

1159-138 Geometric and Functional Correlates of Exercise-Induced ST Depression in Coronary Artery Disease

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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 scanning (MPS). MPS findings included the number of ischemic segments (NIS) determined from a 20 segment model, a summed stress score (SSS) describing total severity calculated from a 5-point score within each ischemic segment, and a summed stress average (SSA) representing the SSS/NIS. Patients were separated according to the presence of single (n=19) or multiple (n=30) contiguous ischemic areas.

Results: Within the total population, STD was poorly correlated with NIS (r=0.131, p=ns) and with SSS (0.203, p=ns) and slightly more strongly with SSA (0.336, p=0.02). Patients with multiple ischemic areas had greater NIS (7.9 vs 3.4 segments), greater SSS (17.1 vs 4.8 points), and greater SSA (2.1 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=ns), as was peak workload expressed as % maximum predicted heart rate achieved (90 vs 91%). Correlations 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 findings 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?

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Background: The interpretation of exercise-induced myocardial ischemia has traditionally relied on evoking significant ST-segment depression (≥ 1 mm), angina pectoris, 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 $\geq 85\%$ 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 \pm SD age = 57.3 yrs, \pm 13.6) who underwent diagnostic treadmill testing with concomitant myocardial perfusion imaging (technetium (Tc)-99m sestamibi [cardiolite]). The equation, 220-age, was used to estimate HR max. **Results:** Two hundred eighty-one of the 999 patients (28%) failed to achieve 85% HR max. Transient myocardial perfusion abnormalities were noted in 74 of these patients (26%), whereas 23 (8%) and 40 (14%) demonstrated ischemic ST depression and angina pectoris, respectively. Among those who achieved $\geq 85\%$ HR max (718), 108 (15%) showed transient myocardial perfusion abnormalities, 53 (7%) demonstrated ST segment depression, and 63 (9%) experienced angina pectoris. Signs and symptoms of exercise-induced myocardial ischemia were noted across the continuum of achieved heart rates, including a substantial cohort (n = 137) with inadequate levels of cardiac stress (i.e., < 85% HR max). When these groups (n = 281, < 85% HR max] versus (n = 718, $\geq 85\%$ HR max]) were adjusted for age and compared, there were no significant differences in diagnostic yield. **Conclusion:** These findings suggest that signs and/or symptoms of exercise-induced myocardial ischemia, manifested as significant ST segment depression, angina pectoris, and transient myocardial perfusion abnormalities, occur at varied levels of cardiac stress, and that 85% HR max does not appear to represent a demarcation in this regard.

1159-140 Left Atrial Enlargement Is a Key Indicator of Exercise Intolerance

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Background: Resting echo measures of ventricular function have been related to exercise tolerance, but the impact of left atrial size is largely unexamined. 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 the link between depression and coronary events, enrolling 296 pts (98% male, mean 71 yrs) from 7/2000-7/2001. 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-ventricular systole and indexed to body surface area, using the established threshold for LAE (32 ml/m²). **Results:** Pts with LAE (n=102) had shorter ETT times than those without LAE (mean \pm standard deviation: 6.2 \pm 2.0 vs. 7.2 \pm 2.5 min, p=0.002), and this pattern was also evident by quartile of LA index (table, overall p=0.008). Using stepwise linear regression of 16 resting echo parameters, larger LA size was independently associated with shorter

ETT time (p=0.008). Other independent predictors were mitral E (0.03) and A wave size (0.006) and aortic sclerosis (p=0.02). **Conclusions:** In this ambulatory, elderly male population, LAE is a strong independent predictor of exercise intolerance that is easily measured.

