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EDITORIAL COMMENT

Implementing Quality Control of LV Longitudinal Strain Measurement*

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Symptoms and left ventricular (LV) systolic function are the main determinants of the management of patients with cardiovascular diseases. Left ventricular ejection fraction (LVEF) is the most frequent measure of LV systolic function and is the key parameter to decide the timing of surgical intervention for valvular heart disease or indication for cardiac resynchronization therapy implantation in heart failure patients, for example (1,2). In addition, the use of treatments that are potentially cardiotoxic such as chemotherapy demands close surveillance of LVEF in order to adjust the dosage and prevent further deterioration of LV systolic function (3). Current American Society of Echocardiography (ASE) and the European Association of Cardiovascular Imaging (EACVI) recommendations for cardiac chamber quantification advocate the use of biplane method of discs to measure LVEF (4). However, visual estimation of LVEF is frequently used to confirm quantitative LVEF. Advances in transducer technology, incorporation of harmonic imaging and widespread use of echocardiographic contrast to enhance the endocardial border have reduced interobserver and intraobserver variability of LVEF measurement. In addition, image acquisition and interpretation are important components of the imaging process that may influence the outcome of the patients and specific benchmarks of quality have been established for each of these (5).

Quality control assessment and teaching programs have been shown to significantly reduce interobserver variability in estimation of LVEF (6,7). A teaching intervention consisting of tutorial review of reference cases and group discussion of each case with quantitative determination of LVEF according to biplane Simpson method resulted in 40% reduction in the interobserver variability for visual estimation of LVEF (from ±14% to ±8%; $F = 2.8$; $p = 0.007$) (6).

These exercises have not been extensively evaluated with the use of novel techniques such as deformation imaging.

Assessment of myocardial deformation with tissue Doppler imaging or speckle tracking echocardiography provides incremental prognostic information (8,9). Echocardiographic speckle tracking LV global longitudinal strain (GLS) is the most frequently used deformation parameter reflecting LV systolic function. The superior interobserver and intraobserver variabilities for the measurement of LV GLS have been demonstrated (10). The ASE, EACVI, and the ultrasound imaging industry launched in 2010 a joint standardization initiative to reduce intervendor variability of LV GLS measurement (11). As a result, reproducibility of LV GLS measurements has been shown good (interobserver relative mean errors ranging from 5.4% to 8.6%, and intraobserver relative mean errors ranging from 4.9% to 7.3%) and superior to conventional echocardiographic LVEF measurement (12). However, there remains the small, but statistically significant, variation across vendors that should be considered when performing sequential evaluations, for example in patients receiving chemotherapy (13). In addition, quality control assessment and teaching programs would be advisable in order to ensure accurate measurements of LV GLS.

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In this issue of *iJACC*, Negishi et al. (14) have investigated the impact of experience on the accuracy and reproducibility of LV GLS and the effect of a training program on these quality measures. Fifty-eight readers from North America, Europe, Asia, and

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Oceania with various grades of experience in performing strain analysis measured LV GLS in 4 cases with good image quality. To assess measurement precision, average strain measurements from 5 highly experienced readers were compared with those from less experienced readers. In addition, as part of the multicenter SUCCOUR (Strain sUrveillance during Chemotherapy for improving Cardiovascular OUtcomes) trial, a substudy was performed to evaluate the impact of personalized feedback and training on the reproducibility of LV global and regional longitudinal strain compared to that of LVEF. Although the level of experience had a significant impact on the reproducibility of LV GLS, the intraclass correlation coefficient was very good in all groups (from 0.975 for the nonexperienced group to 0.996 for the highly experienced group). The intraclass correlation coefficients for the measurement of LV GLS were significantly better than those reported for LVEF, independent of image quality. Interestingly, the feedback and training initiative did not have an impact on the quality measures of LV GLS and only improved moderately the SD and coefficient of variance of LV segmental strain. These results are encouraging indicating that current technology to analyze LV GLS is not much influenced by the reader and permits more accurate and reproducible assessment of LV systolic function than LVEF.

However, in daily clinical practice, LVEF remains the mainstay measurement to evaluate LV systolic function. Probably, clinicians are more familiar with using LVEF than LV GLS and know the cutoff value of LVEF to define LV systolic dysfunction. Although normative values of LVEF are well established, current recommendations do not provide the normative values of LV GLS and only indicate that a LV GLS of −20% is considered normal (4). In patients receiving chemotherapy, the current European Society of Cardiology position document defines cancer therapeutics-related cardiac dysfunction as a decrease in LVEF of more than 10 percentage points to a value below the lower limit of normal (13). The document highlights the promising role of strain imaging to detect early LV systolic dysfunction secondary to cancer therapy and defines early LV systolic dysfunction as a relative reduction in LV GLS of more than 15% from baseline (13). Without establishing a normative value of LV GLS, the implementation of this tool in routine clinical practice may take a long time.

The present study highlights the importance of quality assessment and training measures in order to ensure accurate interpretation of regional LV systolic function. Specific initiatives using internet-based case studies to assess variation of interpretation and to compare against a gold standard would be helpful to improve echocardiographic measurements of LV GLS (15). However, it seems that the technological advances in post-processing imaging data have already achieved high-quality measurements independent of the experience of the reader. These advances, particularly in the field of strain imaging, may have an impact on the design and results of new trials testing the effects of therapies on LV systolic function.

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