**Safety of New Contrast Agent, Sonazoid, for Contrast-Enhanced Myocardial Perfusion Echocardiography During Dipyridamole Stress Test**

Christine Whitman, Jeanne Dinkins, Xiaofang Xu, Kathy Morris, James D. Thomas, Cleveland Clinic Foundation, Cleveland, OH

Background: Limited data is available in safety of Sonazoid™ (Amersham), which contains stabilized perfluorocarbon microbubble. The aim of study is to summarize the safety of Sonazoid for the assessment of myocardial perfusion during contrast enhanced dipyridamole stress echocardiography. Methods: Triggered replenishment or Ultrasonic imaging (TRI or UH) (Philip HDI 5000 and Sonos 5500) was performed on 62 patients (59 ± 13 years old; 43 males) with suspected coronary artery disease during dipyridamole stress test. Sonazoid was infused continuously (IV; 0.01 to 0.02 ml/kg/min) with mechanical index of 1.3 (n=35) and 1.8 (n=27) for destruction and 0.3-1.5 for imaging respectively. A full safety evaluation was performed. Results: No neurological deficits or other abnormalities were demonstrated from complete physical examination 24 hrs after the infusion. No significant arrhythmia was detected during the entire study. Table summarized the data of ventricular ectopics (PVC’s) occurrence.

<table>
<thead>
<tr>
<th>Rest Stress</th>
<th>(n=35)</th>
<th>(n=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without contrast (PVU/min)</td>
<td>0.86±3a</td>
<td>na</td>
</tr>
<tr>
<td>Contrast infusion (MI 0.3-0.5) (PVU/min)</td>
<td>0.09±0.4</td>
<td>0.04±0.1</td>
</tr>
<tr>
<td>Contrast + triggering (PVU/min)</td>
<td>0.09±0.4</td>
<td>0.04±0.1</td>
</tr>
<tr>
<td>Contrast destruction (PVU/stress or rest)</td>
<td>0.14±0.1</td>
<td>0.13±0.1</td>
</tr>
</tbody>
</table>

All variables are expressed as mean ± SD. M1 1.3 to 1.6 was used for bubble destruction. No significant differences were demonstrated in cardiac enzymes, renal function, liver function, coagulation profile before, 15 mins and 24 hrs after the stress test. Conclusions: This new contrast agent was well tolerated and safe in patients with suspected coronary artery disease. Ventricular ectopics occurred more frequently in response to bubble destruction. No significant arrhythmia was detected.

**Intermediate Mechanical Index Triggered Replenishment (Every Cardiac Cycle) Myocardial Contrast Echocardiography: A New and Accurate Method for the Assessment of Coronary Artery Disease**

Paramjeet Jeejee, Michael Hickman, Roxey Senior, Northwick Park Hospital, Harrow, United Kingdom

Background: High mechanical index (MI) myocardial contrast echo (MCE) may cause myocardial capillary damage, requires prolonged imaging times, and in most cases requires off-line background subtraction to adequately assess myocardial blood flow (MBF). Low MI imaging may lead to reduced sensitivity for the detection of microbubbles, and usually requires higher infusion rates. Experimental studies using Sonazoid (Amer sham Nycomed Imaging) have shown that intermediate MI imaging does not destroy microbubbles and therefore requires shorter imaging times to assess microbubble replenishment following a high MI pulse. Background noise is also reduced allowing on-line assessment of images without the need for background subtraction. We hypothe-

1043-29

**The Effect of Low Mechanical Index Pulse Sequencing Schemes Which Use Amplitude Versus Polarity Variation on Microbubble Destruction Rates**

Feng Xi, Thomas R. Porter, Carolin Sonne, Joseph R. Oberdorfer, University of Nebraska Medical Center, Omaha, NE

