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ABSTRACTS
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CONTRIBUTIONS

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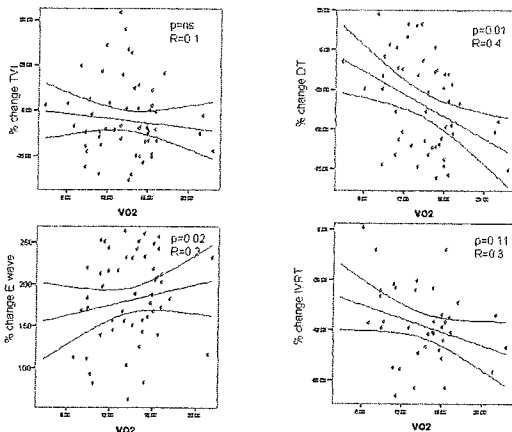
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Conclusion: Simultaneous Doppler measures of diastolic function during CPX testing are feasible and provide insight into a mechanism of exercise intolerance among patients with systolic heart failure. Higher patient exercise tolerance correlated with hearts that had greater diastolic reserve. Diastolic parameters used in our study are load dependant.

Figure 1 Linear regression analysis of Systolic (TV) or Diastolic (E-wave, DT, IVRT) parameters compared with exercise MV02



2:30 p.m.

903-279 Ventricular Mechanics in Pulmonary Hypertension: A New Method of LV Diastolic Function Evaluation

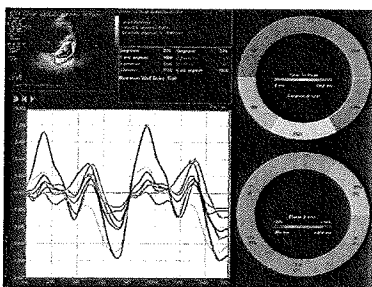
Petra Niemann, Helene Houle, David J Sahn, Elyse Foster, OHSU, Portland, OR, UCSF, San Francisco, CA

Background: Stress can induce high PASP in pts with pHTN and impacts exercise tolerance directly by affecting RV function and indirectly by affecting LV function (ventricular interaction). We assessed LV peak systolic twist/untwisting in pts with stress induced pHTN.

Methods: We studied 15 pts with pHTN (48y± 16, f 63%, m 37%, m resting PASP 45mmHg ± 12) and 5 controls who underwent TTE and cardiac stress imaging. WHO classification of pHTN: class 1 (8), class 2 (3), class 5 (1). Images were obtained with a Siemens Sequoia US system at LV apical and basal short axis views and with Doppler imaging of TR jet (standard supine bicycle protocol). VVI (Siemens) was used for offline analysis of LV twist and untwisting. All data were correlated to TR jet measures of PASP.

Results: At baseline, peak LV systolic twist was -12.4° ± 5° in controls, and -6.3° ± 2.6° in pHTN pts, and untwisting was -1.9° ± 2.4° in pHTN pts. Twist/untwisting in the controls was highest in the septal and inferior area, while in pts with pHTN twist/untwisting was most significantly decreased in the septum. An inverse relationship between RV pressure and peak LV systolic twist/diastolic untwisting was found. Patients with high PASP on stress testing showed lower LV systolic peak twist and untwisting. Patients with highest RV pressures showed the largest decrease in peak twist/untwisting.

Conclusion: In our study peak LV twist and untwisting decreased with increasing RV pressure load, and time to peak LV untwisting increased in concordance with PASP measures.



2:30 p.m.

903-280 Mechanisms of the Clinical Benefit of Enhanced External Counterpulsation Therapy: Hemodynamic, Myocardial, Valvular, and Perfusion Effects by Serial Supine Bicycle Stress Echocardiography with Doppler and Perfusion Imaging

Vicki L. McHugh, Michelle A. Mathiason, Lori Schams, Kelly Ray, Marcia Kendall, Steven C. Smart, Gundersen Lutheran Medical Center, La Crosse, WI

Background: Enhanced external counterpulsation (EECP) is effective for improving quality of life (QOL) in patients with end stage inoperable coronary artery disease (CAD) and life limiting symptoms. Supine bicycle stress echocardiography with Doppler/perfusion

imaging (SBSEDP) permits assessment of regional and global left and right ventricular (LV and RV) systolic function, valvular function, diastolic function, and myocardial perfusion. We aimed to evaluate physiologic and hemodynamic changes by SBSEDP to better understand the mechanisms of improved QOL by EECP.

Methods: Consecutive patients underwent EECP from 8/1/04 to 12/31/06 and SBSEDP before and after treatment. EECP was performed according to standard protocol of 35-50 one-hour treatments over 7-10 weeks. SBSEDP was done in stages with quantitative Doppler for tricuspid regurgitation (TR), mitral regurgitation (MR), and RV pressure. LV size and ejection fraction (EF) were calculated. Data were recorded by chart review. Pre- and post-EECP variables assessed by SBSEDP were analyzed by paired t-tests. Definity myocardial perfusion imaging was done during immediate recovery. Mantel-Haenszel Chi-Square analysis was used to assess changes pre- and post-EECP. Responders were defined as having ≥ 2-class improvement in functional or angina class.

Results: Data was available on 49 subjects (mean age 65.4 ± 12, 63% male). 49% of subjects had history of smoking and 37% were current smokers. Only one subject (2%) suffered a medical event (MI) during treatment time frame. EECP improved EF at baseline and peak (p=0.008, p<0.001), wall motion abnormalities at baseline and peak (p=0.003, p=0.001) and myocardial perfusion (p<0.001). There were dramatic improvements METS (p<0.001). Chi-Square demonstrated improved MR at baseline and peak (p=0.013, p<0.001), RV size at baseline and peak (p=0.011, p=0.014), and TR at peak (p=0.001). 71% of patients were responders.

Conclusions: EECP is effective for life-limiting angina in those with end stage CAD. Mechanism of the clinical improvement is not only improved regional and global myocardial function and perfusion, but also by reduced MR and right heart abnormalities.

2:30 p.m.

903-281 Prognostic Significance of Positive Stress Echo in Angiographically Non Significant Coronary Artery Disease

Roopa Subbarao, Jothihran Mahenthiran, Judy Foltz, Irmina Gradus-Pizlo, Harvey Feigenbaum, Stephen Sawada, Indiana University, Indianapolis, IN, Krannert Institute of Cardiology, Indianapolis, IN

Background: Prior studies have shown that patients (pts) without significant CAD by angiography have good outcome (<1% annual mortality). We assessed the outcome of pts without significant CAD who had ischemia on stress echocardiography (stress echo) to see if ischemia influences the prognosis of these pts.

