(Medtronic or CPI), were obtained in 29 patients undergoing routine exercise or dipyridamole Tl-201 stress testing. Patches were positioned over the anterior, mid, or posterior axillary line in the fourth intercostal space. Gated planar Tl-201 images with and without patches were used to determine the presence of preserved regional wall motion in the area of the patch-induced attenuation defect. Readers were blinded to the patch type, location, and order of imaging, which were all randomized. Two independent readers: (1) inspected the 2 sets of the 32 raw images from the 180° acquisition to determine if the patch was visible, (2) interpreted 2 sets of tomograms for defects, and (3) assessed regional wall motion in the area of the defect. *Results:* Patch location could be identified in 42% of patients with CPI patches and 71% with Medtronic patches. Attenuation defects were observed in 6 patients (35%) with Medtronic patches and 4 patients (33%) with CPI patches. In the subset of patients with patch-induced defects, preserved wall motion was present in 89% of these regions. *Conclusions:* Subcutaneous patches can cause attenuation defects which may be mistaken as an area of infarction. Normal wall motion on gated images allows differentiation between attenuation artifacts due to the patches from fixed defects due to infarction.

1010-120 Comparison of Arbutamine Stress and Treadmill Exercise Thallium-201 SPECT: Hemodynamics and Diagnostic Accuracy

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Arbutamine (ARB), a new β-agonist developed as a pharmacologic stress agent, was compared with treadmill exercise testing (Ex) in a multicenter study using thallium-201 (Tl) SPECT A total of 75 patients (pts) performed both forms of stress. Of the 73 pts having quantitative angiography, 68 (93%) had coronary artery disease ($\geq$50% stenosis). Tl scans were obtained in 68 pts and were scored by a central laboratory using a twenty segment (seg)/scan visual analysis (5 point system: 0 = normal, 4 = absent uptake; segmental score $\geq$2 = defect). Stress Tl segs with defects were further classified as reversible (rev) or nonreversible (nonrev). Hemodynamic response was summarized for 75 pts. Maximum heart rate (HR) by ARB and Ex was 122 vs 141 bpm, respectively ($p < 0.05$); mean %HR change from baseline was similar (79% vs 82%, respectively). Maximum systolic BP for ARB and Ex was 173 vs 176 mmHg, respectively and mean %change from baseline was 31% vs 26%, respectively (p = NS for both). In the 68 pts with angiographic CAD, sensitivity for detecting CAD by ARB Tl was 94% and 97% by Ex Tl-SPECT (p = NS). Stress Tl-SPECT segmental agreement for presence or absence of defect between ARB and Ex in 1360 segs (68 pts) was 94% (k = 0.7). Of 76 discordant segs, 38 (50%) were normal by ARB and abnormal by Ex. Exact segmental stress Tl score (0–4) agreement was 85% (k = 0.7). Of the 199 segs with discordant scores, the ARB-Tl score was higher in 98 (49%). Among 346 segs with stress defects by both ARB and Ex, defect rev agreement was 86% (k = 0.7). Of the 50 discordant segs, 25 (50%) were rev by ARB and nonrev by Ex. Adverse events were mostly mild. Sustained arrhythmias were not observed; 3 pts had nonsustained ventricular tachycardia with ARB and 1 with Ex.

Conclusion: In this patient population, arbutamine and treadmill exercise produced a similar degree of hemodynamic response compared to baseline. The two forms of stress yielded similar diagnostic accuracy and high agreement for the presence, extent, severity and reversibility of stress myocardial perfusion abnormalities.

1010-121 Is a Dobutamine Infusion a Legitimate Alternative to Exercise?

Robert Panther, Steven C. Port. *University of Wisconsin Medical School, Milwaukee, WI*

The purpose of this study is to compare left ventricular ejection fraction (LVEF) and regional wall motion (RWM) during exercise to LVEF and RWM during dobutamine infusion in the same pts. Ten pts (8 males, 2 females, mean age 56.9 ± 11.1), with known or suspected coronary disease, who had abnormal symptom-limited upright bicycle exercise first-pass radionuclide angiograms (FPRNA), had dobutamine FPRNA within 3 months of the exercise study and prior to any intervention or interim cardiac event. Dobutamine was given incrementally up to 40 μg/kg/min. Atropine was given to increase heart rate as needed. FPRNA was performed by injecting 25 mCi of Tc-99m-sestamibi at the peak dobutamine dose.

