JACC: CARDIOVASCULAR IMAGING VOL. 11, NO. 2, 2018

PUBLISHED BY ELSEVIER

iVIEW

EDITOR'S PAGE


A Strain by Any Other Tracking Would Perform as Sweet?

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THE NEED AND VALUE OF STRAIN IMAGING

Strain imaging by echocardiography based on speckle tracking and cardiac magnetic resonance (CMR) based on feature tracking are increasingly reported upon and used in clinical practice. They provide quantitative data on temporal, spatial, and global contraction and relaxation as well as contraction velocity and relaxation velocity. These can be used to objectivize myocardial motion and separate various motion components such as longitudinal, circumferential, and radial strain on a global and regional basis and to provide measures of synchronicity. However, despite this wealth of quantitative data, only few of these measures have made it into routine clinical practice, and scientific data backing their widespread use remain inconclusive. So far, only the assessment of global longitudinal strain (GLS) by echocardiography is recommended in the guidelines on hypertrophic cardiomyopathy (1) and patients assessed for cardiotoxicity of chemotherapy (2). The true value of strain imaging and what it truly contributes to standard measures remain under discussion.

WHAT ARE THE POSSIBLE ADVANTAGES OF STRAIN IMAGING?

Strain imaging may provide pathophysiological data not available from other parameters. Because fiber orientation within the heart is more circumferential in the subepicardial layers and more longitudinal in the subendocardial layers, predominant damage to one layer may cause a predominant change of the respective component; that is, more subendocardial damage, as seen in ischemic heart disease, would mainly compromise longitudinal strain, whereas inflammatory conditions, with wider distribution of pathology (midwall and subepicardial), would mainly compromise circumferential strain (3). Despite reports on increased accuracy of strain imaging to detect coronary artery stenoses during dobutamine stress, this concept has not been taken up by clinicians and may be burdened by the fact that all motion components are generated by all myocardial fibers, and as such the dichotomous view of endocardial and epicardial damage resulting in longitudinal or circumferential abnormalities may not hold up.

Conversely, pathophysiology that leads to rather diffuse change of the myocardium, such as left ventricular hypertrophy and myocardial damage due to cancer therapy, seems to primarily affect longitudinal strain. Whether this is a true change of longitudinal function with preservation of circumferential function or rather a more sensitive ability to measure small changes in longitudinal strain versus small changes in ejection fraction remains to be demonstrated. Notably, in patients with left ventricular hypertrophy, ejection fraction is an inadequate parameter to measure function, because of the small end-diastolic volumes leading to preservation of ejection fraction despite reduced myocardial function. The superiority of GLS over global circumferential strain or ejection fraction may, however, be due purely to a more reproducible assessment of the former, which allows the generation of smaller effect sizes and thus improved differentiation between health and disease. Longitudinal function may be the preferential measure for reproducible numbers, as it

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ISSN 1936-878X/$36.00 https://doi.org/10.1016/j.jcmg.2018.01.003

is relatively homogenous across locations in the left ventricle as well as across myocardial thickness.

CAN THE OBSERVATIONS MADE BY ECHOCARDIOGRAPHIC SPECKLE TRACKING BE TRANSFERRED TO CMR FEATURE TRACKING?

In principle the 2 methods are based on the same basic concepts. Important differences are that because of the lack of speckles within the myocardium in CMR images, strain is calculated mainly from the endocardial border rather than the full transmurality of the myocardium. As such circumferential shortening in particular may be higher. In this issue of *iJACC*, Vo et al. (4) report on an effort to determine similarities and assess reasons for differences between and variability of CMR-based strain measures. They confirm the superiority of GLS and global circumferential strain as the preferred parameters as well as close similarity of GLS determined by feature tracking, strain encoding, and echocardiographic speckle tracking. However, they also show large variability among studies and were not able to provide normal values because of these variations. The results demonstrate the need for standardization, larger studies, and validation of results against a true reference standard.

It is important, however, to remember that there are 2 major advantages of CMR in comparison with echocardiography, which need to be taken into account when discussing the value of these novel techniques. First, CMR allows the determination of accurate 3-dimensional volumes in almost all patients, with excellent visualization of all myocardial segments, resulting in a highly accurate and reproducible assessment of left ventricular ejection fraction. This advantage may eliminate the better effect size of GLS versus ejection fraction, as observed in echocardiography.

Second, CMR allows direct tissue characterization on the basis of late gadolinium enhancement for regional scar as well as mapping techniques for diffuse disease. These techniques have shown excellent diagnostic and prognostic accuracy (5–8) and may similarly eliminate the effect of strain as a surrogate measure of diffuse tissue alterations. Most of the data in the strain arena, however, only show descriptive differences among patient groups, sometimes compared with variously defined control subjects, and do not really address determinants of abnormal strain or treatment interventions on the basis of such measurements. Standardization among various vendors and protocols is also needed and is beginning to be addressed. As such, one of the first steps for future research should focus on the accuracy and prognostic value of strain by CMR or echocardiography versus tissue characterization by CMR. This will place these newer techniques in the correct clinical perspective and simplify clinical decision making for frontline clinicians, especially in diseases with diffuse subclinical or early myocardial involvement that is not easily detectable by current methods.

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