable of acquiring real-time volumetric LV data. Three-dimensional (3D) techniques can measure all strain components in all LV segments and LV torsion from a single acquisition.[11] 3D speckle tracking echocardiography (3D-STE) thus offers an opportunity to overcome a significant limitation of 2D-STE: out-of-plane speckle motion.[4]

Nevertheless, tracking in three dimensions is challenging, as both the spatial and the temporal resolution of the 3D data set are inferior to 2D imaging, and there is the possibility of speckle decorrelation between subsequent volumes.[12,13] Even so, 3D-STE has been validated in simulated models, in vitro and in vivo, against sonomicrometry and MRI markers.[11] LV 3D-STE has been shown to be a reliable

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technique for the assessment of LV global systolic function, highly correlated with left ventricular ejection fraction and Doppler-derived cardiac output.[14] Subsequent studies in different clinical scenarios such as ischemia and hypertensive and valvular heart disease have provided further evidence of the utility of LV 3D-STE.[11]

In this issue of the *Journal*, Guedes et al.,[15] using both classic and advanced echocardiographic parameters, present a study of a group of patients with myotonic dystrophy type 1 (DM1) with no established cardiovascular disease plus a control group of healthy subjects. Regarding advanced imaging, the authors focused on 3D LV myocardial mechanics assessed with an Artida scanner (Toshiba® Medical Systems). The following parameters of LV cardiac mechanics were calculated: LV longitudinal, radial and circumferential strain; LV area tracking; and twist. The authors concluded that DM1 patients had lower values of 3D LV longitudinal strain than the control group. Moreover, assessment of 2D myocardial mechanics did not identify differences between the groups, in contrast to 3D assessment. Based on previous data from clinical studies,[16] 2D-STE[17] and cardiac MRI of myocardial fibrosis[18] in DM1 patients, the authors theorized that this 3D LV longitudinal strain reduction could represent subclinical myocardial damage.

Although these results are of interest, some limitations are to be noted. Speckle-tracking analyses can be complex and time-consuming, and can generally only be obtained from high-quality images. It is therefore important to provide data regarding feasibility. Secondly, inter- and intraobserver variability in assessment of cardiac mechanics (and echocardiography in general) is a concern. The intra-class correlation coefficient can be used, but, for simplicity, other measures of variability may be more appropriate, such as the absolute difference divided by the mean of repeated observations, expressed as a percentage. Finally, the overlap of values between cases and controls makes it unlikely that 3D-STE will in fact add real value in clinical practice.

Conflicts of interest

The author has no conflicts of interest to declare.

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