

## Exercise 2D Strain Echocardiography: Is it Feasible?

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During the last few decades, the continued growth and expansion of stress echocardiography in daily clinical practice has led to the search and development of new and more quantitative technologies in an attempt to reduce the subjectivity of wall motion analysis by conventional visual method. (1) The evaluation of coronary flow reserve by Doppler echocardiography and myocardial deformation parameters by Tissue Doppler imaging (TDI) and, more recently, by 2D strain have been shown to provide diagnostic and prognostic information in patients with ischemic heart disease. (2-4) 2D strain imaging is a technique based on speckle-tracking echocardiography analysis, where the deformation is obtained by automatic tracking during the cardiac cycle of the distance between two pixels of a myocardial segment during the cardiac cycle. This method enables simultaneous evaluation of the 3 components of myocardial deformation (radial, longitudinal and circumferential), with the advantage of angle independence. The evaluation of longitudinal deformation in this context is particularly important, because subendocardial longitudinal fibers are the first to be affected by myocardial ischemia, while the conventional wall motion analysis is based on myocardial thickening (radial deformation) and endocardial excursion. Moreover, the human eye cannot perceive shorter delays in the onset and termination of myocardial systolic thickening secondary to ischemia, which however can be detected by 2D strain techniques.

The group of Lowenstein et al (2) demonstrated the value of longitudinal 2D strain during Dipyridamole stress echocardiography for the diagnosis of ischemia, while Ran et al (5) recently reported the role of this technology during adenosine stress echocardiography for the assessment of myocardial viability. However, the feasibility and value of 2D strain in tests with a significant increase in heart rate have not been entirely established. Some previous experimental and clinical studies have evaluated the value of 2D strain during dobutamine stress echocardiography for the assessment of ischemia and viability. (6-11) However,

to date, there are no studies evaluating the value of 2D strain during exercise echocardiography, the most frequent and first-line recommended non-invasive test for ischemia. (12)

In the article published in the *Revista Argentina de Cardiología* by Caniggia et al (13), the authors evaluated the feasibility and the performance of 2D longitudinal strain in patients undergoing exercise stress echocardiography. They studied 93 patients with chest pain or indication for risk stratification or ischemia detection who were in a hemodynamically stable condition and with an optimal acoustic window. All the patients underwent a supine exercise stress echocardiography and the 2D images were acquired at rest, during peak exercise and immediately post-exercise (1-30 seconds after exercise). Wall motion abnormalities (WMA) were evaluated visually by an experienced observer. 2D longitudinal strain was measured by means of specific software using the 3 standard apical views. Regarding the main focus of the study, the feasibility of this technique during exercise stress echocardiography, the authors demonstrated a good feasibility in the post-exercise stage (97%). However, the feasibility during peak exercise was lower (77%), being able to measure only 1147 of 1488 segments. During the test, 21 of the 93 patients (22.5%) developed ischemia detected by the presence of wall motion abnormalities. Of note, there was a very good sensitivity (79%) and specificity (96%) for the values of 2D longitudinal strain in the apical segments. Eleven of the 14 patients with WMA in the apical segments showed a decrease or no change in 2D longitudinal strain, whereas 76 of the 79 patients without WMA showed a normal increase in this parameter. By contrast, 2D longitudinal strain values in the inferior, posterior and lateral segments, demonstrated a low sensitivity (43%) and specificity (41%) for the diagnosis of ischemia. The authors suggested that the low diagnostic accuracy in these segments could be related to the decrease in lateral resolution secondary to the increase in the depth of the field and the translational movement of the heart during the car-

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diac cycle. Interestingly, in the study of Hanekom et al., (8), the accuracy of 2D strain was also higher in the left anterior descending territory. However, when they performed the analysis with tissue Doppler imaging derived strain—a technique less dependent on the image quality—the diagnostic accuracy was higher than with 2D strain on the posterior and lateral walls but similar in the LAD territory, reflecting the importance of the image quality for the analysis of 2D strain. Nonetheless, although this issue could represent a limitation in the future application of 2D strain during exercise stress echocardiography, this technique can be used as a complementary tool for the diagnosis of ischemic heart disease in difficult cases. However, data from larger studies are needed to support the use of strain in stress tests.

The future of this technique is promising if new technology and transducers capable of acquiring better 2D quality images at high heart rates demonstrate a good diagnostic accuracy of 2D strain in the different segments. In addition to the improvement in image quality, easy and fast post-processing software, and the standardization of strain values between different vendors' equipment are key issues in the expansion of this technology in the next few years.

#### Conflicts of interest

None declared

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