

a discriminant analysis that incorporates 3 easily derived exercise variables which were prospectively validated.

945-119

### Comparison of Very Early vs Pre-discharge Exercise Treadmill Tests After Myocardial Infarctions

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Risk stratification early after myocardial infarction (MI) is useful in identifying high risk patients with inducible ischemia who would benefit from aggressive invasive management and low risk pts who could be discharged early thus reducing hospital costs. The optimal time for an exercise stress test has not been established. We performed two symptom-limited ETTs very early (3.6 days) and pro-discharge prior to intervention (8.2 days) in 31 pts with uncomplicated acute myocardial infarctions (15 non-Q and 16 Q MI). The exercise duration was longer on the later ETT ( $8.7 \pm 3.6$  vs  $10.4 \pm 4.4$  min). However, the peak HR ( $118 \pm 20$  vs  $121 \pm 30$  beats/min), and the peak BP ( $146 \pm 25$  vs  $151 \pm 24$  mmHg) were similar ( $p = NS$ ). There were no complications during the ETTs. Positive exercise response with ST-segment depression was observed in more patients on the very early ETT [14 pts (44%) vs 8 (25%)  $p = 0.04$ ] despite similar myocardial stress as evidenced by rate pressure product. **Conclusions:** Exercise stress tests were performed in the same patients very early (3.6 days) and pro-discharge (8.2 days) after MI without complications. Despite similar peak heart rate and blood pressure achieved, very early tests were more often positive than tests performed 1 week after the MI. This may relate to a more significant residual stenosis in the infarct vessel very early after MI which may decrease in severity with time as the superimposed thrombus and or spasm resolves.

945-120

### Effects of Beta-Blockade on Dobutamine Stress Echocardiography

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Dobutamine is an effective pharmacologic stress because of its beta-agonist properties. Concurrent beta blockade (BB) might alter this effectiveness as a diagnostic tool, however DSE protocols often are not modified for patients on BBs nor are there consistent recommendations for withholding BB prior to a DSE. To determine if BB alters the ability of a DSE to detect a significant coronary stenosis and to quantitate the effect of BB on the timing and magnitude of change in the physiologic responses to dobutamine, paired DSEs were performed in 8 instrumented dogs before and after BB (esmolol). A standard DSE with and without a fixed coronary stenosis and with and without BB was performed ( $n = 32$  DSEs). Heart rate (HR), aortic and left ventricular pressure (SBP) and proximal LAD coronary flow (CF) were monitored. Wall thickening (WT) was determined by sonomicrometers. From mid-ventricular short axis echo images, % area change (%AC) was calculated at each stage. DSE endpoints were wall motion abnormality (WMA), cavity obliteration or maximum dobutamine dose (40 mcg/kg/min). **Results—** With BB, the HR, CF, WT and %AC at each dobutamine dose and at peak infusion were lower ( $p < 0.01$ ) despite achieving a higher maximal dobutamine dose ( $17.9 \pm 6.2$  vs  $34.3 \pm 3.7$  mcg/kg/min,  $p = 0.001$ ). At the low dose (5 mcg/kg/min), the increased CF, WT, and %AC noted without BB was eliminated by BB ( $p < 0.05$ ). Most importantly, BB prevented ( $n = 2$ ) or delayed ( $n = 6$ ) the onset of a WMA in all dogs. **Conclusions—** BB attenuates the magnitude and delays the timing of the physiologic response to dobutamine and consequently decreases the ability of a DSE to detect a coronary stenosis. By decreasing the cardiac workload and inotropic response at each dose, the ability of a DSE to detect inducible ischemia with concurrent BB is influenced in this canine model. Therefore, the sensitivity and specificity of DSE to diagnose coronary artery disease in patients on BB requires clarification. Modifications of the standard DSE protocol (time of infusion/stages, maximum dose) or withdrawal of BB may be necessary prior to a DSE to preserve accuracy. Although the accuracy of the test as a diagnostic tool may be adversely effected, these data support its strength in assessing therapeutic effectiveness.

945-121

### The Paradoxical Hypertensive Systolic Blood Pressure Response to Dipyridamole Infusion — What are its Etiology and Implications?

