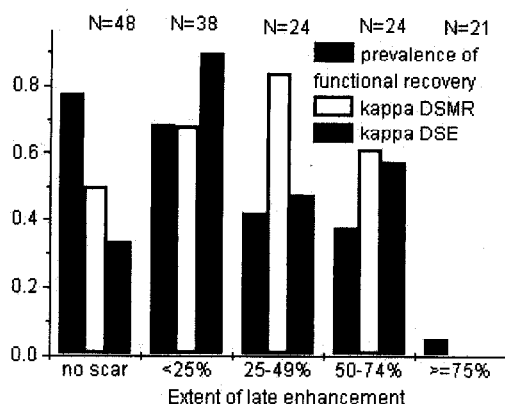superior to DSE for diagnosis(exception:endocardial scars <25%).

Conclusions: In segments with non-transmural late enhancement additional dobutamine stress testing improves predictive value for hibernating myocardium.

11:30 a.m.

883-5   **Color-Encoded Semiautomatic Analysis for Multislice First-Pass Magnetic Resonance Perfusion: Comparison to 99m Technetium Single-Photon Emission Computed Tomography and X-Ray Angiography**

Holger Thiele, Sven Plein, Marcel Breeuwer, John P. Ridgway, Penelope J. Thorley, Gerhard Schuler, Mohan Sivananthan, University of Leipzig - Heart Center, Leipzig, Germany, Leeds General Infirmary, Leeds, United Kingdom

Background: First pass myocardial perfusion magnetic resonance (MR) has the advantage of a high spatial resolution, which allows differentiation between subendocardial and transmural perfusion defects. Furthermore it is free from attenuation artifacts. However, the absence of efficient, easy and reliable image analysis software is an obstacle for the introduction of this method into clinical practice. **Methods and results:** Thirty-two patients underwent both 99m Technetium SPECT and first-pass magnetic resonance perfusion imaging under rest and stress using adenosine. Off-line image analysis was performed in 6 steps on a dedicated workstation using prototype software (EasyScil, Philips Medical Systems, The Netherlands), which allows image analysis in less than 10 min. per slice and displays the results in color-encoded images. Visual interpretation of the color displays was performed by two independent observers and areas of relative underperfusion were reported. All SPECT studies were analyzed in the conventional manner using a subjective scale and results were compared to MR. Taking SPECT as a reference method resulted in a sensitivity of 80%, specificity of 91%, positive predictive value of 68%, negative predictive value of 95% and a total accuracy of 89. In comparison to X-ray angiography overall accuracy was 87% for-MR perfusion and 77% for SPECT to detect significant coronary artery disease with stenosis > 70%. **Conclusions:** Post-processing of first pass myocardial perfusion MR imaging using a new semiautomatic software, which easily generates the results semi-quantitatively and displays it visually as color-encoded images has a high sensitivity and specificity for detection of perfusion defects in comparison to SPECT and a higher accuracy in detecting significant coronary artery disease. This post-processing method may accelerate the time-consuming analysis of MR perfusion images thus enabling a more widespread clinical utility.

11:45 a.m.

883-6   **Comparative Diagnostic Value of Dipyridamole and Adenosine-Triphosphate Stress First-Pass Myocardial Perfusion Magnetic Resonance Imaging for Detection of Coronary Artery Disease**

Bonpei Takase, Hosaka Haruhiko, Teruyoshi Kihara, Akira Kameyama, Masayoshi Nagata, Fumitaka Ohsuzu, Akira Kurita, National Defense Medical College, Tokorozawa, Japan

A whole-heart coverage MRI sequence, which is a hybrid of Fast gradient echo and Echo planar imaging, has recently been developed. Using this sequence, a first-pass myocardial perfusion MRI could be a good noninvasive modality for detecting coronary artery disease (CAD). To investigate comparative accuracy of dipyridamole and adenosine-triphosphate stress first-pass myocardial perfusion MRI for diagnosing CAD (>70% stenosis), we performed first-pass myocardial perfusion MRI in 256 patients with suspected CAD. Patients were allocated into dipyridamole or adenosine-triphosphate stress protocol; 194 patients (66±10 years) recieved dipyridamole stress and 62 patients (64±15 years) underwent adenosine-triphosphate stress. Using a 1.5 T cardiac MR imager (GE CV/i), eight slices of short axis MR images of LV were acquired by injecting gadolinium (0.1 mmol/kg) under dipyridamole infusion stress (0.56 mg/kg) or 4 minutes infusion of adenosine-triphosphate (0.16mg/kg/min). Aminophylline (250 mg) was injected or adenosine-triphosphate infusion terminated for rest imaging. Perfusion defect was determined with visual qualitative analysis. In dipyridamole stress, stress perfusion defect has 86% sensitivity and 88% specificity for diagnosing CAD. In adenosine-triphos-

phate stress, perfusion defect has 87% sensitivity and 89% specificity for diagnosing CAD. Conclusion; Dipyridamole and adenosine-triphosphate stress first-pass myocardial perfusion MRI are both clinically useful and practical modality for diagnosing CAD. Adenosine-triphosphate stress might be feasible because of simple and time saving procedure.