Background: Different pulse sequence schemes (PSS) have been developed for real time non-destructive myocardial perfusion imaging and intravascular microbubbles (MB). These include alternating polarity (PDI), alternating amplitude (PM), and both alternating polarity and amplitude (PAPS). Although these should have a similar effect on MB when used at the same mechanical index (MI), differences in averaged pulse amplitude as well as shift composition of MB after the threshold MI where destruction occurs. To test this, we injected either albumin coated (Option+) or lipid encapsulated (Definity) MB into a recirculating tissue phantom (attenuation 0.49 db/cm/MHz). MB destruction slopes were determined at transducer standoffs of nine and 2.2 centimeters. PDI (ATL), PM (Philips) and PAPS (Voluson 730) MB at 1.5-1.7 MHz frequency and frame rates of 36 Hz were tested at an MI of 0.1, 0.2, and 0.3. Results: *p<0.05 PID compared to PM and CPS at same MI. Initial contrast enhancement was equal for both MB agents at each standoff. However, PID had a lower threshold for MB destruction with both Option and Definity (Graph). Amplitude varying PSS (PM and CPS) did not destroy Option until 0.2 MI, and Definity until 0.3 MI. Conclusion: At the same MI, differences in PSS significantly affect MB destruction rates. PSS that use alternating amplitude are less destructive and therefore can be used at a higher MI setting than PSS that utilize alternating polarity.

1043-45

**Correlation of Coronary Flow Reserve Measured by Myocardial Contrast Echocardiography and Coronary Angiography**

Serena M. Bierig, Karen Klatte, Morton Kem, Arthur J. Labovitz, Saint Louis University, Saint Louis, MO

Introduction: myocardial contrast echocardiographic MB (MCE) has emerged as a reliable method of assessing myocardial perfusion. Few studies have looked at invasively measured coronary flow reserve and compared it to non-invasively measured MCE. The aim of this study was to simultaneously evaluate coronary flow reserve by cardiac flow wire and MCE. Methods: Ten normal patients undergoing routine cardiac catheterization were evaluated for coronary flow reserve using MB and 128Gp bolus injections. MB were measured and adenosine induced hyperemia. Myocardial perfusion was obtained by bolus then infusion of Option+TM at rest and peak hyperemia. Real-time and triggered echocardiographic perfusion images were digitized and analyzed off-line. MCE uptake was analyzed and curve fit to obtain flow and velocity by using Optisone + (1-e^-t). Twelve myocardial segments in the apical four and two chamber views were analyzed with correlation made to the respective coronary territory. Results: Two patients had nondiagnostic images for post test analysis. The left anterior descending was measured in 7 patients, with 1 patient having unstable angina. OPGH, Dopper flow wire measurements showed 100% MBF and CRR ranged from 2.2-4.2. PFSMA and Real-time imaging resulted in the most accurate assessment of CFR by MCE. Conclusion: MCE can accurately identify normal CFR in normal patients when compared to invasively measured Doppler wire assessment.

1043-46

**Accuracy of Quantitative Assessment of Collateral Blood Flow Estimated by Real-Time Myocardial Contrast Echocardiography: Comparison With Microsphere Method**

Avisio Miki, Kasumi Masuda, Kanto Otsuji, Juri Okazaki, Tatsunori Toyoda, Akiko Iwata, Toshikiko Asauma, Fusimizu Inuki, Shinriko Bepwu, Osaka University, Suita, Japan

Background: Assessment of residual collateral-derived myocardial blood flow (MBF) is important to protect against myocardial ischemia following acute coronary occlusion. Purpose: The aim of this study was to reveal the accuracy of MBF by coronary vessels estimated by real-time myocardial contrast echocardiography (MCE) by comparing with microsphere derived MBF. Methods: Short axis view of the left ventricle was recorded using real time MCE by Sequoia 512 (Siemens) during infusion of Definity® in 6 open chest dogs. The left circumflex coronary artery (LCX) was totally occluded by a 1.5‐mg coronary wire. MBF and the contrast echo video intensity were evaluated in the control and ischemic areas. The ischemic area was divided into 3 zones (1 Core and 2 Border zones). The replenishment curve in each region was fitted to an exponential function: y = A(1-e⁻^t). MCE derived MBF(A) by the ischemic area was normalized as %MBF of control area. Microsphere(B) were injected from left auricle at 30 seconds after LCX occlusion and %MBF of the area at risk was calculated from the postmortem specimen. Results: Real time MCE revealed definite recruitment by collateral in the area at risk after occlusion. The video intensity over time in the core zone was significantly lower than those in the border zone (27±14.9 vs. 42±13.5, p<0.001). The %MBF by MCE correlated with that by microsphere method (n=0.84, p<0.005). %A did not correlate with %MBF by microsphere method. Conclusion: Real time MCE is a useful non-invasive method to evaluate the collateral-derived residual MBF within area at risk, which can be an accurate index of protection against myocardial ischemia following acute coronary occlusion.