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To evaluate the etiology and implications of a paradoxical increase in systolic blood pressure (SBP) following dipyridamole infusion (0.56 mg/kg), we characterized the hemodynamic, symptomatic, electrocardiographic, and image findings in 341 consecutive patients undergoing clinically indicated stress myocardial perfusion studies from January to October, 1993. Most patients ( $n = 292$ ) experienced a typical, generally mild, hypotensive SBP response

(range 0–73 mmHg, average 22 mg Hg). Among 49 patients with a hypertensive SBP response (range 2–81 mmHg, average 27 mmHg), 18 were considered mild (0–19 mmHg), 22 were moderate (20–39 mmHg) and 9 were severe ( $\geq 40$  mmHg).

In those with a hypertensive compared to those with a typical SBP response, no significant difference was found in the prevalence of coronary vascular territories demonstrating total scintigraphic defects (0.88 vs 0.73) or reversible defects (0.51 vs 0.46). Heart rate increased directly in parallel with SBP ( $p < 0.05$ ). Comparing hypertensive to typical responders, the presence of symptoms of headache or induced pain in the chest, abdomen, neck or jaw (20/49 vs 77/292,  $p < 0.05$ ) were found more frequently. Significant ST segment depression was also more frequent in the hypertensive group (9/49 vs 19/292,  $p < 0.05$ ). Finally, mild hypertensive responders demonstrated no difference in the nature or frequency of induced symptoms, electrocardiographic, or heart rate changes compared to those with the typical SBP response.

These results suggest that a moderate or severe paradoxical hypertensive SBP response to dipyridamole infusion is not specific for induced ischemia but more often likely relates to induced pain symptoms, another cause of increased catecholamine levels. This response does not appear to relate to the presence or extent of coronary artery disease or to the presence or nature of induced image abnormalities.

945-122

### Energy Cost of Occupational Work

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Data regarding expected energy requirements of occupational work is helpful in evaluating the ability of some patients to safely resume occupational work following a cardiac event. However, current data on energy expenditure in the work setting is very limited and outdated. The purpose of this study was to evaluate oxygen uptake and heart rate (HR) responses in several job categories requiring physical labor including factory ( $n = 102$ ), building construction ( $n = 85$ ), landscaping/ground-care/forestry ( $n = 41$ ), farming ( $n = 36$ ), auto mechanic ( $n = 29$ ), kitchen/cafeteria ( $n = 26$ ), laundry service ( $n = 16$ ). A portable Cosmed K2 unit was used to measure oxygen uptake and HR for 20 min/worker. Oxygen uptake (ml/kg/min) responses (means  $\pm$  SD) for workers within the above job categories averaged  $8.5 \pm 3.0$ ,  $12.9 \pm 4.2$ ,  $12.6 \pm 5.2$ ,  $12.4 \pm 4.8$ ,  $8.2 \pm 2.3$ ,  $8.3 \pm 2.0$ ,  $9.2 \pm 3.0$ , respectively. In terms of specific job tasks, most required  $< 14.0$  ml/kg/min (i.e.,  $< 4$  METs). Those requiring higher demands included chain sawing/chipping, power push mowing, barn cleaning, air hammering, dry wall/masonry, and weight carrying/repetitive lifting. Among factory workers, METs did not differ significantly due to age or gender. Relative effort with factory work, based on treadmill maximal testing of 40 workers, averaged  $25 \pm 8\%$  maximal oxygen uptake and  $52 \pm 9\%$  maximal HR.

**Conclusion:** The average energy expenditure of most jobs requiring physical labor is  $< 4$  METs.

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### Clinical Applications of New Technology

Tuesday, March 21, 1995, 9:00 a.m.–11:00 a.m.

Ernest N. Morial Convention Center, Hall E

Presentation Hour: 10:00 a.m.–11:00 a.m.

946-103

### Incremental Prognostic Power for Perioperative Cardiac Events of Clinical History and Semi-Quantitative Dobutamine Before Major Vascular Surgery

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Using the presence of stress induced ischemia with dobutamine-atropine stress echocardiography (DSE) for predicting perioperative cardiac events (CE) in patients undergoing major vascular surgery has a high negative but low positive predictive value (PPV).

**Aim of the study:** to improve the PPV of DSE by combining the value of clinical markers and DSE.

**Methods:** in 300 consecutive patients clinical risk factors (diabetes, angina, Q waves on ECG, age  $> 70$  years, and history of ventricular arrhythmias) were assessed. DSE results were analyzed by quantifying the extent and severity of new wall motion abnormalities (NWMA) at peak stress. Also, heart rate threshold (HR-Thres) at which NWMA occurred was noted. Low HR-Thres was defined as NWMA at  $< 70\%$  of maximal age and sex related heart rate.