ORAL CONTRIBUTIONS

884   **Stress Echocardiography: Ploughing New Ground**

Wednesday, April 02, 2003, 10:30 a.m.-Noon
McCormick Place, Room S401

10:30 a.m.

884-1   **Delay in Transition From Segmental Contraction to Relaxation Activity (TT) Reliably Predicts Changes in Myocardial Perfusion During Dobutamine Stress**

Gabriel W. K. Yip, Bijoy Khandheria, Cristina Pislaru, Peter Anagnostopoulos, Marek Belohlavek, Patricia Pellikka, James Seward, Theodore P. Abraham, Mayo Clinic, Rochester, MN

Using strain echocardiography (SE) we have previously demonstrated that prolongation in the time to transition (TT; time from R wave on ECG to transition from contraction to relaxation on SE) correlates with regional ischemia in an animal model at rest, and new wall motion abnormalities in humans during dobutamine stress. Aim: In a closed chest animal model, we tested whether % TT change correlates with changes in regional myocardial blood flow (RMBF) at peak dobutamine stress. Methods: Using general anesthesia and fluoroscopy, an angioplasty balloon was inflated to cause a subtotal stenosis in the left anterior descending artery in 6 pigs. Dobutamine infusion (5 to 20 μg/kg/min) was administered before and during stenosis. Colored microsphere (BioPAL) injections and transthoracic SE were performed at rest and peak dobutamine (without and with stenosis). Using custom software, we measured segmental % TT change, corrected for heart rate [(baseline TT-peak TT)/baseline TT*100]. We compared TT(ms) and RMBF (ml/min/g tissue) from the same segments at peak dobutamine, with and without stenosis. Results: With coronary stenosis, % TT change was blunted and reflected a smaller increase in RMBF with dobutamine, compared to without stenosis. Hemodynamics were similar with and without stenosis (Table). Conclusion: TT, a novel, quantitative parameter of regional myocardial function, reliably predicted changes in RMBF with dobutamine stress. TT may introduce a new paradigm in the detection of inducible ischemia.

	Peak HR (bpm)	%RM BF	%T T	dp/dt_{max} (mmHg/s)	dp/dt_{min}(mmHg/s)	tau (s)
Pre-stenosis (normal)	163±14	400±10	50±5	3515±589	-2150±343	13.9±5.3
Stenosis (ischemic)	166±14	260±15	34±13	3200±398	-1987±406	13.4±7.2
p value	NS	<0.001	0.02	0.08	0.25	0.54

%RMBF & %TT = % change in value between baseline and peak dobutamine, normalized to baseline. Peak HR= heart rate at peak dobutamine.

10:45 a.m.

884-2   **Impact of Blood Pressure on False Positive Results During Exercise Echocardiography: Is There a Gender Difference?**

Joon-Han Shin, Takahiro Shiota, Jian Xin Qin, Yoko Eto, James D. Thomas, L. Leonardo Rodriguez, The Cleveland Clinic Foundation, Cleveland, OH

Background: False-positive results of exercise echocardiography (ExE) to diagnose coronary artery disease in women still seems to be higher than in men. Recent studies showed that high blood pressure (BP) at peak exercise is one of the important factors related to false-positive results. The relative impact of BP on females, however, was not evaluated. Therefore, we assessed the hypothesis that response to BP during ExE might influence lower specificity in women.
Methods: We enrolled 446 patients (mean age 61±12 yrs, 162 women) who had both coronary angiography and ExE, retrospectively. All subjects were classified into quartiles depending on systolic BP at peak exercise. Sensitivity (ST) and specificity (SP) were determined for each quartile of BP.
Results: Overall, the ST and SP of ExE were 86% and 72%, respectively. SP for women (64%) was significantly lower than for men (78%, p<0.05). There was no difference of ST between women (88%) and men (85%). Table showed ST and SP per quartile of peak systolic BP. SP was decreased as peak systolic BP increased in all patients without changes of the ST. SP in women fell sharply with BP 180-199 mmHg and even further at BP >200 mmHg, while the SP began to decrease at BP ≥ 200mmHg in men.
Conclusion: Exercise related hypertension impacts negatively on the specificity of ExE. This effect is observed at a lower level of systolic BP at peak exercise in women than in men. Positive ExE results when BP is ≥ 200 mmHg should be confirmed with another stress modality, especially in women.

systolic BP at peak exercise (mmHg)	≤ 159	160-179	180-199	≥ 200
number of patients (% of female)	112 (35%)	122 (35%)	115 (35%)	115 (35%)
ST/SP (%) in all patient	83/91	88/87	87/76	83/44
ST/SP (%) in female	82/90	92/92	88/53	90/26
ST/SP (%) in male	84/92	87/83	86/85	81/57

11:00 a.m.

