Beyond Ejection Fraction: Integrating Myocardial Strain and Cardiac Magnetic Resonance into the Contemporary Assessment of Left Ventricular Function

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Short Editorial related to the article: Concordance Between Echocardiographic Left Ventricular Ejection Fraction by Simpson's Method, Global Longitudinal Strain, and Cardiac Magnetic Resonance

The assessment of left ventricular function is undergoing a profound transformation. For decades, left ventricular ejection fraction (LVEF) has occupied a central role in clinical practice, guiding diagnosis, risk stratification, and therapeutic decision-making across a broad spectrum of cardiovascular diseases. Its extensive clinical validation, ease of acquisition, and reproducibility have established two-dimensional echocardiography as the first-line modality for evaluating left ventricular systolic function.[1,2]

However, advances in cardiovascular imaging have demonstrated that myocardial function cannot be fully characterized by a single volumetric parameter. Although LVEF remains a robust marker of global left ventricular performance, its dependence on loading conditions and its limited sensitivity for detecting early contractile abnormalities underscore the need for a more comprehensive functional assessment.

In this context, the incorporation of myocardial deformation imaging through global longitudinal strain (GLS) represents one of the most significant advances in echocardiography over the past two decades. By directly quantifying the deformation of longitudinal myocardial fibers, which are predominantly located within the subendocardial layer, GLS enables the detection of myocardial dysfunction before reductions in LVEF become apparent.[3] Consequently, its use enhances diagnostic sensitivity, improves risk stratification, and provides incremental prognostic information across a wide range of cardiovascular diseases.

Concurrently, cardiac magnetic resonance (CMR) has become the reference standard for the quantification of ventricular volumes and systolic function owing to its high accuracy, excellent spatial resolution, superior reproducibility, and independence from the acoustic window limitations inherent to echocardiography.[4] Furthermore, its unique ability to characterize myocardial tissue has substantially expanded our understanding of the pathophysiological mechanisms underlying cardiovascular diseases, strengthening its role in the multimodality assessment of cardiac structure and function.

This technological evolution has fundamentally reshaped the paradigm of cardiovascular imaging. The contemporary objective is no longer to identify a single marker capable of summarizing the complexity of ventricular function, but rather to integrate complementary information obtained from different imaging modalities, each reflecting distinct aspects of myocardial mechanics. From this perspective, LVEF, GLS, and CMR should not be viewed as competing techniques; instead, they provide complementary information that, when interpreted together, allows a more accurate and comprehensive evaluation of ventricular performance.

It is within this framework that the study published in this issue of the journal should be interpreted. By evaluating the agreement between LVEF measured by the Simpson biplane method, GLS, and ventricular function assessed by CMR, the authors address a clinically relevant question: to what extent can different imaging modalities be considered equivalent for the assessment of left ventricular function?

More importantly than simply comparing diagnostic techniques, the study highlights an aspect that is often overlooked in the literature: the distinction between correlation and agreement. In method-comparison studies, a high correlation coefficient does not necessarily imply clinical equivalence. Accordingly, the authors should be commended for their methodological approach, which includes Lin's concordance correlation coefficient, Bland–Altman analysis, and weighted kappa statistics, all of which provide a more robust assessment of agreement between different imaging techniques.[5]

The results demonstrated good agreement between LVEF measured by two-dimensional echocardiography and that obtained by CMR, as well as substantial agreement between GLS-derived parameters and CMR-based functional assessment. In addition, strong agreement was observed between measurements obtained using the Simpson biplane method and those derived from myocardial deformation analysis, reinforcing both the robustness of conventional echocardiography and the incremental value of strain imaging in the characterization of ventricular function.

Perhaps the study's most important contribution, however, lies not in demonstrating high statistical agreement among the different methods, but rather in showing that

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statistical agreement should not be interpreted as clinical interchangeability. Although concordance coefficients were high, Bland–Altman analyses revealed relatively wide limits of agreement between the imaging modalities. This finding has important practical implications, particularly when therapeutic decisions rely on specific LVEF thresholds or when small serial changes may influence the interpretation of disease progression in patients with heart failure.

Likewise, the study reinforces a concept that has become increasingly well established in the literature: GLS should not be regarded as a substitute for LVEF. Rather, these parameters reflect distinct physiological dimensions of ventricular function and respond to different mechanisms of myocardial adaptation. Whereas LVEF primarily represents the global volumetric performance of the left ventricle, GLS directly quantifies the longitudinal deformation of subendocardial fibers, which are often affected during the earliest stages of several cardiovascular diseases.[3] The integrated interpretation of these parameters provides a more comprehensive and biologically meaningful characterization of ventricular function than either measurement alone.

From this perspective, the growing interest in strain imaging should not be interpreted as an attempt to replace LVEF, but rather as the incorporation of a functional biomarker that complements its interpretation. This concept is particularly relevant in clinical settings in which LVEF remains preserved despite the presence of early myocardial abnormalities, including cancer therapy-related cardiotoxicity, valvular heart disease, infiltrative cardiomyopathies, and heart failure with preserved ejection fraction. The integration of these complementary parameters enhances diagnostic sensitivity and contributes to more refined risk stratification.

Another noteworthy aspect of this study is its pragmatic design. By including patients with a broad spectrum of cardiovascular conditions, the investigators reproduced the heterogeneity routinely encountered in clinical practice. Although this diversity may increase variability among imaging methods, it also strengthens the external validity of the findings, making them more representative of the challenges faced by cardiovascular imaging specialists in daily practice.

Naturally, several limitations should be acknowledged. The relatively small sample size, single-center design, absence of three-dimensional echocardiography, and lack of feature-tracking strain analysis by CMR partially limit the generalizability of the results. Nevertheless, these limitations do not diminish the study's scientific relevance. On the contrary, they highlight the need for larger multicenter investigations capable of integrating different imaging modalities into more comprehensive models of functional assessment and clinical validation.

The future of cardiovascular imaging will likely not be defined by the replacement of one modality with another. Rather, true progress lies in the integration of complementary information that more faithfully reflects the complexity of ventricular mechanics. Echocardiography, myocardial deformation imaging, and CMR should be regarded as synergistic tools, each providing unique insights that contribute to a more comprehensive characterization of myocardial structure, function, and pathophysiology.

Rather than debating which imaging modality should occupy the central role in the assessment of left ventricular function, contemporary cardiology increasingly recognizes that no single biomarker can fully capture the complexity of myocardial performance. The future of cardiovascular imaging lies in the rational integration of complementary diagnostic modalities, leveraging the strengths of each technique to provide a more accurate, individualized, and clinically meaningful evaluation.

From this perspective, the study discussed in this issue reinforces a paradigm that is becoming firmly established in clinical practice: LVEF remains indispensable; GLS provides important incremental value; and CMR continues to represent the reference standard for ventricular quantification. The integration of these complementary tools, rather than the replacement of one with another, represents the natural path toward a truly contemporary assessment of left ventricular function.

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