Methods: Study group comprised of pts without significant CAD by angiography (< 50% diameter stenosis) who had ischemia on stress echo. Pts with prior revascularization, reduced ejection fraction (EF), prior transmural infarctions were excluded. Cardiac events were defined as admission for angina, heart failure, revascularization, infarction (MI) or death.

Results: There were 124 pts (mean age 56.3±10.4 years, women 66%). The mode of stress was treadmill 41(33%), supine bicycle 23 (19%), and dobutamine 60 (48%). Fifty nine pts (48%) had hypertension and 32 (26%) were diabetic. The mean EF was 58±11%. The mean resting wall motion score index (WMSI) was 1.05±0.1 and peak WMSI was 1.3±0.2. Mean follow up was 39±31 months. There were 27 (22%) pts with 33 events (angina 11, heart failure 2, revascularization 2, MI 3, death 15). The annualized event and mortality rates were 6.8% and 3.8% respectively. Univariate predictors of events were resting left circumflex (LCX) WMSI (p=0.02 hazard ratio [HR] 111.1[2.3-5420]), peak WMSI (p=0.005 HR 7.8[1.9-33]), peak left anterior descending artery (LAD) WMSI (p=0.016 HR 4.0[1.3-12]). Chest pain (P=0.064 HR 0.32[0.09-1.07]) and statin use (HR 0.33 [0.8-1.4] p=0.09) were borderline predictors of outcome. The presence of mild disease (30% to < 50% stenosis) was not predictive. On multivariate analysis resting LCX WMSI (p=0.05 HR 57.9 [1.01-3313]) and peak LAD WMSI score (P=0.04 HR 3.2 [1.035 -10.11]) were independent predictors of events and statin use showed a trend towards better outcome (p=0.056 HR 0.238).

Conclusions: Pts without significant CAD by angiography remain at higher risk for events and mortality (3.8% vs. 1.0% annual mortality of historical controls) in presence of stress-induced ischemia. Resting wall motion abnormalities in LCX territory and ischemia in LAD territory are independent predictors of events and statin use predicts event-free survival.

2:30 p.m.

903-282 Incremental Value of Acute Changes in Left Ventricular Asynchrony During Dobutamine Stress Echocardiography as a Powerful Detector of Acute Ischemia

Toshio Saito, Eiichi Hyodo, Kumiko Hirata, Kazue Okajima, Makoto Hirose, Yuji Sakanoue, Yukio Nishida, Takahiko Kawarabayashi, Minoru Yoshiyama, Junichi Yoshikawa, Higashisumiyoshi Morimoto Hospital, Osaka, Japan

Background: Decreased Left ventricular (LV) asynchrony with bi-ventricular pacing is associated with clinical improvement. However, acute changes in LV asynchrony during dobutamine stress echocardiography (DSE) and their clinical significance have not been elucidated. The purpose of this study was to clarify the clinical utility of acute changes in LV asynchrony for the detection of ischemia during DSE.

Methods: Thirty patients were subjected to DSE followed by coronary angiography (mean age 68 ± 10). At baseline and at peak DSE, LV short axis images were acquired in apical, mid and basal level. The time from the aortic valve opening to peak myocardial strain value was measured by 2D tracking methods (Echopac PC, version 5.1.1, GE medical Systems), and its ratio to ejection time multiplied by 100 (Ta) was derived in the 4 apical, 6 mid and 6 basal segments of LV. In addition, we calculated the standard deviation of Ta (Asynchrony index: AI) reflecting asynchrony of 16 LV segments. AI at peak DSE divided by that at baseline was defined as AI Ratio.

Results: Strain profiles in 30 patients of 35 could be analyzed properly using 2D speckle tracking methods during peak DSE(75%). In these patients, coronary angiography revealed

3:00 p.m.

1024-84 Does Continuous ST-Segment Monitoring Add Prognostic Information to the TIMI, PURSUIT, and GRACE Risk Scores?

Pedro L. Carmo, Jorge S. Ferreira, Carlos T. Aguiar, Pedro A. Goncalves, Luis F. Raposo, Antonio M. Ferreira, Jose M. Aniceto Silva, Hospital Santa Cruz, Carnaxide, Portugal

Background: Recurrent ischemia is frequent in patients (pts) with non-ST-elevation acute coronary syndromes (NSTE-ACS), and portends a worse prognosis. Continuous ST-segment monitoring (CSTM) adequately reflects the dynamic nature of myocardial ischemia and allows the detection of silent ischemic episodes. The aim of this study is to investigate whether CSTM adds prognostic information to the risk scores currently used in clinical practice.

Methods: We studied 234 pts with NSTE-ACS in whom CSTM was performed in the first 24 hours after admission. An ST episode was defined as a transient ST-segment deviation in ≥ 1 lead of ≥ 0.1 mV, and persisting ≥ 1 min. Three risk scores were calculated for each pt: TIMI (for NSTE-ACS), PURSUIT (death/MI model), and GRACE. The endpoint was defined as death or nonfatal myocardial infarction (MI), whichever occurred first by 1 year follow-up.

Results: ST episodes were detected in 54 pts (23.1%) and associated with worse 1-year outcome: 25.9% endpoint rate vs 12.2% for pts without ST episodes (OR = 2.51; 95% CI, 1.18-5.35; P = 0.026). All 3 risk scores predicted 1-year outcome, but the GRACE risk score (c-statistic = 0.755; 95% CI, 0.695-0.809) was superior to both TIMI risk score (c-statistic = 0.632; 95% CI, 0.567-0.694) and PURSUIT risk score (c-statistic = 0.644; 95% CI, 0.579-0.706). A GRACE risk score >124 showed the highest accuracy for predicting the study endpoint. The presence of ST episodes added independent prognostic information to the TIMI risk score (HR = 2.23; 95% CI, 1.13-4.38) and to the PURSUIT risk score (HR = 2.03; 95% CI, 1.03-3.98), but not to the GRACE risk score.

Conclusions: CSTM provides incremental prognostic information beyond the TIMI and PURSUIT risk scores, but not the GRACE risk score. Hence, the GRACE risk score should be the preferred stratification model in daily clinical practice.

3:00 p.m.

1024-85 Chromogranin A Levels in the Acute Phase Independently Predicts Mortality and Heart Failure Hospitalizations During Follow-up in Patients With Non-ST Elevation Acute Coronary Syndromes

Helge Rosjo, Anna M. Jansson, Alan Flyvbjerg, Anita Persson, Thomas Karlsson, Marianne Hartford, Torbjorn Omland, Kenneth Caidahl, Akershus University Hospital, Lorenskog, Norway, Karolinska University Hospital, Stockholm/ Solna, Sweden

Introduction: The neurohumoral marker chromogranin A (CgA) has in small studies been shown to predict mortality and heart failure hospitalizations after ST-elevation myocardial infarction. We hypothesized that CgA also would predict mortality and heart failure hospitalizations during follow-up in patients with non-ST elevation acute coronary syndromes (NST-ACS), and that CgA would provide additional information to echocardiographic findings and contemporary cardiovascular biomarkers.