884-3   Nitroglycerin Effect on Coronary Flow Reserve Measurements: Transthoracic Doppler Echocardiographic Study

Nozomi Watanabe, Yasuko Yamaura, Tomohiko Toyoda, Miwako Tsukiji, Maki Akiyama, Shuichiro Kaji, Yasuhiro Saito, Takashi Akasaka, Kiyoshi Yoshida, Kawasaki Medical School, Kurashiki, Japan

Background: In the current Doppler guide wire method, advance administration of nitroglycerin (NG) prior to the measurements of coronary flow velocity reserve (CFVR) has been recommended to avoid coronary diameter changes during vasodilator administration, because epicardial coronary diameter itself can affect coronary flow velocity. Recently, CFVR can be measured easily and noninvasively by transthoracic Doppler echocardiography (TTDE). We sought to examine whether advance sublingual administration of NG affects CFVR measurements NGNG and feasibility of using TTDE in the diagnosis of coronary stenosis.
Method: We studied 46 patients who underwent coronary angiography for the assessment of coronary artery disease. The study population consisted of 10 patients with significant left anterior descending artery (LAD) stenosis (group A) and 36 patients without significant LAD stenosis (group B). Firstly, without prior administration of NG, CFV in the distal LAD were recorded at rest and during hyperemia induced by intravenous ATP infusion (150μg/kg/min) to measure CFVR. Then, CFVR was also measured under the prior sublingual NG administration.
Results: The mean diastolic coronary flow velocities (MDV) at baseline were significantly lower with NG than those measured without NG (19.4±8.1cm/s vs 23.4±7.9cm/s, p<.01), while MDV at hyperemia did not differ regardless of using NG or not. Hence, CFVR was significantly higher under using NG compared with those without using NG (2.6±1.0 vs 2.3±0.8, p<.05). There were significant differences in MDV between groups A and B regardless of the administration of NG (NG (-); 1.3±0.3 versus 2.9±0.7; p<.0001, NG (+); 1.2±0.2 versus 2.6±0.7; p<.0001). With NG, a CFVR from MDV <2.0 had a sensitivity of 100% and a specificity of 94% for the presence of significant LAD stenosis. Without NG, a CFVR from MDV <2.0 had a sensitivity of 100% and a specificity of 89% for the presence of significant LAD stenosis.
Conclusion: With prior sublingual NG administration, noninvasive CFVR measurements by TTDE have much higher specificity in the diagnosis of significant LAD stenosis than those without NG administration.

11:15 a.m.

884-4   Development of a Clinical and Echocardiographic Score for Assigning Risk of Major Events After Exercise and Dobutamine Echocardiograms

Thomas H. Marwick, Colin Case, Charles Vasey, Stephen Sawada, University of Queensland, Brisbane, Australia

The prognostic value of exercise (ExE) and dobutamine echocardiograms (DbE) has been well defined in large studies. However, while risk is determined by both clinical and echo features, no simple means of combining these data has been defined. We sought to combine these data into risk scores.
Methods. At 3 expert centers, 7650 pts underwent standard ExE (n=5211) and DbE (n=2439) for evaluation of known or suspected CAD and were followed for up to 10 years (mean 5±2) for major events (death or myocardial infarction). A subgroup of 2953 ExE and 1025 DbE pts was randomly selected to develop separate multivariate models for prediction of events. After simplication of each model for clinical use, models were validated in the remaining ExE and DbE pts.
Results. The total number of events was 200 in the ExE and 225 in the DbE pts, of which 58 and 99 events occurred in the respective testing groups. The following regression equations gave equivalent results in the testing and validation groups for both ExE and DbE;
DbE = (Age*0.02) + (DM*1.0) + (Low RPP*0.6) + ([CHF+Ischemia+Scar]*0.7)
ExE = ([DM+CHF]*0.9) + 0.9(Ischemia #) + 1.5(Scar#) - (METS*0.19)
(where each categorical variable scored 1 when present and 0 when absent, Ischemia# = 1 for 1-2 VD, 6 for 3 VD; Scar# = 1 for 1-2 VD, 1.7 for 3 VD).
The table summarizes the scores and equivalent outcomes for ExE and DbE.
Conclusions. Risk scores based on clinical and ExE or DbE results may be used to quantify the risk of events during follow-up.

|	Exercise		Dobutamine	
	Score	Outcome	Score	Outcome
Low risk	<-1.3	>98%	<1.5	>94%
Intermed risk	-1.3 to 0.8	83-98%	1.5-2.7	75-94%
High risk	>0.8	<83%	>2.7	<75%

11:30 a.m.