LA index (quartile)	N	Mean ETT time, min	Exceeded Bruce Stage 2
< 25 ml/m ²	43	7.1 \pm 2.6	68.7%
25 up to 32 ml/m ²	63	7.3 \pm 2.5	70.2%
32 up to 42 ml/m ²	51	6.5 \pm 2.1	58.6%
≥ 42 ml/m ²	51	5.9 \pm 1.9	44.2%

1159-161 Referral for Pharmacologic Stress Testing Is an Independent Pretest Predictor of Reduced Survival in Ambulatory Patients With Suspected Coronary Disease

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Background: Patients with suspected coronary disease are evaluated with either exercise or pharmacologic stress testing (Pharm) depending on their ability to exercise.

Methods: To determine whether referral for Pharm was an independent predictor of risk, we analyzed 3999 consecutive ambulatory patients with symptoms of suspected coronary disease who presented for their initial stress evaluation between 1995 and 2001. Mean follow-up time was 2.7 \pm 1.6 years. Endpoint was all-cause mortality. Variables considered were age, sex, symptoms, risk factors, pretest score, pretest medications, and baseline ECG findings. Analysis was performed using the Kaplan-Meier method and Cox Proportional Hazards. **Results:** There were 135 deaths (3.4%) with 93 in 1036 Pharm patients (9.0%) and 42 in 2963 exercise stress patients (1.4%) (p<0.0001 Pharm vs exercise). Multivariable analysis found that Pharm (HR 1.9, p<0.0001), age (HR 1.1, p<0.0001), male sex (HR 1.4, p<0.001), diabetes (HR 1.4, p<0.0001), abnormal ECG (HR 1.4, p<0.001), and beta-blocker absence (HR 1.4, p<0.03) were all independent predictors of reduced survival. When a pretest score incorporating 9 clinical variables (HR 1.1, p<0.0001) was substituted for those clinical variables, Pharm remained a strong predictor (HR 2.1, p<0.0001). **Conclusion:** Even after adjusting for pretest clinical risk, abnormal resting ECG, and medication usage, referral for Pharm was a significant predictor of reduced survival. Therefore, referral for Pharm must be factored into pretest and posttest risk assessments.

1159-162 The Impact of Diabetes on Functional Measurements in Patients Referred for Stress Testing

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Background: Whether diabetes affects functional capacity : oxygen consumption/weight/time (VO₂/kg/min), oxygen consumption/exercise heart rate (O₂/HR), and exercise heart rate, independent of body mass index (BMI), sex, age, exercise ejection fraction (EEF), or beta blocker therapy (BBT) has not been identified.

Methods: Symptom limited treadmill testing was performed in 613 patients aged 50 years or older. 409 were males and 204 were females, with 148 having a history of diabetes. Echocardiographic EEF was measured immediately post-exercise, and oxygen consumption and exercise heart rate were measured at peak-exercise.

Results: Diabetic patients in comparison to non-diabetics had greater BMI, 29.6 vs 27.1 (p<0.0001), but sex (57% male and 43% female in both groups), BBT (24% vs 22%), mean age (68.1 vs 68.2), and mean EEF (0.71 vs 0.73) were not significantly different. Functional measurements at peak exercise were significantly different in the diabetics vs the non-diabetics: VO₂/kg/min was 16.5 vs. 20.1 (p<0.0001), O₂/HR was 10.3 vs 11.1 (p<0.01) and exercise heart rate was 127 vs 136 (p<0.0001). Analysis was done using Student's t-test and chi-square. Multivariate correlations of functional measurements with independent variables noted above include:

	VO ₂ /kg/min	O ₂ /HR	Exercise Heart Rate
Sex	p < 0.0001	p < 0.0001	p < 0.05
Age	p < 0.0001	p < 0.0001	p < 0.0001
BMI	p < 0.0001	p < 0.0001	p = 0.44
EEF	p < 0.0001	p < 0.0001	p < 0.01
BBT	p < 0.01	p = 0.53	p < 0.0001
Diabetes	p < 0.0001	p < 0.0001	p < 0.0005
correlation coefficient	0.73	0.53	0.47

Conclusion: Diabetes has adverse effects on functional measurements independent of age, sex, BMI, EEF, and BBT. Measures that will decrease BMI, or increase EEF have the potential of improving functional capacity independent of age or diabetes.