**Results:** 27 CE occurred of which 5 cardiac deaths, 12 myocardial infarctions and 10 patients with unstable angina. One-hundred patients had no

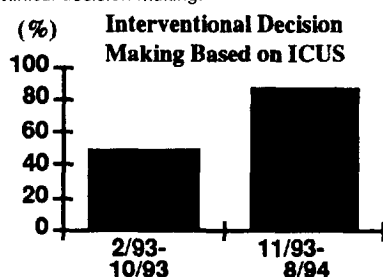
clinical risk factors, 200 one or more. All but 1 CE occurred in patients with 1 or more risk factors. In 27 of 72 patients with a positive DSE a CE occurred (PPV 38%). Quantifying the extent and severity of NWMA at peak stress provided no additional information. The HR-Thres at which ischemia occurred improved PPV. In 30 patients with a low HR-Thres, 20 CE occurred (PPV 67%). In the remaining 42 patients with a high HR-Thres, only 7 CE occurred (16%). The improvement of PPV from 38% to 67% is statistically highly significant ( $P < 0.01$ ). All patients with a fatal CE and 8 of 12 patients with a myocardial infarction had a low HR-threshold.

**Conclusions:** 1) in patients with no clinical risk factors additional stress testing is not efficient. 2) in patients with one or more risk factors semi-quantitative DSE allows stratification of patients in low, intermediate, and high risk groups for CE.

#### 946-104 The Evolving Utility of Intracoronary Ultrasound

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Although the use of intracoronary ultrasound (ICUS) imaging before and/or after the specific intervention has been reported by many investigators, its utility for altering interventional decision making has not been fully assessed. **Methods:** Eighty four successive cases of ICUS were divided into 2 time periods and studied as to how frequently the ICUS affected the coronary interventional strategy. A 3.5 F, 30 MHz (Boston Scientific) catheter with a HP Intravascular Imaging System was used. An ICUS image that led to a decision not provided by angiographic finding was considered as having changed interventional strategy. **Results:** Frequency of interventional decision making based on ICUS significantly increased from 48.5% in early series (2/93-10/93) to 84.3% in recent series (11/93-8/94) ( $p = 0.0006$ ). ICUS imagings were considered significantly more useful for decision making in stent cases (85.7%) and in directional coronary atherectomy (DCA) or excimer laser coronary angioplasty (ELCA) cases (81.3%) than in PTCA cases (51.5%) ( $p = 0.0023$ ). Between the 2 periods, there were changes in the indications for ICUS. Post-stenting imaging significantly increased from 15.2% (5/33) to 41.2% (21/51) ( $p = 0.0154$ ), and post-PTCA imaging significantly decreased from 60.6% (20/33) to 27.5% (14/51) ( $p = 0.0033$ ). Peri-ELCA or peri-DCA imaging increased from 12.1% (4/33) to 32.4% (16/51) and the imaging of angiographically ambiguous lesions including ostial segments increased from 24.2% (8/33) to 41.1% (22/51) ( $p = 0.0011$ ). **Conclusion:** The frequency of decision making based on ICUS findings has increased dramatically in association with a pre-selection of patients having stents, DCA or ELCA, and angiographically ambiguous lesions, indicating that ICUS imaging has changed from being predominantly an investigative tool to a method for supporting clinical decision making.



#### 946-105 Percutaneous Arterial Revascularization in Females Compared to Males

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The results of peripheral angioplasty (PTA) for lower extremity peripheral arterial disease (PAD) in females are not well known. Between June 1988 and June 1994, 63 female patients and 143 male patients underwent 293 interventions (PTA) for symptomatic PAD. Female patients (97 PTA's) were significantly older than male patients (196 PTA's; mean age 68 versus 63,  $P < 0.0001$ ), had lower prevalence of documented coronary artery disease (56% versus 78%,  $P < 0.0002$ ), and had higher rates of hypertension (65% versus 48%,  $P < 0.01$ ). Both groups had similar prevalence of diabetes, hyperlipidemia and smoking. Females (299 lesions) and males (608 lesions) had similar lesion distributions ( $P = NS$ ). Success rate in females was 98% for all lesions versus 96% in males, and 96% versus 81% ( $P < 0.003$ ) for total chronic occlusions.