884-5   Survival Benefits of Early Myocardial Revascularization After Stress Echocardiography: A Propensity Analysis

Michael S. Lauer, Claire E. Pothier, Colin Case, Charles Vasey, Stephen Sawada, Thomas H. Marwick, The Cleveland Clinic Foundation, Cleveland, OH, University of Queensland, Brisbane, Australia

Background: Although myocardial revascularization is often performed to alleviate documented myocardial ischemia, the impact of this practice on survival has not been demonstrated in randomized trials. Standard observational analyses suffer from severe confounding and selection biases.
Methods: We used propensity analysis to determine whether revascularization following stress echocardiography (STE) improved survival among 7957 patients in 3 different institutions. During the first 3 months after STE, 317 (4%) underwent revascularization. We generated a propensity score using logistic modeling involving 13 demographic, clinical, and echocardiographic variables.
Results: Patients who underwent revascularization were older (64 vs. 61 years) and more likely to have ischemia (63% vs. 20%). We propensity matched these 317 patients with 317 patients who did not undergo revascularization with resulting similarities of age (64 vs 64 years) and equivalent rates of ischemia (63% vs 62%). During 5 years of follow-up, 75 patients (25%) who did not undergo revascularization died, whereas only 50 patients (16%) who did undergo revascularization died (propensity and covariate adjusted hazard ratio after 3 months 0.51, 95% CI 0.31-0.83, P=0.0073). Absolute benefits were primarily noted in patients with ischemia in ≥ 2 vascular territories (Figure).
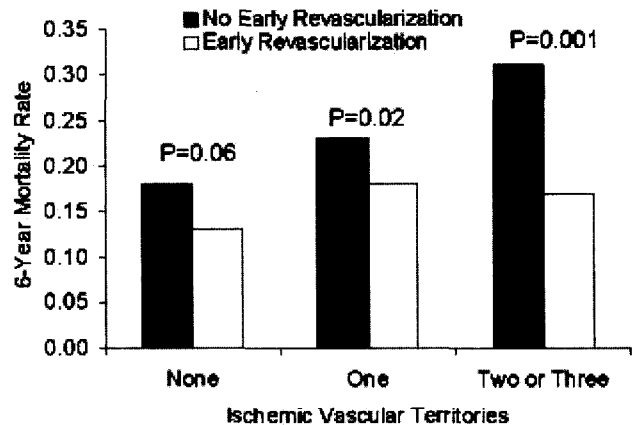
Conclusion: Early myocardial revascularization is likely to lead to a survival benefit, especially among patients with inducible multivessel ischemia.

11:45 a.m.

884-6   Impact of Doppler Angle Correction to the Diagnostic Accuracy of Tissue Doppler Imaging During Dobutamine Stress Echocardiography

L. Elif Sade, John Gorcsan, III, Donald A. Severyn, Kathy Edelman, William E. Katz, University of Pittsburgh, Pittsburgh, PA

Objective: Assessment of regional left ventricular (LV) function during dobutamine stress echo (DSE) is subjective. Tissue Doppler (TD) methods for quantification are more objective, but limited by the angle-dependence of Doppler.
Methods: To test the hypothesis that a new TD system with angle-correction can increase the accuracy of quantification of regional wall motion during DSE, we studied 15 pts with normal and 14 pts with abnormal DSE. TD data were analyzed with and without angle-correction (ApliQ, Toshiba, Corp). Segmental tissue velocity derived from TD images of parasternal long, short axis (mid and apical level), apical 4 and 2 chamber views were compared to consensus routine 2D reading and coronary angiography.
Results: Tissue velocity was underestimated in segments where the wall motion was less parallel to the ultrasound beam: lateral and septal segments in short axis views, mid-anterior and mid-lateral segments in apical views. In these regions, the diagnostic accuracy of the angle-corrected method was superior to that of the non-angle corrected method. The angle corrected TD method had a sensitivity (Sen) of 88%, specificity (Sps) of 82% and accuracy (Acc) of 83% for an optimal cut-off of 2 cm/s The non-angle corrected TD method had a sensitivity of 69%, specificity of 75% and accuracy of 73% for an optimal cut-off 1cm/s, Figure. Area under curve= AUC.