Methods: CgA, cardiac troponin I, C-reactive protein (CRP) and B-type natriuretic peptide (BNP) were measured within 24 hrs of admission in 477 patients with NST-ACS (mean age 65 years, 32 % female). Echocardiographically determined left ventricular ejection fraction (LVEF) was obtained within day 5 of admission (n=357).

Results: During a median follow-up of 44 months, 85 patients (18%) died and 50 (10%) were hospitalized for heart failure. By Cox proportional hazards regression model (hazard ratio per 1 SD increase in log transformed CgA), baseline CgA concentration was strongly associated with the primary outcome mortality or heart failure hospitalizations (HR 1.61 [1.39-1.86], p<0.0001). After adjusting for contemporary cardiovascular biomarkers and conventional risk markers (age, gender, smoking status, prior myocardial infarction, diabetes, hypertension, congestive heart failure, heart rate, Killip class (>1) on admission, creatinine clearance, and peak CKMB), CgA still predicted outcome (HR 1.33 [1.07-1.66]; p=0.01). Further adjustment for LVEF attenuated the association, but baseline CgA concentrations were still predictive of mortality or heart failure hospitalizations (HR 1.33 [1.03-1.73], p=0.03).

Conclusions: CgA is a powerful predictor of mortality and heart failure in NST-ACS and provides incremental prognostic information to cardiac Troponin I, CRP, BNP, and LVEF.

3:00 p.m.

1024-86 Effect of Enhanced External Counterpulsation on Symptoms, Quality of Life, 6-Minute Walking Distance, and Left Ventricular Systolic and Diastolic Function After 35 Days of Treatment and at 1-Year Follow-Up in 47 Patients With Chronic Refractory Angina

Anil Kumar, Wilbert S. Aronow, Aniket Vadnerkar, Puneet Sidhu, Sanjay Mittal, Ravi R. Kasliwal, Naresh Trehan, Soundshore Medical Center/New York Medical College, New Rochelle, NY, ESCORTS Heart Institute and Research Center, New Delhi, India

Background: Enhanced external counterpulsation (EECP) improves symptoms and exercise duration in patients with refractory angina pectoris. The effect of EECP on left ventricular (LV) systolic and diastolic function needs to be investigated.

Methods: In a prospective study, EECP was performed for 1 hour each day for 35 days in 47 patients, mean age 61 ± 8 years, with prior coronary revascularization who had chronic refractory angina despite antianginal drugs and who were not candidates for further coronary revascularization. The effect of EECP on symptoms, quality of life, 6-minute walking distance, and LV systolic and diastolic function measured by 2-dimensional and Doppler

echocardiography was investigated after 35 days of EECP and at 1 year after EECP. **Results:** Compared to baseline values, EECP significantly improved anginal symptoms, dyspnea on exertion, and quality of life after 35 days of treatment (p<0.001) and at 1-year follow-up (p<0.001). Compared to the baseline value of 653 ± 249 feet, EECP significantly improved the 6-minute walking distance to $1,025 \pm 234$ feet after 35 days of treatment (p<0.001) and to $1,040 \pm 221$ feet at 1-year follow-up (p<0.001). However, EECP did not significantly affect LV ejection fraction, LV end-diastolic and end-systolic dimensions, LV end-diastolic and end-systolic volumes, E/A ratio, isovolumic relaxation time, and deceleration time measured by 2-dimensional and Doppler echocardiography. **Conclusions:** EECP caused a significant improvement in symptoms and in exercise tolerance after 35 days of therapy and at 1-year follow-up in patients with refractory angina pectoris who were not candidates for further coronary revascularization. However, EECP did not improve any measurements of LV systolic function or LV diastolic function.

3:00 p.m.

1024-87 Do Different Healthcare Systems Impact Major Outcomes in Stable Coronary Disease Patients Enrolled in COURAGE?

Bernard R. Chaitman, Pamela M. Hartigan, David C. Booth, Koon K. Teo, John Mancini, William J. Kostuk, John A. Spertus, David J. Maron, Marcin Dada, Robert A. O'Rourke, William S. Weintraub, William E. Boden; for the COURAGE Investigators, Daniel S. Berman, Leslee J. Shaw, Saint Louis University School of Medicine, St. Louis, MO

Background: The COURAGE trial reported no significant differences in major cardiovascular outcomes when coronary angioplasty (PCI) was added to optimal medical therapy (OMT) after a median 4.6 yr follow-up. Patients were enrolled from US Veteran Affairs (VA) (n=968), US non-VA (US) (n=385) and Canadian (CDN) (n=931) healthcare systems; randomization was blocked by hospital and prior bypass surgery. We examined cardiovascular outcomes by individual healthcare system (HCS) to determine whether HCS (and their associated practice cultures) was associated with the study.

Methods: Cox regression analyses after adjustment for baseline patient characteristics was used to assess the association of HCS with death and for the composite endpoint of death/myocardial infarction (MI).

Results: Baseline demographics were not significantly different among treatment groups within each HCS. Five yrs after randomization, the percent of pts that exercised 30-45 min at least 5 times/week was 33%, 35% and 46% (p<0.001) and LDL cholesterol was <70 mg/dL in 39%, 42% and 50% of pts (p<0.001) in the VA, US, and CDN HCS, respectively. In spite of these differences, the interaction between HCS was not significant for the endpoint of death (p=0.25) or the composite endpoint of death/MI (p=0.24). Similar results were obtained after analyses for cardiovascular death and cardiovascular death/MI.

Conclusions: In COURAGE, PCI was not shown to improve survival or reduce death/MI compared to OMT across all 3 healthcare systems studied.

	OMT	PCI	P	OMT	PCI	P
	Death	Death		Death/MI	Death/MI	
VA	58 (12.1)	42 (8.6)	0.07	104 (21.7)	107 (21.9)	0.94
US	15 (7.9)	15 (7.7)	0.94	38 (19.9)	30 (15.3)	0.24
CDN	22 (4.7)	28 (6)	0.37	60 (12.8)	74 (16)	0.17
Total	95 (8.3)	85 (7.4)	0.38	202 (17.8)	211 (18.4)	0.62

3:00 p.m.