HR x SBP	LVEF	EDV	ESV	RWMA	REF
Exercise					
33,100 ± 4,882	61 ± 6.2	182 ± 56	76 ± 32	10 ± 10	46 ± 6.8
Dobutamine					
24,669 ± 5,571	72 ± 5.5	135 ± 44	43 ± 20	3 ± 10	67 ± 8.8
*	*	**	**	***	*

*p = < 0.0001 (T test), **p = 0.05 (T test), ***p = 0.005 (chi-square)
EDV = end diastolic volume, ESV = end systolic volume, RWMA = regional wall motion abnormality, REF = regional ejection fraction of abnormal segments, SBP = systolic blood pressure, HR = heart rate

Exercise and dobutamine regional and global LV function are not comparable diagnostically or prognostically. Dobutamine LV function is not a surrogate for exercise LV function.

1010-122 Stress-Rest Dobutamine SPECT Tc-99m Sestamibi Accurately Predicts Myocardial Viability in Dysynergic Left Ventricular Segments

Roxy Senior, Usha Raval, Sumit Basu, Avijit Lahiri. *Northwick Park Hospital, Harrow, UK*

There has been increasing controversy regarding the ability of SPECT Tc-99m Sestamibi (MIBI) for identification of myocardial viability in regions of the left ventricle affected by severe wall motion abnormality. We have evaluated 27 patients with documented coronary artery disease (CAD) and severe regional wall motion abnormality of the left ventricle due to CAD. All patients underwent low dose (5–10 μg/kg) dobutamine echocardiography and maximal (15–40 μg/kg/min) stress dobutamine MIBI. A separate day SPECT MIBI was performed at rest. The left ventricle was divided into 3 regions; a total of 37 regions were found to have severe wall motion abnormality by echocardiography, of which 35 showed improved wall thickening with low dose dobutamine (gold standard for myocardial viability in this study). Rest MIBI uptake was assessed semiquantitatively for each of the matching regions, and this was graded from 1 to 4, from normal to absent perfusion. Regions with myocardial perfusion of a grade of 3 or less were considered viable by rest MIBI. Rest MIBI detected viability in 32 (93%) of the viable regions, as defined by echocardiography, the concordance was 92% (kappa = 0.54, $p < 0.001$). Furthermore, stress-rest MIBI revealed completely reversible defects in 18 (23%), partially reversible defects in 24 (69%) and Grade 4 uptake and fixed (non-viable) defects in 3 (8%) regions defined as viable by dobutamine echocardiography. Thus, rest MIBI is a good indicator of myocardial viability in left ventricular segments showing severe regional dysynergy, and reversible ischaemia detected by stress-rest dobutamine MIBI in these segments provides further proof that sestamibi SPECT accurately defines regional myocardial viability.

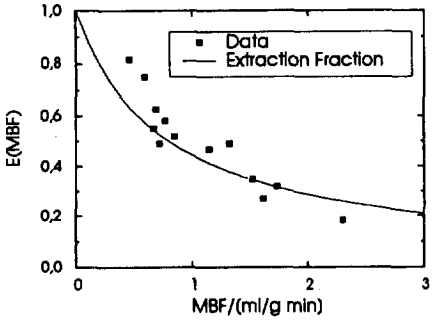
1011 Positron Emission Tomography

Wednesday, March 22, 1995, Noon–2:00 p.m.
Ernest N. Morial Convention Center, Hall E
Presentation Hour: Noon–1:00 p.m.

1011-116 Myocardial Rb Extraction Fraction: Determination in Humans

Gerhard Glatting, Klaus P. Bergmann, Jens C. Stollfuß, Peter Weismüller, Matthias Kochs, Vinzenz Hombach, Sven N. Reske. *Universität Ulm, Germany*

Quantitation of myocardial blood flow (MBF) with diffusion-limited radiotracers as ^{82}Rb and positron emission tomography (PET) requires knowledge of flow dependence of myocardial ^{82}Rb extraction fraction. To determine this dependence we evaluated 7 patients (mean age (61.0 ± 9.7) years, 4 males, 3 females) who had undergone coronary angiography with exclusion of relevant coronary stenoses and normal left ventricular function. ^{82}Rb-PET clearance was simultaneously assessed with global MBF by the argon (Ar) inert gas method. ^{82}Rb clearance was dynamically measured by a CTI-Siemens ECAT 931-08-12 scanner after i.v. injection of 1–1.2 GBq ^{82}Rb. Ar gas desaturation was obtained by simultaneous arterial and coronary sinus blood sampling. Measurements were performed at rest and during vasodilatation induced by i.v. dipyridamole (0.7 mg/kg/4 min). Mean ^{82}Rb clearance and Ar flow values were (0.39 ± 0.03) ml/g/min and (0.69 ± 0.14) ml/g/min at rest, respectively, and (0.47 ± 0.09) ml/g/min and (1.48 ± 0.49) ml/g/min during hyperemia. A fit with a two compartment model yielded E = PS/(PS + MBF) with PS = (0.82 ± 0.09) ml/g/min (PS: permeability surface area product). These data (figure) provide for the best of our knowledge the first measured ^{82}Rb extraction fraction in humans and may form the basis for more accurate quantitation of myocardial blood flow with ^{82}Rb-PET.



