The stress echo dilemma: time counts, but image quality too

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This editorial refers to 'Comparison of real-time tri-plane and conventional 2D dobutamine stress echocardiography for the assessment of coronary artery disease'† by E. Eroglu et al., on page 1719

Stress echocardiography has become an attractive tool in the hands of the clinical cardiologist helping in the diagnosis and risk stratification of patients with suspected or known coronary artery disease. However, there are some significant limitations to the technique, so that it remains difficult to acquire the data and to analyse the images.

Main limitations for stress echo acquisition are: (i) image quality during transthoracic scanning with insufficient visualization of left ventricle (LV) walls; (ii) probe positioning difficulties resulting in inadequate image planes; and (iii) the time-consuming serial acquisition of different image planes which has to be performed in a narrow time window during peak stress while wall motion abnormalities exist. Regarding data analysis, subjectivity of image interpretation still is the major problem, which leads to poor inter-observer agreement and causes a relevant examiner-dependency. All factors together result in a lack of ability to detect regional myocardial ischaemia and in reduced test accuracy.

Over the last 15 years numerous attempts have been undertaken to make stress echocardiography easier and less problematic. Some cardiologists use pharmacological approaches (dobutamine plus atropine) instead of physical stress/exercise to improve image quality and increase the available time for peak level image acquisition. Harmonic imaging with and without contrast enhancement of LV cavity has been shown to improve the endocardial delineation and thus the image quality significantly. Advanced echocardiographic modalities (tissue Doppler imaging, colour-coded wall motion tracking, and strain analysis) may help detecting and quantifying wall motion abnormalities. However, because of the complexity of these techniques, most of them have not made their way to widespread clinical use. Furthermore, training and experience of the examiner lowers inter-observer variability and increases test sensitivity as does a common definition of what wall motion pattern is pathological.

Each of these different approaches was reported to increase stress echo test accuracy—always claiming the conventional standard procedure is still insufficient. Of course a certain 'enthusiastic bias' of studies that present a new method has to be taken into account when interpreting these results. Yet, already the variety of attempts demonstrates that today's stress echocardiography obviously is not perfect.

With the advent of matrix array transducers again new technical possibilities come into play: The simultaneous acquisition of two or three image planes or even the acquisition of a complete pyramidal volume data set (so-called 'full volume' mode) decreases the number of serially acquired heart beats.

In this issue of the European Heart Journal, Eroglu et al. report on a comparative study of triplanar echocardiography during dobutamine stress and simultaneously acquired conventional 2D stress echo in 36 patients. Coronary angiography was used as the reference method and interestingly no patient was excluded due to inadequate image quality.

The authors found a good correlation between conventional and triplanar stress echocardiography with a nearly identical sensitivity, specificity, and accuracy. Main difference between both stress echo techniques was a significantly shorter scanning time to acquire a triplanar data set covering the complete LV (equal to one loop from an apical window) compared with the serial scanning of three different 2D image planes. Importantly, the shorter scanning time did not reduce test accuracy.

Although this is one of the first studies to compare multiplanar with conventional 2D stress echocardiography and coronary angiography in a small study group, the results are not surprising, but nevertheless relevant.

Of course, as a consequence of this study a possible question of clinical cardiologists might be: if sensitivity and specificity are equivalent, why then use a matrix array transducer at all and not continue to do a 2D stress echo?

There are several advantages of multiplanar imaging during the routine clinical workflow besides a shorter scanning time, which have not been covered in the present study. There is no need to change the transducer position during apical scanning once the echo window is found. This makes acquisition easier and faster for both the...
The narrow time window at peak stress (especially in exercise stress echo) can be used much more effectively when acquiring two or even three image planes simultaneously. Another recent publication\(^2\) has demonstrated that this results in a higher heart rate during exercise stress acquisition—a prerequisite for ischaemia detection. A shorter time needed for scanning at peak stress and a more complete monitoring (more segments can be observed on-line during stress testing) also reduces the potential risk of prolonged myocardial ischaemia for the individual patient. Finally, reduction of stress echo duration on the long run may also reduce costs and increase throughput in the stress echo lab.

However, despite all enthusiasm, some limitations have to be mentioned. Image quality using matrix array transducers still is worse than with high-end 2D equipment. This is not only because of the technological constraints of a matrix transducer but also to the mechanical limitation of a relatively large probe footprint, which interferes with narrow intercostal spaces. Furthermore, there are authors who still claim that left heart contrast-enhancement is mandatory for adequate endocardial delineation—at least when acquiring full-volume 3D data\(^3\). In addition, the limited sector width (maximum of about 80°) may not be wide enough to encompass the complete LV in the ultrasound sector especially in patients with apical aneurysm or dilated ventricles. Even ‘off-axis’ scanning sometimes cannot circumvent this problem. Although three simultaneously acquired image planes are better than one, the ultimate goal remains the fast acquisition of a ‘full-volume’ 3D data set including the complete LV\(^5\). Last, but not least, temporal resolution at present is limited to about 40–50 ms. Especially during peak stress this clearly influences test sensitivity and remains unsatisfactory—even if several 2D stress echo studies published only 4–6 years ago used a comparable frame rate.

Unfortunately, a lot of enthusiastic articles on newly developed diagnostic modalities often claim extremely high and sometimes hard-to-believe test sensitivities. In contrast, the study by Eroglu et al.—under the light of the abovementioned limitations—presents remarkably realistic data. Nevertheless, triplanar stress echocardiography is only another step forward in our way to solve the old dilemma in stress echo: reducing the scanning time and covering the complete LV without loosing image quality. At the end of the road, real-time 3D stress echocardiography without any doubt will be the fastest and probably sometime the best way to do a stress echo.

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**References**