1024-88 Routine PCI Improves Short but not Long term Angina Status in Patients with an Occluded Infarct Artery: Results from the Occluded Artery Trial (OAT)

Gerard P. Devlin, Daniel B. Mark, Gervasio A. Lamas, Antonio C. Carvalho, Vladimir Dzavik, Sandra A. Forman, Carlos R. Vozzi, Michael Ragosta, Jamie M. Rankin, Paulo Caramori, George Sopko, Eduardo Balcells, Jonathan Leor, Bruce A. Barton, Judith S. Hochman, Waikato Hospital, Hamilton, New Zealand, New York University School of Medicine, New York, NY

Background: OAT (n= 2201) reported no reduction in the primary endpoint of death, re-PCI or heart failure with routine (3-28 days post-MI) percutaneous coronary intervention (PCI) (n=1101) of an occluded infarct-related artery (IRA) relative to medical treatment (MED) (n=1100). Anginal symptoms and non-protocol revascularization (revasc) were major secondary endpoints.

Methods: Angina status and revasc were collected at 4 months and then annually. Rx comparisons are by intention-to-treat.

Results: During follow-up, 764 pts developed angina. Compared with MED, 6 per 100 more pts assigned to PCI were angina free at 1 year (p=.002) (figure) narrowing to 3 per 100 at 3 yrs (p=.08). Use of anti-anginal therapy was similar in the 2 groups. At 5 yrs, revasc was more frequent in MED (22% vs. 19% for PCI, p=.03). However, in pts with follow-up angina (n=764), revasc rates were not different between groups (17% PCI vs. 19% MED, p=.56). Most pts with angina in follow-up either had no revasc or had it performed prior to symptom onset (PCI 83% vs. MED 81%, p=.56). Reasons for revasc were similar in the 2 groups including ACS in 37%, stable angina in 33%, physician preference in 18%, other in 12%.

Conclusions: In a large randomized clinical trial of stable post MI pts, PCI of an occluded IRA produced a modest early benefit on angina status that was lost by 3 years. Follow-up revasc was slightly more common in the MED group and was not driven by more frequent ischemia, with almost one in five procedures related to physician preference alone.

risk for CAD. All patients underwent both a CMR and SPECT. CMR included cine, adenosine-stress and rest perfusion, and delayed enhancement. SPECT included stress and rest perfusion, assessment of wall motion and ejection fraction. If either of the two stress tests were positive, patients were referred for coronary angiography. Patients were followed for myocardial infarction, revascularization, or cardiac death. Results: Thirty-seven patients were referred for coronary angiography, 13 of whom had significant CAD (>70%). The sensitivity, specificity, positive predictive value and negative predictive value for CMR are 71%, 83%, 56%, and 91% and for SPECT are 64%, 87%, 60%, and 89%, respectively. In patients who had a negative CMR and SPECT, there were no clinical events on follow up (mean 2 1/2 years). Conclusion: In patients being evaluated for the presence of CAD, CMR has similar diagnostic accuracy as SPECT.

Baseline Characteristics			
Characteristics	Entire Group (n=63)	CAD (n=13)	No CAD (n=50)
Age(years)	58.1	58.5	58
Males	41(65%)	11(85%)	30(60%)
Diabetes	12(19%)	5(38%)	7(14%)
Hypertension	38(60%)	10(77%)	28(56%)
Hypercholesterolemia	32(51%)	8(61%)	24(48%)
Statins	28(44%)	8(61%)	20(40%)
Beta Blocker	18(29%)	6(46%)	12(24%)
Aspirin	30(48%)	9(69%)	21(42%)
C-reactive Protein	0.4	0.58	0.36

11:00 a.m.

Myocardial Ischemia and Infarction

1031-65 Clinical Outcomes in Older Patients Treated with Optimal Medical Therapy with or without Percutaneous Coronary Intervention for Stable Coronary Disease: A Pre-Specified Subset Analysis of the COURAGE Trial

William E. Boden, Steven P. Sedlis, Teo Koon, Robert O'Rourke, David Maron, Pamela Hartigan, Marcin Dada, William Weintraub, Western New York VA Healthcare Network and Buffalo General Hospital/SUNY, Buffalo, NY

Background: Individuals ≥ age 65 years comprise the fastest growing segment of the U.S. population. The impact of percutaneous coronary intervention (PCI) on clinical outcomes in older patients with stable coronary artery disease (CAD) treated with optimal medical therapy (OMT) remains ill-defined. While age dichotomized at 65 years was one of 8 prespecified covariates that did not show a difference between PCI and OMT for the primary endpoint of death or MI during a median 4.6 year follow-up, other important cardiovascular (CV) outcomes that could vary by treatment in older vs. younger patients have not been previously reported.

Methods: We compared baseline characteristics and long-term CV outcomes of patients whose age was < 65 years vs. ≥ 65 years enrolled in the COURAGE trial. Results: Of the 2,287 patients randomized to OMT or OMT + PCI, 1,381 patients (60%) were < age 65 years (mean age: 56 ± 6 years) and 904 patients (40%) were ≥ age 65 years (mean age: 72 ± 5 years). Rates of death, MI, stroke, and ACS stratified by treatment arm and age dichotomized at 65 years are shown (Table).

CV Outcomes	Age	PCI + OMT	OMT	P value
Death	< 65	28 (4%)	41 (6%)	0.12
	≥ 65	57 (12%)	54 (12%)	0.92
MI	< 65	83 (12%)	76 (11%)	0.52
	≥ 65	60 (13%)	52 (12%)	0.54
Death or MI	< 65	107 (16%)	109 (16%)	0.93
	≥ 65	104 (23%)	93 (21%)	0.54
Death, MI, stroke	< 65	113 (16%)	114 (16%)	0.99
	≥ 65	109 (24%)	99 (22%)	0.62
ACS	< 65	87 (13%)	85 (12%)	0.83
	≥ 65	60 (13%)	52 (12%)	0.47
Death, MI, stroke, ACS	< 65	172(25%)	175 (25%)	0.91
	≥ 65	141 (31%)	130 (29%)	0.65

Conclusions: Patients ≥ age 65 years had more deaths than younger patients, but not more nonfatal MIs. The addition of PCI to OMT did not reduce CV events; thus, it appears difficult to justify PCI as an initial strategy in older stable CAD patients, and it is unlikely to be cost-effective as well. These data support adherence to published ACC/AHA treatment guidelines advocating OMT as the preferred initial strategy, regardless of age.

11:00 a.m.

