Geometric and Functional Correlates of Exercise-Induced ST Depression in Coronary Artery Disease

Jonathan W. Wernest, Franklin J. Wong, Jeff Walden, Masaimiliano Szuc, Peter M. Oken, Paul Kligfield, Cornell Medical Center, New York, New York.

Background: The anatomic, geometric, and functional correlates of exercise-induced ST-segment depression (STD) are not well established. STD might be related to the magnitude of ischemic area, the severity of ischemia within the ischemic myocardium, the orientation of ischemic territories, or combinations of these findings.

Methods: We examined correlates of maximum STD in 49 consecutive patients with both STD>0.1 mV and treadmill exercise-induced defects during myocardial perfusion imaging (MPI). MPI findings included the number of ischemic segments (NIS) determined from a 20 segment model, a summed stress score (SSS), and a summed stress test (SST) representing the SSS/NIS. Patients were separated according to the presence of angina (n=19) or mild (n=30) continuous ischemic areas.

Results: Within the total population, STD was poorly correlated with NIS (r=0.131; p=n.s.) and with SSS (0.203, p=n.s.) and slightly more strongly with SSA (0.339, p=0.02). Patients with multiple ischemic areas had greater NIS (7.9 vs 3.4 segments), greater SSS (17.1 vs 6.8 points), and greater SSA (7.1 vs 1.5 units) than patients with single ischemic areas (p<0.0001 for each), but mean STD was comparable in both groups (2.7 vs 2.5 mm, p=n.s.), as was peak workload expressed as % maximum predicted heart rate achieved (90 vs 91%). Correlates of STD were significant (p<0.05) only for SSS and SSA in the patients with single ischemic areas, but no significant correlations were present in patients with multiple ischemic areas. All STD correlations within single ischemic areas were stronger than those within multiple ischemic areas (NIS, r=0.211 vs 0.094; SSS, r=0.509 vs 0.161; SSA, r=0.544 vs 0.260).

Conclusions: These data suggest that exercise-induced STD is more closely correlated with the average or summed severity of ischemia than with the number of ischemic segments alone. ECG correlations with nuclear findings are stronger in patients with single ischemic areas, which suggests that cancellation of ischemic vector forces may confound the predictive value of STD alone in patients with multivessel coronary disease.

1159-139
Re-Examining Conventional Criteria for Adequate Cardiac Stress During Exercise Testing: A New Paradigm?
Bret C. Belayashi, Mazen Shoukfeh, Judith A. Boura, Barry A. Franklin, William Beaumont Hospital, Royal Oak, Michigan.

Background: The interpretation of exercise-induced myocardial ischemia has traditionally relied on evoking significant ST-segment depression (≥1 mm), angina pectoris, and transient myocardial perfusion abnormalities, or combinations thereof. Negative exercise tests are often considered "inconclusive," unless the patient has attained an adequate level of cardiac stress, generally defined as achieving ≥ 85% of the predicted maximal heart rate (HR max). Nevertheless, few data are available regarding the validity of this cut-point, and its associated diagnostic yield.

Methods: To examine the relationship between the %HR max achieved and evidence of exercise-induced myocardial ischemia, we reviewed 999 consecutive patients (451 men, 548 women, mean ± SD age = 57 ± 13 yrs, 28.0% of whom underwent diagnostic treadmill testing with concomitant myocardial perfusion imaging). The equation, 220-age, was calculated for each patient. STD>0.1 mV and treadmill exercise-induced defects during myocardial perfusion imaging were classified as ischemic if they fell into one of 5-point score within each ischemic segment, or a summed stress test (SST) represented the SSS/NIS. Patients were divided into three groups based on %HR max achieved: (1) < 85% HR max, (2) 85-94% HR max, and (3) > 94% HR max. Patients who failed to achieve 85% HR max were excluded from further analysis. Negative exercise tests were defined as groups (1) and (2) above.

Results: The 200 patients who achieved < 85% HR max were divided into two groups, based on %HR max achieved: (1) < 85% HR max, (2) 85-94% HR max. Transient myocardial perfusion abnormalities were noted in 24% of patients (28% of those who achieved ≥85% HR max, 18% of those who achieved >85% HR max (718), 18% of 15%) showed transient myocardial perfusion abnormalities, 53% (7%) demonstrated ST segment depression, and 6% (3%) experienced angina pectoris. Sins and symptoms of exercise-induced myocardial ischemia were noted across the continuum of achieved heart rates, including a substantial cohort (n = 137) with inadequate level of cardiac stress (i.e., <85% HR max), whereas 23 (8%) and 40 (14%) demonstrated ischemic ST changes and symptoms of exercise-induced myocardia ischemia, respectively. Among the patients who achieved ≥85% HR max, 93 in 10886 patients (9.0%) and 42 in 2963 exercise stress patients (1.4%) (p<0.0001 Pharm vs exercise).

Conclusions: These data suggest that exercise-induced STD is more closely correlated with the average or summed severity of ischemia than with the number of ischemic segments alone. ECG correlations with nuclear findings are stronger in patients with single ischemic areas, which suggests that cancellation of ischemic vector forces may confound the predictive value of STD alone in patients with multivessel coronary disease.

1159-140
Left Atrial Enlargement Is a Key Indicator of Exercise Intolerance
Brad G. Angelis, Paul Varghese, Salman Arain, Lanny Wang, Syed N. Ahmed, Petrit Ndrio, Maria Ansari, Mary A. Whologist, Nelson B. Schiller, University of California, San Francisco, San Francisco, California, VA Medical Center, San Francisco, California.

Background: Resting echo measures of ventricular function have been shown to have exercise tolerance, but the impact of left atrial size is largely unanswered. Because left atrial enlargement (LAE) may reflect cumulative cardiac dysfunction, we hypothesized that LAE would be associated with shorter exercise treadmill (ETT) times in a cohort of ambulatory cardiac patients.

Methods: The Heart & Soul Study is a VA-based, prospective study of exercise limitation and coronary events, enrolling 296 pts (98% male, mean ± SD age 70 ± 70/000/07). Baseline ECG, echo, and ETT-echo were obtained. We selected pts reaching at least Bruce stage 2 (n=210, 71%), de-emphasizing orthopedic limitations. The 2-dimensional biplane LA volume was measured at end-diastolic systolic volume and indexed to body surface area and indexed to body surface area. Additional echo measures were calculated by the software (1.0 m²/m²).

Results: Pts with LAE (n=102) had shorter ETT times than those without LAE (mean±standard deviation: 6.2±2.0 vs 7.0±2.5, p<0.002), and this pattern was also evident by quartile of LA index (table, overall p=0.005). Using stepwise linear regression of 16 resting echo parameters, larger LA size was independently associated with shorter