Positron Emission Tomography: Clinical Studies

Monday, March 08, 2004, 9:15 a.m.-10:30 a.m.
Morial Convention Center, Room 243

804-1
18F-Fluoro-2-Deoxyglucose as a Memory Marker of Transient Myocardial Ischemia
Brian G. Abbott, Yi-Hwa Liu, James A. Arrighi, Yale University School of Medicine, New Haven, CT; VA Connecticut Healthcare System, West Haven, CT

Background: Myocardial uptake of fluorine-18 labeled 2-deoxyglucose (FDG) parallels endogenous glucose uptake. Experimental data have shown that glucose utilization increases during acute myocardial ischemia in proportion to its severity and duration, and may persist for up to 24 hours. Whether FDG uptake can be imaged as a memory marker of ischemia in humans is unknown. Methods: Patients with mild to moderate ischemia on a clinical exercise SPECT myocardial perfusion imaging (MPI) underwent repeat exercise testing within 1-2 weeks, to an equivalent workload after overnight fast. Positron emission tomography (PET) was performed after injection of FDG 60 minutes post exercise. SPECT and PET images were assessed visually and quantitatively using regions of interest for heart/lung ratios and a circumferential profile-based analysis modified for “hot-spot” imaging. A change in regional maximal uptake >10% on SPECT and regional FDG PET uptake >110% was considered as evidence of ischemia. Results: Ten males with stress SPECT ischemia (mean age 69 years, 7 known coronary artery disease; CAD) were studied. The mean difference in the rate pressure product between the 2 exercise tests was 1.5±19. FDG was injected 66±10 min after exercise. Visually, 5 of 10 patients had enhanced regional FDG uptake (mean [range] heart/lung ratio 5.3 [3.5-7.8] in visually abnormal vs. 3.0 [2.5-3.4] without visual uptake, p=0.02 respectively). Using circumferential profiles, 7 patients had maximal FDG uptake >110%; mean FDG uptake in these regions was 130±12%. Overall, 8 of 10 patients studied had evidence of FDG uptake by visual and/or quantitative analysis. All patients with a visually and/or quantitatively positive FDG scan had uptake in either an ischemic SPECT region or a territory with known CAD by angiography. Conclusion: Regional myocardial uptake of FDG is enhanced even when injected 1 hour post-exercise stress in a subset of patients with ischemia on exercise SPECT MPI. Enhanced FDG uptake localized with regional SPECT ischemia and/or angiographic CAD. The ability to image FDG uptake injected 1 hour after an ischemic episode suggests the potential utility of FDG as a memory marker of transient ischemia.

804-2
Efficacy of Lipid Lowering Therapy in Inducing Arrest or Reversal of Coronary Disease as Assessed With Positron Emission Tomography
Michael E. Merhige, George M. Watson, Joseph G. Oliverio, Victoria Shelton, Shannon N. Frank, Anthony F. Perna, State University of New York at Buffalo, Buffalo, NY

Background: PET myocardial perfusion imaging (PET MPI) identifies coronary disease (CAD) progression and reversal in response to lipid lowering therapy (LLT). Optimal lipid (HDL) myocardial perfusion imaging (PET MPI) identifies 26% of patients with progressive CAD, despite LLT, who have a high-risk of subsequent hard coronary events.

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Follow Up</th>
<th>% Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol</td>
<td>168 +/- 38</td>
<td>152 +/- 30</td>
<td>10.5</td>
</tr>
<tr>
<td>LDL</td>
<td>95 +/- 36</td>
<td>82 +/- 23</td>
<td>12.6</td>
</tr>
<tr>
<td>HDL</td>
<td>45 +/- 13</td>
<td>49 +/- 14</td>
<td>8.9</td>
</tr>
<tr>
<td>Triglyceride</td>
<td>137 +/- 74</td>
<td>105 +/- 59</td>
<td>23.4</td>
</tr>
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</table>

Conclusions: PET MPI identifies 26% of patients with progressive CAD, despite LLT, who have a high-risk of subsequent hard coronary events.

804-3
The Effects of Cardiac Resynchronization Therapy on Regional Left and Right Ventricular Energetics and Metabolic Reserve in Patients With Dilated Cardiomyopathy
Juhani M. Knuuti, Jan Sundell, Erik Engblom, Juhani Koskinen, Antti Ylitalo, Kira Q. Stolen, Rikka Kalliokoski, Stephan G. Nekolla, Jeroen J. Bax, Juhani K.E. Arakasinen, University of Turku, Turku, Finland

Background: Cardiac resynchronization therapy (CRT) has been found to enhance on left ventricular (LV) energetics and metabolic reserve in patients with heart failure. The purpose of the study was to investigate the effects of CRT on regional energetics and right ventricle (RV).