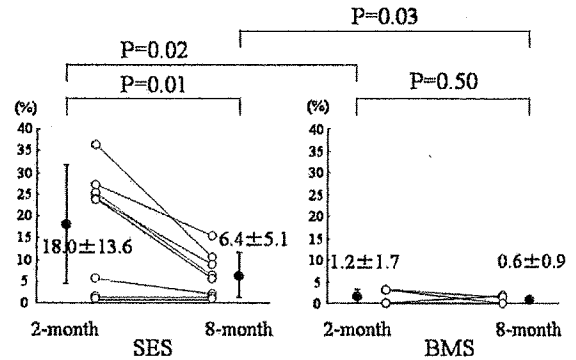
1031-66 Serial Analysis of Neointimal Coverage Following Sirolimus-eluting Stent Implantation Using Optical Coherence Tomography: Comparison with Bare-metal Stent

Tatsuya Ito, Mitsuyasu Terashima, Yoshihiro Takeda, Jean-François Surmely, Osamu Katoh, Tetsuo Matsubara, Takahiko Suzuki, Toyohashi Heart Center, Toyohashi, Japan

Background: Late stent thrombosis (LST) in sirolimus-eluting stents (SES) after discontinuation of antiplatelet therapy develops a serious complication. Previous pathologic studies have shown the relationship between LST and delayed arterial healing following SES implantation. However, the time course of arterial healing is unknown in the clinical setting. Optical coherence tomography (OCT) is a novel imaging technique with high resolution and is expected to visualize microscopic vascular response to coronary intervention. The aim of this study was to investigate healing process following

SES implantation in comparison with bare metal stent (BMS) using OCT. Methods: We evaluated 8 SES in 6 patients and 5 BMS in 5 patients. Serial OCT images of implanted stent segment were analyzed at intervals of 1mm. Eight SES including 1270 struts and 5 BMS including 787 struts were evaluated in each stent at 2-month and 8-month chronologically. Every observed strut was classified into either covered or uncovered by OCT findings. The frequency of uncovered struts in each stent were calculated. Results: At 2-month, frequency of uncovered struts was significantly higher in SES than in BMS (18.0 ± 13.6% vs 1.2 ± 1.7%, p=0.02). Although uncovered struts gradually decreased with time, even 8 months after implantation of SES, these sites were not completely covered, whereas BMS were almost completely covered (6.4 ± 5.1 vs 0.6 ± 0.9%, p=0.03). Conclusions: The window of thrombotic risk for SES extends far beyond that for BMS.

Frequency of Uncoverd Stent Struts (%)



11:00 a.m.

1031-67 Circulating Progenitor Cells and Erythropoietin Levels in Patients Undergoing Enhanced External Counterpulsation

BARRY A. BOILSON, Thomas J. Kiernan, Linda J. Tesmer, Adriana Harbuzariu, Laurel S. Kleppe, Robert D. Simari, Gregory W. Barsness, Mayo Clinic, Rochester, MN

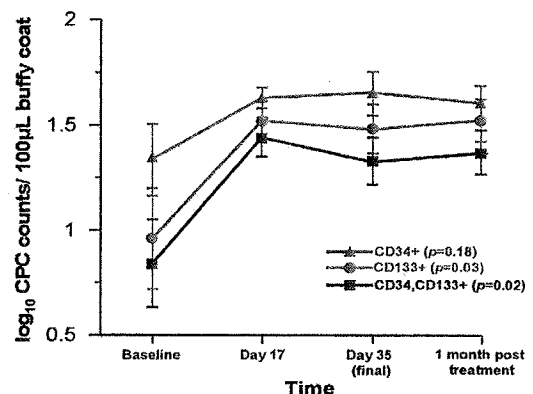
Background: The mechanism underlying the benefits of Enhanced External Counterpulsation (EECP) is not clear. We hypothesized that this could be associated with an increase in circulating bone-marrow derived progenitor cells (CPCs) and increased erythropoietin (Epo) levels, as studies have demonstrated that Epo is a potent mobilizer of bone marrow cells to the peripheral circulation, partly accounting for its pro-angiogenic properties.

Methods: Nine patients scheduled to receive EECP treatment were enrolled. Blood (5ml) was drawn on day 1, day 17, day 35 (final session) and one month post completion of therapy. Buffy coat was extracted and FACS enumeration of CD34+ and/or CD133+ CPCs was performed using ISHAGE criteria. Epo levels were measured at baseline and at day 35.

Results: Flow cytometric analysis revealed an increase in CPC counts over the course of treatment, which was statistically significant for CD133+ and CD34+,CD133+ CPCs (p<0.05) (see figure). Epo levels also increased significantly with EECP therapy (12±2 MU/ml at baseline to 22±3 MU/ml at day 35, p<0.05).

Conclusions: This study shows that CD133+ and CD34, CD133+ CPCs are significantly increased in response to EECP therapy, and this is matched by a significant increase in circulating Epo. This may reflect increased release of progenitor cells from the bone marrow, likely through hormonal activation. Homing of these cells to the coronary vasculature may effect improvements in vascular function and clinical symptomatic improvement.

Figure: One-way ANOVA analysis of progenitor cell counts over time



11:00 a.m.

1031-68

Enhanced External Counterpulsation Improves One Year Mortality in Angina Patients With End Stage Coronary Disease

William E. Lawson, John CK Hui, Elizabeth D. Kennard, Marc A. Silver, Oslem Soran, Sheryl F. Kelsey, Gregory Barness, Andrew Michaels, SUNY Stony Brook, Stony Brook, NY, University of Pittsburgh, Pittsburgh, PA

Background: Enhanced External Counterpulsation (EECP) improves angina class and ischemia, exercise tolerance and function, QOL in refractory angina patients (pts) with end stage coronary disease, but its effect on mortality and what factors predict survival in this group of pts is unknown.

Methods: The IEPR is a prospective registry of 8,000 EECP treated pts. About 14% of pts do not complete (≥ 30 hours) EECP therapy (1.7% for medical reasons), providing a comparator group for Landmark analysis when early events (within 60 days of starting therapy) are censored. Demographics, comorbidities, baseline characteristics were recorded and (1 year) outcomes, including mortality, were compared using Kaplan-Meier survival analysis and a Cox proportional hazards regression model from centers providing 1 year follow-up. Multivariable analysis of pts alive at 60 days after EECP was begun was used to determine independent predictors of one year mortality.

Results: Records of 4,597 pts were analyzed; 3,962 pts (86%) completed (C) the usual course of therapy, 14% did not (IC). Cardiac events (death, MI, CABG, PCI) accounted for 12% of the IC. Baseline demographics and history of IC and C cohorts were comparable: 89% prior CABG or PCI, 70% prior MI, 91.5% Class III or IV angina, and only 15% considered candidates for CABG or PCI. Post EECP angina class improved significantly, 85% versus 25% improving ≥ 1 CCS, in the C (mean 36 ± 4 hours) versus the IC cohort (mean 13 ± 8 hours). At 1 year there was a significant difference in mortality rates favoring the C group (4.1% versus 14.1%; $p < 0.001$), and decreased rates of myocardial infarction (4.1% versus 7.7%), CABG (2.5% versus 6%), and PCI (6.3% versus 11.3%) (all $p < 0.001$). Predictors of 1 year mortality in pts alive at 60 days included: LVEF $\leq 35\%$, HR=2.70 ($p < 0.001$); completion of EECP, HR=2.00 ($p < 0.001$); CHF, HR=1.65 ($p < 0.001$); Diabetes, HR=1.47 ($p = 0.012$); Age (per year), HR=1.05 ($p < 0.001$).