1011-117 Comparison of ^{82}Rubidium Positron Emission Tomography to ^{99}Technetium-Methoxyisobutyl Isonitrile Perfusion Imaging

Klaus P. Bergmann, Gerhard Glatting, Brigitte Grab, Matthias Hess, Heinz Breuer [1], Matthias Kochs [1], Vinzenz Hombach [1], Sven N. Reske. *Department of Nuclear Medicine, University of Ulm, Germany; [1] Medical Clinic, University of Ulm, Germany*

This study was designed to prospectively compare myocardial perfusion imaging with rubidium-82 (^{82}Rb) by positron emission tomography (PET) to technetium-99^{m} — methoxyisobutyl isonitrile (MIBI) by single photon emission computed tomography (SPECT). Detection of inducible ischemia and prior infarction was assessed in 53 patients (pts) with known coronary artery disease (CAD) who had undergone quantitative coronary angiography. To assign independently myocardial viability both techniques were compared to resting, glucose loaded myocardial uptake of fluorine-18 fluorodeoxyglucose (FDG) PET in a subgroup of 27 pts. with left ventricular wall motion abnormalities. Intravenous dipyridamole vasodilatation (0.7 mg/kg) was used as myocardial stress modality, with ^{82}Rb and MIBI being injected simultaneously under identical hemodynamic conditions. SPECT and PET results were scored in a 13 segment model of the left ventricle as normal, inducible ischemia, infarction or infarction with adjacent ischemia. There were concordant findings in 48 out of 53 analysed pts. (91%). However, in 5 pts. (9%) MIBI-SPECT showed fixed perfusion defects but ischemia by ^{82}Rb-PET and evidence of viable myocardium with FDG-PET, whereas there was no segment with infarction in ^{82}Rb-PET and ischemia in SPECT. We conclude that MIBI-SPECT detects less inducible ischemia but more fixed perfusion defects compared to ^{82}Rb-PET in the same patient population. Sensitivity of stress/rest ^{82}Rb-PET in detection of $\geq$70% stenosed vessel was 33/33 (100%) in LAD territory respectively 31/32 (97%) in LCx/RCA territory with specificity of 93%. MIBI SPECT sensitivity in the same group was 29/33 (88%) for LAD and 31/32 (97%) for LCx/RCA territory with specificity of 90% in LAD territory respectively 71% in LCx/RCA. These data strongly suggest that MIBI-SPECT underestimates the presence of ischemic and still viable myocardium in comparison to ^{82}Rb- and FDG-PET. In contrast myocardial viability as assessed by ^{82}Rb- and FDG-PET correlated well. Thus stress/rest ^{82}Rb-PET holds promise for reliable assessment of reversible ischemia and myocardial viability.

1011-118 Blood Flow Regulation in Collateral Dependent Myocardium

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Myocardial blood flow (MBF) regulation in collateral dependent myocardium (CD) of patients with coronary artery disease has not been fully elucidated. To this purpose, 19 patients with stable angina, no previous myocardial infarction and isolated occlusion of the left anterior descending (n = 14) or left circumflex (n = 5) coronary artery were evaluated. MBF measurements were obtained off-therapy, using dynamic positron emission tomography and nitrogen-13 Ammonia, at baseline, during atrial pacing tachycardia and after i.v. dipyridamole (0.56 mg/kg over 4 min). MBF in CD and remote regions were compared with MBF values obtained in 13 normal subjects. At rest, MBF was similar in CD and in the remote myocardium (0.61 $\pm$ 0.11 vs 0.63 $\pm$ 0.17 ml/min/g), both values were lower than normal (1.00 $\pm$ 0.2 ml/min/g, $p < 0.01$). During pacing MBF increased to 0.84 $\pm$ 0.25 and 1.11 $\pm$ 0.39 ml/min/g in CD and contralateral areas, respectively ($p < 0.05$ vs baseline); both these values were lower ($p < 0.01$) than normal (1.86 $\pm$ 0.61 ml/min/g). Dipyridamole induced a further increase in MBF in remote areas (1.36 $\pm$ 0.57 ml/min/g, $p < 0.01$ vs pacing) but not in CD (0.93 $\pm$ 0.37 ml/min/g, ns vs pacing); both values were reduced ($p < 0.01$) with respect to normals (3.46 $\pm$ 0.78 ml/min/g). Dipyridamole MBF in CD was slightly lower in patients with poor than in those with well developed collaterals (0.75 $\pm$ 0.29 vs 1.06 $\pm$ 0.38 ml/min/g, respectively, $p = 0.06$), however, the former showed a higher flow inhomogeneity (CD/control flow ratio: 0.58 $\pm$ 0.10 vs 0.81 $\pm$ 0.22, respectively, p $\pm$ 0.02). Despite so different coronary anatomy (one vessel occluded the other normal), a linear, direct correlation was observed between flow reserve of CD and remote regions ($r = 0.83$, $p < 0.01$). Thus, despite resting hypoperfusion, CD maintains a residual perfusion reserve that can be almost fully utilized during moderate increases in oxygen consumption. A global microvascular disorder affects the adaptation to chronic coronary occlusion.