Methods: Ten patients with idiopathic dilated cardiomyopathy who had undergone implantation of biventricular pacemaker 8.5 months earlier were studied during 2 conditions: CRT ON and after CRT switched OFF for 24 hours. LV function was measured using echocardiography and oxidative metabolism using 13C-labeled positron emission tomography (Kmon) from both LV and RV. Both measurements were performed at rest and during dobutamine induced stress (5.0µg/kg/min). Basal and adrenaline (140 µg/kg min) stimulated myocardial blood flow were quantitated using 13C-glucetate. Results: As found previously when CRT was turned OFF global myocardial efficiency of forward work deteriorated significantly. The regional LV Kmon were changes significant only in the anterolateral regions (p=0.013) while in other regions no changes were seen (p>0.05). LV oxidative metabolism was increased by 2.7% during stress oxidative metabolism was more enhanced when CRT was ON (0.076±0.02 vs. 0.069±0.027, p=0.003). No significant effects were seen in myocardial perfusion. In 5 patients the response to CRT was striking (mean LV stroke volume increase by 32%) while in other no significant change was seen (+2%). None of the measured parameters except RV oxidative metabolism were associated with the CRT response. In responders RV Kmon at rest was lower than in non-responders (0.098±0.01 vs. 0.058±0.02, p=0.04). Conclusion: Long term CRT has beneficial effects on LV function and myocardial efficiency in patients with heart failure. However, the change in absolute oxidative metabolism by CRT appears significant only in anterolateral regions of LV. CRT appears to increase RV oxidative metabolism especially during stress likely indicating changes in RV loading. The patients responding to CRT appear to have lower RV oxidative metabolism. This suggests significant role of RV in the response to CRT.

804-4
The Relationship Between Minute Ventilation and the Rate of CO2 Elimination Reflects the Right Ventricular Oxidative Metabolism in Heart Failure
Heikki Ukkonen, Rob de Kemp, Ross Davies, William Dafoe, Ian Burwash, Haissam Haddad, Karen Mostert, May Aug, Terry Ruddy, Rob Beanlands, University of Ottawa Heart Institute, Ottawa, ON, Canada

Background: The relationship between minute ventilation and the rate of CO2 elimination (the VE/VO2 slope) is strongly related to mortality in patients with congestive heart failure (CHF) and provides complimentary prognostic information to peak oxygen uptake (peak VO2). The VE/VO2 slope has been proposed to reflect pulmonary vascular resistance (PVR) in CHF patients. Therefore, we hypothesized that an increased VE/VO2 slope would be associated with elevated right ventricular (RV) oxidative metabolism relative to the left ventricle (LV).

Subjects and methods: 15 patients with CHF (ischemic [n=14], non-ischemic [n=1]; 65±10 yrs; BMI 29±5 kg/m2; LVEF 30±8 %; NYHA class 2.5±0.5; all pts on ß-blockers except RV oxidative metabolism were measured at rest. Results: Both measurements were performed at rest and during dobutamine induced stress (5.0µg/kg/min). Basal and adrenaline (140 µg/kg min) stimulated myocardial blood flow were quantitated using 13C-glucetate. Results: As found previously when CRT was turned OFF global myocardial efficiency of forward work deteriorated significantly. The regional LV Kmon were changes significant only in the anterolateral regions (p=0.013) while in other regions no changes were seen (p>0.05). LV oxidative metabolism was increased by 2.7% during stress oxidative metabolism was more enhanced when CRT was ON (0.076±0.02 vs. 0.069±0.027, p=0.003). No significant effects were seen in myocardial perfusion. In 5 patients the response to CRT was striking (mean LV stroke volume increase by 32%) while in other no significant change was seen (+2%). None of the measured parameters except RV oxidative metabolism were associated with the CRT response. In responders RV Kmon at rest was lower than in non-responders (0.098±0.01 vs. 0.058±0.02, p=0.04). Conclusion: Long term CRT has beneficial effects on LV function and myocardial efficiency in patients with heart failure. However, the change in absolute oxidative metabolism by CRT appears significant only in anterolateral regions of LV. CRT appears to increase RV oxidative metabolism especially during stress likely indicating changes in RV loading. The patients responding to CRT appear to have lower RV oxidative metabolism. This suggests significant role of RV in the response to CRT.

804-5
Impact of Increased Fatty Acid Delivery on Myocardial Fatty Acid Metabolism in Obese Young Women
Lindra R. Petersen, Pilar Herrerio, Zulia Kiszewska-Ware, Carmen Dence, JoAnn Marsala, Robert J. Gottlieb, Washington University, St. Louis, MO

Background: Obesity is associated with an increased risk of heart failure. We have shown that myocardial fatty acid utilization (MFAU) and oxidation (MFAO) are increased in obese young women. Results of studies in animal models of obesity show that high fat diets further increase myocardial fatty acid (FA) metabolism and esterification (MFAE), which contributes to cardiac dysfunction. FA levels increase in obese humans cause an increase in myocardial FA metabolism is unknown.

Methods: We studied 6 women (body mass index 40 ± 7 kg/m2, 21-37 yrs) who were