Conclusions: EECP therapy completion improves CCS angina class and 1 year survival in end stage CAD pts. Predictors of mortality are similar to those having prognostic value in coronary disease pts, including: heart failure and left ventricular dysfunction, diabetes, male gender, age.

11:00 a.m.

1031-69

Is Cardiac Magnetic Resonance Imaging a Useful Test in the Diagnosis of Women with Microvascular Angina?

Melissa H. Slivka, Chrisandra Shufelt, Yuching C. Yang, Louise E. Thomson, Saibal Kar, Leslie Shaw, Daniel S. Berman, Bina Ahmed, Kirsten Tolstrup, C. Noel Bairey Merz, Cedars Sinai Medical Center, Los Angeles, CA

Background: Women with microvascular angina (open coronary arteries but myocardial ischemia) have an adverse prognosis comparable to that of obstructive coronary disease as shown in prior research. Coronary reactivity testing (CRT) is useful in this diagnosis as traditional imaging tests are unable to detect subendocardial ischemia. Cardiac magnetic resonance imaging (CMR) may be useful to detect subendocardial ischemia due to abnormalities in coronary vascular function. We tested the sensitivity of CMR in women with angina and open coronary arteries for the diagnosis of microvascular angina using CRT as gold standard.

Methods: Forty women with clinical evidence of ischemia and non-obstructed coronary disease were referred for CRT and CMR. Women with myocardial bridging ($n=1$), left ventricular hypertrophy ($n=1$), obstructive coronary disease ($n=2$) and anomalous coronary ($n=1$) were excluded. CRT included intra-coronary artery adenosine coronary flow reserve (CFR) (non-endothelial microvascular function), changes in coronary blood flow and vessel diameter following intra-coronary acetylcholine (endothelial dependent macro and microvascular function) and vasodilatation following intra-coronary nitroglycerine (non-endothelial dependent macrovascular function). CMR included adenosine stress and rest perfusion using a 17 segment myocardial model with visual interpretation by two observers blinded to the CRT and angiography findings.

Results: The mean age of women was 54 ± 9.3 years, 19% were non-white, 48% dyslipidemic, 34% hypertensive, 46% had history of smoking. An abnormal CRT was found in 91%, and 68% had abnormalities in CMR subendocardial stress perfusion with normal delayed enhancement and ventricular function. The sensitivity of CMR to CRT defined vascular dysfunction was 69% with a positive predictive value (PPV) of 92%. For the quantitative read, scoring the % ischemic myocardium of $\geq 10\%$ by CMR resulted in a sensitivity of 68% and PPV of 88%.

Conclusions: Women with ischemia and open coronary arteries have a high rate of CRT and CMR abnormalities. CMR appears to have a fair sensitivity and good PPV for microvascular angina. Further study is indicated.

11:00 a.m.

1031-70

Effect of Enhanced External Counterpulsation on Ejection Fraction in Patients with Ischemic Heart Disease

William E. Lawson, Himanshu Padh, Subramanian Ramasamy, John CK Hui, Samarpan Heart Hospital and Research Center, Jamnagar, India, The People's College of Medical Sciences, Jamnagar, India

Background: Enhanced External Counterpulsation (EECP) has been shown to decrease symptoms of myocardial ischemia, improve perfusion, endovascular function, and exercise capacity. There are no large studies evaluating the effect of EECP on ejection

fraction (EF) in patients with ischemic heart disease.

Methods: Two-dimensional transthoracic echocardiography was performed on 505 patients with ischemic heart disease 1 week before their 35 hours (1 hour daily) of EECP treatment and repeated within 1 week after completion of treatment. Patients were divided into two groups, one with baseline EF $> 35\%$ ($N=360$) and the other with EF $\leq 35\%$ ($N=145$). Pre- and post echo parameters were compared in both groups using a 2-tailed paired t-test with significance at $p < 0.05$.

Results: The EF $> 35\%$ group was slightly younger than EF $\leq 35\%$ group (58.1 versus 61.3 years), predominately male (86 versus 88%), with similar percentage with diabetes (55 versus 50%), hypertension (75 versus 72%), hypercholesterolemia (64 versus 61%), MI (48 versus 49%), CABG (21 versus 31%) and PCI (13% versus 8%). In the EF $\leq 35\%$ group, the EF and stroke volume (SV) increased significantly from a baseline of $29.3 \pm 6.3\%$ and 67.7 ± 8.4 ml to $45.1 \pm 7.9\%$ and 75.0 ± 9.2 ml ($p < 0.001$), with no significant change in heart rate (78 ± 13 to 77 ± 13 beats/min). Surprisingly, the mean EF and SV of the $> 35\%$ group also increased from $48.1 \pm 7.4\%$ and 78.4 ± 8.2 ml at baseline to $56.3 \pm 5.5\%$ and 85.6 ± 9.3 ml post-EECP ($p < 0.001$). The improvement in EF and SV was mainly from a significant reduction of end systolic volume from 59.3 ± 10.4 to 53.6 ± 8.4 ml ($p < 0.001$) in the EF $\leq 35\%$ group and from 54.6 ± 7.6 ml to 50.4 ± 6.0 ml in the EF $> 35\%$ group, without significant change in end diastolic volumes (127.0 ± 10.8 to 128.6 ± 10.9 ml and 133.8 ± 11.8 to 136.0 ± 10.4 ml respectively).

Conclusions: EECP treatment significantly increased ejection fraction and stroke volume, mainly due to a decrease in end systolic volume. Potential underlying mechanisms include improvement in left ventricular contractility due to improved myocardial perfusion and/or afterload reduction secondary to normalization of endovascular tone and function.

11:00 a.m.

1031-71

Cardiac Magnetic Resonance Imaging and Coronary Reactivity Testing: A Useful Noninvasive Tool

Chrisandra L. Shufelt, Saibal Kar, Melissa Slivka, Louise Thomson, Yuching Yang, Daniel Berman, Donna Polk, Kristen Tolstrup, C. Noel Bairey Merz, Cedars-Sinai Medical Center, Los Angeles, CA

Background: Coronary reactivity testing (CRT) is used in the diagnosis of microvascular dysfunction based on endothelial and non-endothelial dependent markers. Adenosine stress cardiac magnetic resonance imaging (CMR) may be a useful non-invasive method to detect subendocardial ischemia. We sought to determine the relationship between CRT and CMR abnormalities in a selected population of women.