1011-119 Effect of Nisoldipine on Hypoperfused Dyssynergic Viable Myocardium After Myocardial Infarction

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After infarction, regional dysfunction can occur in still viable myocardial regions because of the presence of baseline hypoperfusion. Recent evidence suggests that these areas may maintain a residual perfusion reserve. Aim of this study was to evaluate whether oral Nisoldipine can increase regional myocardial myocardial blood flow (MBF) in dyssynergic but viable myocardium after myocardial infarction. To this purpose, 15 patients with isolated left anterior descending coronary (LAD) stenosis were studied 1 month after first myocardial infarction. Patients underwent F18-deoxiglucose imaging, while MBF was measured, using positron emission tomography and 13N-Ammonia, at baseline and following dobutamine (10 μcg/kg/min over 5 minutes, DOB). MBF measurements were repeated 24 hours later after Nisoldipine (10 mg bid). Among a total of 102 LAD related regions, 23 showed normal wall motion at 2D-echo and normal metabolic activity (Normal), 58 showed wall motion abnormality and preserved deoxiglucose uptake (Viable), while 21 dyssynergic regions were necrotic (Necrotic). MBF data (ml/mm/100 g) were as follows:

	Before Nisoldipine		After Nisoldipine	
	Basal MBF	DOB MBF	Basal MBF	DOB MBF
Normal	92 $\pm$ 23	119 $\pm$ 38	85 $\pm$ 18	121 $\pm$ 46°
Viable	62 $\pm$ 25†	93 $\pm$ 40$^{\dagger,\circ}$	73 $\pm$ 25$^{\wedge}$	102 $\pm$ 51°
Necrotic	46 $\pm$ 24$^{\dagger,@}$	51 $\pm$ 25$^{\dagger,@}$	52 $\pm$ 20$^{\dagger,@}$	56 $\pm$ 28$^{\dagger,@}$

$^{\dagger}p < 0.05$ vs Normal, $^{@}p < 0.05$ vs Viable, $^{\circ}p < 0.05$ vs relative Basal, $^{\wedge}p < 0.05$ vs Basal before Nisoldipine

Necrotic areas showed the largest reduction in baseline MBF. Dyssynergic viable regions showed a reduced resting MBF, but maintained a residual perfusion reserve in response to inotropic stimulation. Thus, Nisoldipine selectively improved basal perfusion in dysynergic viable myocardium.

1012 Vascular Biology/Thrombosis

Wednesday, March 22, 1995, Noon–2:00 p.m.
Ernest N. Morial Convention Center, Hall E
Presentation Hour: Noon–1:00 p.m.

1012-101 Vascular Smooth Muscle-Directed Adenoviral Vectors

Keith L. March, Soonpin Yei, Julia Madison, Bruce C. Trapnell. *Krannert Institute of Cardiology and RL Roudebush VAMC, Indpls, IN; Genetic Therapy, Inc., Gaithersburg, MD*

Gene transfer to the vascular wall utilizing locally-delivered recombinant adenoviral vectors has shown promise as a novel technique for therapeutic as well as experimental modulation of vascular wall gene expression. Infusion of such vectors using porous balloon catheters (PBC) has previously been demonstrated to result in transduction of extravascular cells at the delivery site, as well as substantial systemic transduction as a consequence of release of vector into the circulation. Introduction of a vascular-directed promoter into the adenoviral vector should thus contribute to targeting the expression of genes to the vascular wall, while reducing peri-vascular and systemic expression. In order to test the feasibility of utilizing the vascular smooth muscle α-actin (SMA) promoter to confer tissue specificity upon a recombinant adenoviral vector, we constructed an adenovirus (AvLacZ5) employing a 1.1 kilobase region of the murine SMA promoter to direct the expression of the nuclear-targeted beta-galactosidase (lacZ) gene and evaluated gene transduction by this vector, in comparison with a vector differing only by the presence of the RSV-LTR promoter. Several cell types were used as targets, including bovine aortic smooth muscle cells (BASMC), human pulmonary epithelial carcinoma cells (A549 cells), and transformed human