The complication rate was low and similar in both groups, with the exception of need for blood transfusions (3% versus 0%,  $P < 0.05$  female vs. male pts). The occurrence of large hematomas, 10% vs. 7.5%, vascular repair, 2%

vs. 0%, and acute closure, 1% vs 0%, were all similar ( $P = NS$ ) for females versus males. There were no strokes, infarctions, amputations, emergent bypass surgeries, or deaths. At mean follow-up of  $29 \pm 20$  months, symptomatic improvement was 60% for females and 77% for males ( $P < 0.05$ ). There was no significant difference in the rate of revascularization by PTA or bypass surgery in either group.

**Conclusions:** 1) PTA in females is a safe procedure and is associated with similar complication rates as in men. 2) Females with symptomatic PAD benefit from PTA as much as males, and actually have a higher success rate with chronic total occlusions. 3) However, on long-term follow-up, symptomatic status of females is worse than that of males.

#### 946-106 Papillary Muscle Perfusion Assessed with Myocardial Contrast Echocardiography in Humans

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Papillary muscle perfusion assessed with myocardial contrast echocardiography was compared with coronary anatomy as identified by coronary arteriography in 114 pts without coronary artery disease. Myocardial contrast echocardiography was performed by imaging the parasternal short axis view at the mid papillary muscle level during the right (RCA) and left intracoronary arterial (LCA) injection of sonicated Hexabrix or hand agitated Urografin. The anterolateral papillary muscle was opacified in 113 of 114 (99%) pts with LCA injection and in only 1 of 114 (1%) pt with RCA injection. The posteromedial papillary muscle was opacified in 37 of 114 (32%) pts with LCA injection, in 72 of 114 (63%) pts with RCA injection and in 5 of 114 (5%) pts both with LCA and RCA injection. Both papillary muscle and its adjacent LV wall were opacified with same coronary arterial injection in 94 of 114 (82%) pts, however, they were opacified with different coronary arterial injection in 20 of 114 (18%) pts. **Conclusions:** (1) The papillary muscle is usually supplied by either LCA or RCA in most subjects, but it may be supplied by both RCA and LCA (approximately 5%). (2) The papillary muscle may be supplied by the other artery than that supplies the adjacent area. (3) Thus, there are considerable variabilities in the papillary muscle perfusion.

#### 946-107 Altered Global and Regional Myocardial Backscatter Characteristics in Cardiac Fatigue Following Prolonged Exercise

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Prolonged exercise causes a transient reduction in LV systolic function, including regional wall motion abnormalities in the absence of ischemic ECG or enzyme abnormalities (cardiac fatigue). To assess the possible contribution of local tissue changes such as ischemia, ultrasonic integrated backscatter images (IBS) were obtained in 16 endurance athletes before and immediately after the Ironman triathlon (2.4 mi swim, 112 mi bike, 26 mi run; average duration 12 hrs 03 min). Echoes were recorded using identical acquisition parameters with transmit gain adjusted individually to preclude saturation. Mean IBS (absolute value, dB) at 2 transmit settings was measured using acoustic densitometry for pericardium (P), and septal (S) and posterior walls (PW) and converted to linear mV scale for normalization to pericardial reflectivity (%PR). **Results were:**

	P (dB)	PW (dB)	S (dB)	P (mV)	PW (mV)	S (mV)	PW-%PR	S-%PR
Pre	35.0	12.3	17.7 <sup>†</sup>	437	53	90	12.4	21.6 <sup>†</sup>
Finish	34.0	10.1*	13.4* <sup>†</sup>	402	42*	57*	10.9*	15.5* <sup>†</sup>
% Δ	-2	-13	-21	-3	-13	-27	-5	-27 <sup>†</sup>

\* $p < 0.01$  vs pre, <sup>†</sup> $p < 0.05$  PW vs S by ANOVA

The lack of significant change in pericardial reflectivity at finish indicates that the acoustic properties of the chest were unchanged. Therefore, reductions in S and PW IBS and reflectivity represent global alterations in myocardial characteristics, possibly due to edema and/or ischemia. These changes are more marked in the septum and correlate with previously described wall motion abnormalities in this area. **In conclusion,** careful acquisition of ultrasonic backscatter images with normalization to pericardium allows serial noninvasive tissue characterization in man. IBS changes following prolonged exercise suggest that both global and regional metabolic or perfusion abnormalities may occur following physiologic stimuli and contribute to cardiac fatigue.