Methods: Thirty-five women with clinical evidence of ischemia and open coronary arteries by angiogram underwent both a CRT and CMR. Four markers of microvascular dysfunction measured during CRT included intra-coronary artery adenosine coronary flow reserve (CFR) (non-endothelial microvascular function), changes in coronary blood flow (CBF) and coronary artery diameter with intra-coronary acetylcholine (endothelial micro- and macrovascular function, respectively) and vasodilatation following intra-coronary nitroglycerine injection (non-endothelial macrovascular function). CMR was assessed for perfusion abnormality using a 17 segment visual scoring. We performed uni- and multivariate linear regression analysis with CMR perfusion abnormality and CRT variables.

Results: The mean age was 54 ± 9.3 years, 19% were non-white, 48% were dyslipidemic, 34% hypertensive, 46% had a history of smoking. None were current smokers and there were no diabetics. Univariate analyses demonstrated that CFR and CBF predicted CMR perfusion abnormality (coefficient = -7.43 , $p = 0.045$ and coefficient = 5.3 , $p = 0.048$, respectively). There was no statistical associated trend found with either acetylcholine or nitroglycerine ($p = 0.19$, $p = 0.58$, resp). By multivariate analysis the association between CBF and CFR with CMR abnormality became nonsignificant; however both continued to show trends toward predicting CMR perfusion abnormality ($p = 0.09$, 0.07 , resp).

Conclusions: In women with clinical evidence of ischemia and open coronary arteries, there is a relationship between abnormalities in CBF, CFR and the percent of stress perfusion abnormalities by CMR. This observation suggests CMR may be a useful tool in evaluation of suspected abnormal CFR and study in a larger group including normal controls is needed.

11:00 a.m.

1031-72

Accurate Detection of Coronary Artery Disease without use of Radiation using Non-Stress Magnetocardiography

Indraneil Ray, Amelia Young, David Gallegos, Linn Defensor, Robert J. Siegel, Kirsten Tolstrup, Cedars Sinai Medical Center, Los Angeles, CA

Background: Early diagnosis of coronary artery disease (CAD) is complicated by the poor sensitivity of standard tests (ECG and troponin) and the contraindication for stress testing in unstable angina patients. Currently used diagnostic tests carry risks that involve stress provocation, injection of medication, use of nuclear tracer, contrast, or radiation, as well as the possibility of invasive catheterization. MagnetoCardioGraphy (MCG) is a no risk technology developed for the rapid, non-invasive evaluation and detection of ventricular repolarization abnormalities at rest.

Methods: 111 patients with stable angina, asymptomatic chronic ischemic heart disease or acute chest pain and 29 normal controls were studied with unshielded 9 channel MCG in a general clinical setting. Scan time was 6 minutes. The MCG data were processed utilizing an automated MCG analysis program and results were available immediately. All patients were angina free at the time of scanning.

Results: The patient mean age was 59 ± 13 years and 68% were men. Most had normal ECG (79%) and normal troponin I (88%). A diagnosis of CAD was established in 38% of patients after non-invasive and invasive testing. A normal MCG was seen in all controls. MCG detected CAD with high degree of accuracy ($p < 0.0001$) and high diagnostic value: sensitivity 88%, specificity 80%, positive (PPV) and negative predictive value (NPV) of

ST-elevation MI (STEMI) ongoing, recurrent STEMI, other acute coronary syndrome and renal failure. The 30-day mortality for the overall population was 1.5% (n = 500). The area under the ROC curve for the training set was 90.2%. The Hosmer and Lemeshow p-value was 0.84 indicating no evidence of lack of fit for the model. Corresponding values for the validation set were 91.1% and 0.12 indicating that the model also performed well in this group.

Conclusions: We describe a large, contemporary cohort of consecutive patients undergoing PCI with complete follow-up for 30-day mortality. A robust, validated model of 30-day mortality after PCI was used to construct a risk calculator, the BC-PCI risk score. The risk score will be presented in detail at the meeting.

2900-159 Epidemiology of Cardiogenic Shock Requiring Intensive Care Admission in Olmsted County, Minnesota

Amir H. Shoja, Rodrigo Cartin-Ceba, Mohammed Ahmed, Jaise Poulouse, Girish Mour, Javier Cabello-Garza, Harpreet Suri, Ognjen Gajic, Daryl Kor, Mayo Epidemiology and Translational Research in Intensive Care (M.E.T.R.I.C.), Mayo Clinic College of Medicine, Rochester, MN

Background: While the incidence of Cardiogenic Shock (CS) following an acute coronary syndrome has been described, the epidemiology of all-cause CS requiring an Intensive Care Unit (ICU) admission is not, to our knowledge, known. The purpose of this study was to evaluate the epidemiology of CS in residents of Olmsted county, MN.

Methods: This was a retrospective cohort study of all Olmsted County residents admitted to the ICU's of Mayo Clinic, Rochester, MN. This is the only center capable of providing continuous ICU services for patient's in this demographic. A random quarter sample of the population was selected for analysis. We excluded patients who denied research authorization, were less than 18 years of age and who needed vasoactive support in the immediate post-cardiopulmonary bypass period. Those with prior withdrawal of care orders or a "mixed" distributive and CS picture were also excluded.

CS was defined as a patient having 1. A shock index >1 or Systolic Blood Pressure (SBP) persistently <90 mmHg or need for vasoactive infusions to maintain a SBP >90 mmHg, 2. Evidence of end organ hypoperfusion and 3. Evidence of elevated filling pressures.

Results: The adult population of Olmsted County in 2006 was 100,716. During this one year evaluation, 88 patients developed 100 episodes of CS. Median age of the patients with CS was 76 (IQR 63.5-81) of which 64% were females. The median BMI was 25.2 (IQR 22.7-34.1). The all cause in-hospital mortality following CS was 45% (95%CI 35-65).

CS was caused by NSTEMI in 40%, STEMI in 20% and other causes (arrhythmias, valvular disease, decompensated heart failure) in the remaining 40%.

The cumulative incidence of CS was 99 episodes (95%CI 68-147) per 100000 person-years at risk. This translates to one episode of CS for every 1007 patient years. For a national life expectancy of 77.9 years, approximately one in 13 patients would develop CS in the course of his or her life in Olmsted county.

Conclusions: The incidence of cardiogenic shock in the community appears to be higher than previously reported. This may be explained by our use of more sensitive shock criteria. The in-hospital mortality was lower than expected, possibly due to recent improvements in our therapeutic approach.

