Stress Echocardiography

So Much to Do, So Little Time*

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During the last 2.5 decades, stress echocardiography has evolved and matured into an imaging modality with an established role not only in the diagnosis of coronary artery disease, but also in risk stratification of patients with known or suspected coronary artery disease. This has occurred as a result of extensive clinical research involving thousands of patients and of widespread use of stress echocardiography in clinical practice (1–4).

The stress echocardiographic descriptors of global and regional left ventricular (LV) systolic function that are important for prognosis prediction and that permit identification of high-risk subgroups of patients include an abnormal response of the LV end-systolic volume to stress, percentage of LV segments which are abnormal or ischemic with stress, and the identification of wall motion abnormalities in a distribution consistent with multivessel coronary artery disease. Additionally, 2 parameters that can be assessed during multistage pharmacologic stress echocardiography, a biphasic response and the ischemic threshold, have prognostic value. These descriptors of LV function have been shown to be of incremental prognostic value when added to rest echocardiographic information, exercise electrocardiographic findings, and clinical characteristics.

What about the right ventricle (RV)? In the current issue of the Journal, Bangalore et al. (5) suggest that the RV also should be routinely evaluated during stress echocardiography. These investigators evaluated 2,703 patients undergoing clinically indicated stress echocardiography (56% dobutamine and 44% treadmill exercise), assessing not only LV segmental wall motion abnormalities, but also RV wall motion abnormalities. Wall motion abnormalities in both the LV and RV were graded on a standard 5-point scale at rest and with stress. Follow-up (mean 2.7 ± 1.0 years) for myocardial infarction or cardiac death was obtained. By multivariate analysis, patients with abnormal RV function had a worse prognosis compared with those with normal RV function. This finding was independent of LV ischemia. In an incremental model which considered rest LV ejection fraction and wall motion score index as the first step, and the extent and severity of LV wall motion abnormalities with stress as the second step, the addition of stress wall motion abnormalities of the RV in the final step added incremental prognostic information.

Previous studies have shown that in addition to the extent and severity of wall motion abnormalities involving the LV (1), prognosis is influenced by exercise capacity (1,4) and, in the case of dobutamine stress echocardiography, whether target heart rate is achieved (6). The current study combined patients having either exercise or dobutamine stress echocardiography; therefore, these important variables (exercise capacity and for dobutamine, achievement of target heart rate) were not separately considered.

How was the RV evaluated? The authors state that the RV was analyzed by visual assessment of parasternal long-axis, parasternal short-axis, apical 4-chamber, and subcostal images acquired at rest and peak stress. The RV was best seen in the apical 4-chamber and subcostal views. The RV wall motion was scored in 3 segments: base, mid, and apex. Feasibility was 90%.

During stress echocardiography, the sonographer’s efforts are focused on optimizing and acquiring images of the LV. Subcostal views are not routinely obtained. Attempting in addition to optimize images of the free wall of the RV may prove to be an undesirable distraction in some situations. This may be especially true for treadmill exercise echocardiography, in which there is a limited amount of time available in which to acquire data. In this setting, the sonographer endeavors to acquire images within 1 min of completion of exercise, because ischemic wall motion abnormalities can recover quickly during the post-exercise period as the heart rate declines at an exponential rate. Technical difficulties posed by trying to evaluate the RV during this time frame, and whether this might have compromised detailed assessment of the LV, were not discussed in the current study.

How often do RV abnormalities occur without LV abnormalities? Abnormalities of RV wall motion were present in only 4% of patients. Of note, only 2 patients with normal conventional stress echocardiography (normal LV function at rest and with stress) had isolated abnormalities of the RV; events occurred in both of these patients. The rarity of isolated RV regional wall motion abnormalities with stress is not surprising; in the setting of acute myocardial infarction, significant RV infarction rarely occurs in the absence of LV wall motion abnormalities. In the current study, RV abnormalities tended to occur in the setting in...
which LV abnormalities were also more prevalent. These included patients with increased age, diabetes, hypertension, and known coronary artery disease. These patients had lower ejection fraction, higher rest and stress LV wall motion score index, and greater number of LV ischemic segments. In addition, patients undergoing dobutamine stress echocardiography more often had abnormal RV wall motion. It is possible that more time was spent assessing the RV during dobutamine stress, because there would be more time for imaging.

How then, should stress echocardiography be performed? Bangalore et al. (5) correctly point out that the RV has sometimes been a neglected chamber in echocardiography and is not always fully assessed. More attention could be paid to it during stress echocardiography. In our own stress echocardiography practice, if stress-induced RV enlargement and dysfunction is observed and appreciated by the reviewing echocardiologist, this finding is included in the final stress echocardiogram report. It is worth remembering that rest or stress-induced RV dysfunction and enlargement is not necessarily due to coronary artery disease but can be due to other conditions, such as exercise-induced pulmonary hypertension, which may nevertheless be of prognostic importance.

Of paramount importance, however, is that efforts be concentrated on optimally visualizing all segments of the LV, with clarity, in multiple views, and, in the case of treadmill exercise stress, as soon as possible after termination of exercise. The importance of careful acquisition of this data cannot be overemphasized.

The RV wall motion assessment will be especially useful in patients whom detection of ischemia in the right coronary artery is of clinical importance, e.g., in patients in whom coronary angiography has demonstrated an intermediate grade stenosis of the right coronary artery. Additional views of the RV could be helpful in patients with isolated abnormalities of the basal inferior wall or basal inferoseptum; these isolated abnormalities, which can be associated with the tethering effect of the mitral annulus, have been associated with false-positive studies (7).

During the performance of stress echocardiography in 2007 and beyond, routine assessment of the RV at rest and peak stress will have to compete with other relatively new and potentially valuable echo/Doppler measurements, such as Doppler assessment of LV diastolic function and pulmonary pressures and microbubble-facilitated myocardial perfusion. At peak stress, these data will need to be acquired within a short time frame in the early recovery period. It is likely that this additional imaging and these additional measurements will be prioritized, and possibly individualized, based on the perceived incremental value of each. Three-dimensional echocardiography, which permits acquisition of large datasets with shortened time (8), may facilitate rapid collection of LV and RV data. As stress echocardiography continues to evolve, we would do well to remember that we should not compromise or erode the foundation of this versatile stress imaging modality, that is, the optimal assessment of global and regional LV systolic function and its response to exercise or pharmacologic stress.

REFERENCES