2900-160 Treatment of Patients Previously Deemed "Unrevascularizable" Often Includes Revascularization

Gregory W. Barsness, Linda Tesmer, Ryan J. Lennon, Mayo Clinic, Rochester, MN

Background: There is a growing population of patients with severe ischemic chest pain who are considered poor candidates for traditional revascularization. These patients are often referred to as "no option" or "refractory angina" patients, although the specific characterization is ill-defined, making determination of long-term outcome and comparison of treatment strategies difficult. We studied long-term outcome in severely symptomatic patients referred to a tertiary center for treatment of chronic unrevascularizable coronary disease.

Methods: Clinical characteristics, symptoms and follow-up events were recorded at baseline and at 6 month intervals in 200 consecutive patients with demonstrable coronary disease and CCS class 3 or 4 angina consenting to follow-up. All patients were on optimal medical therapy and deemed unrevascularizable by a referring cardiologist due to comorbidities and/or unfavorable coronary anatomy.

Results: Patients were elderly (median 68 yrs), primarily men (80%), with a history of diabetes (44%), hypertension (76%), tobacco use (54%), heart failure (20%), MI (58%), and prior PCI (67%), CABG (83%), TMR (5%) and/or heart transplantation (1%). Mean LVEF was 50±14%. Initial treatment included traditional revascularization (3% PCI, 2% CABG), TMR (1%), ECP (63%) or continued medical therapy (30%). At 1 year, events included MI (10%), CVA (1%), urgent revascularization (11%) and death (5.5%), resulting in a 1-year event-free survival of 77%. By 1 year, 15.5% of patients in this cohort underwent PCI and/or CABG. Of patients selected to undergo early elective revascularization, there were no deaths at a median of 3 years follow-up.

Conclusions: Patients with symptomatic coronary artery disease deemed to be unrevascularizable by experienced cardiologists may, in fact, be candidates for traditional revascularization. While this referral cohort included many who are at high risk for subsequent non-fatal coronary events, overall mortality was low and did not seem to be increased in those selected for elective revascularization. Further effort is needed to better define appropriate invasive and non-invasive strategies for patients labeled "unrevascularizable."

2900-161 The Impact of Systemic Inflammation on Heat Production in Non-Culprit Lesions.

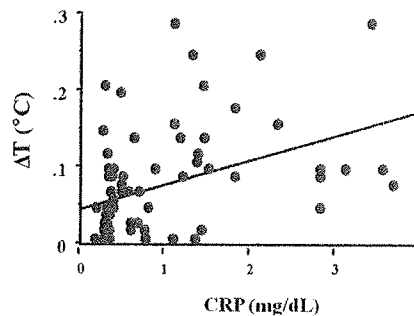
Konstantinos Toutouzas, Maria Drakopoulou, John Karabelas, Sophia Vaina, Maria Riga, Christodoulos Stefanadis, 1st Department of Cardiology, University of Athens, Athens, Greece

Background: Coronary artery disease is related to enhanced systemic and diffuse coronary inflammation. Though, the impact of systemic inflammation on non-culprit lesions (NCL) has not been extensively investigated. We studied: 1) the relation between local plaque temperature and C-reactive protein (CRP), 2) the impact of diabetes (DM) and 3) statin intake on NCL heat production.

Methods: We included 40 patients (pts) with stable angina (SA) and 47 with acute coronary syndrome (ACS), who underwent percutaneous coronary intervention in the CL and had a second intermediate NCL. Systemic inflammation was assessed by CRP. Temperature difference (ΔT) was calculated by subtracting the proximal vessel wall temperature from the maximal one at the NCL.

Results: Pts with ACS had higher ΔT (0.10 ± 0.07 vs. 0.05 ± 0.05 °C, $p < 0.01$) and CRP (1.19 ± 1.06 vs. 0.46 ± 0.35 mg/dL, $p < 0.01$) than SA pts. Pts with DM (n=30) had higher ΔT than non-DM (0.10 ± 0.08 vs. 0.06 ± 0.05 °C, $p = 0.01$). Statin intake (n=40) lowered ΔT (ACS: 0.06 ± 0.04 vs. 0.12 ± 0.07 °C, $p < 0.01$; SA: 0.04 ± 0.04 vs. 0.08 ± 0.07 °C, $p = 0.02$). There was a linear correlation of ΔT and CRP in the study population (figure) and in the ACS and SA groups ($R = 0.44$, $p < 0.001$, $R = 0.34$, $p = 0.01$, $R = 0.41$, $p = 0.01$ respectively). Multivariate analysis showed CRP and DM as independent predictors of ΔT .

Conclusions: Pts with ACS have increased NCL heat production compared to SA pts, possibly due to enhanced systemic inflammatory activation. Statin intake has a beneficial effect on NCL heat production.



2900-162 Risk and Clinical Predictors for Patients with Unstable Angina and Non-ST Segment Elevation Myocardial Infarction Post Early Percutaneous Coronary Intervention.

Eric Chong, Shen Liang, Kian Keong Poh, Huay Cheem Tan, The Heart Institute, National University Hospital, Singapore, Singapore, Biostatistics Unit, National University, Singapore

Background: TIMI score has been used to predict outcomes in patients with unstable angina (UAP) and non-ST elevation myocardial infarction (NSTEMI). We aim to look for clinical predictors for patients in this group undergoing early percutaneous coronary intervention (PCI).

Methods: A cohort of 3822 patients presented with UAP/NSTEMI from June 1996 to March 2007 to our center were recruited. All patients underwent PCI within the same admission. We analyzed the various clinic predictors for prediction of major adverse cardiac events (MACE) and death at 1 month and 6 month.

Results: Median age was 56(22-97), 78.1% was men, 34.5% diabetics, 58.8% had hypertension. Coronary lesions involving left main and proximal left anterior descending artery was 27.6%, 36.1% had NSTEMI.

Clinical predictors	Death at 1 month	Death at 6 month	MACE at 1 month	MACE at 6 month
	Odds ratio (p value)	Odds ratio (p value)	Odds ratio (p value)	Odds ratio (p value)
Age (> 75 years)	2.03 (p=0.279)	5.5 (p=0.001)	2.21 (p=0.042)	1.69 (p=0.049)
Gender (Female)	2.49 (p=0.031)	2.98 (p=0.001)	1.93 (p=0.002)	1.63 (p=0.001)
Diabetes	1.89 (p=0.131)	1.79 (p=0.095)	2.20 (p<0.001)	1.51 (p=0.003)
Anemia (Hemoglobin < 11g/dl)	3.86 (p=0.027)	8.47 (p<0.001)	2.40 (p=0.007)	2.03 (p=0.003)
Baseline Renal Impairment (Creatinine > 1.5 mg/dl)	6.0 (p=0.001)	7.38 (p<0.001)	1.75 (p=0.149)	1.54 (p=0.108)
Development of contrast induced nephropathy (CIN)	7.37 (p=0.019)	5.80 (p=0.005)	2.43 (p=0.05)	1.67 (p=0.116)