1043-47

**Characteristics of Myocardial Contrast Echocardiography, Coronary Flow Reserve, and Coronary Flow Velocity Pattern in Patients With Acute Myocardial Infarction**

Tomoko Tani, Kazuaki Tanabe, Miwa One, Motoaki Ibuki, Naoko Katayama, Koichi Tamita, Kenji Yamabe, Atsushi Yamamuro, Kunihiko Nagai, Kenichi Shiratori, Shigefumi Morioka, Kobe General Hospital, Kobe, Japan

Background: Myocardial contrast echocardiographic (MCE) and coronary flow reserve (CFR) in infarct related artery after acute myocardial infarction (AMI) has been reported to be useful in assessing myocardial viability. Previous study using a Guided doppler wire has reported that coronary flow velocity pattern (CFV) with a rapid diastolic deceleration time (DDT) immediately after percutaneous coronary intervention implies the advanced microvascu-
lar damage in patients with AMI. We investigated MCE with harmonic power Doppler (HPD), CFR and CF by using transonic echocardiography (ETE) in predicting functional recovery. Methods: We performed MCE (SonoSite5500, Philips) by using 1-4 mHz intermitted HPD with Levostat at rest and during ATP in 30 patients two weeks after anterior AMI. Peak videointensity was measured in the risk and control regions. The peak intensity ratios of the risk area to the control area (PIR) at rest and during hyperemia were calculated. We measured CFR of the left anterior descending artery (LAD) two weeks after AMI. CF of LAD by TTE was also obtained within 24 hours after successfully recanalization, and DDO of LAD was measured. Left ventricular (LV) end-diastolic volume (FVSV) and LV ejection fraction (FESV) by angiography were assessed in the acute phase and 6 months after AMI. Results: Pts were divided into 2 groups based on the severity of microvascular damage. CFR correlated with DDO (r=0.724, p<0.006). Conclusions: MCE, CFR and CF are useful for predicting functional recovery following AMI.

Results. A complete CFVR study was achieved in 1208 pts (feasibility: 98.2%), also per- formed in the early phase of acute coronary syndrome. In the remaining 22 pts (1.8%) recanalization was delayed. Minor symptoms or adverse effects occurred in 524 pts (43%) not requiring test termina-

Conclusion. Noninvasive assessment of CFRVR in LAD by CE-TTE is a very feasible method to evaluate the effects of epicardial coronary stenosis and coronary microvascu-

<table>
<thead>
<tr>
<th>Group A (DDO-600mssec)</th>
<th>Group B (DDO-600mssec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=20)</td>
<td>(n=10)</td>
</tr>
<tr>
<td>PIR at rest</td>
<td>0.66±0.178</td>
</tr>
<tr>
<td>PIR during hyperemia</td>
<td>0.76±0.104</td>
</tr>
<tr>
<td>EDV in the acute phase</td>
<td>112±33</td>
</tr>
<tr>
<td>EDV at follow-up (mi)</td>
<td>114±30</td>
</tr>
<tr>
<td>EF in the acute phase</td>
<td>0.5±7</td>
</tr>
<tr>
<td>EF at follow-up (%)</td>
<td>0.5±7</td>
</tr>
<tr>
<td>CFR</td>
<td>2.00±0.6</td>
</tr>
</tbody>
</table>

#PGO.05

1043-48 Feasibility, Symptoms, Adverse Effects and Complications Associated With Noninvasive Assessment of Coronary Flow Velocity Reserve During Intravenous Adenosine Infusion: Experience in 1,222 Patients

Roberta Montisci, Massimo Rusasco, Carlo Calai, Norma Zedda, Rosa Manzi, Christian Cadeddu, Simone Pisanu, Sabino Iliceto, Luigi Mestrli, University of Cagliari, Cagliari, Italy. Echocardiographic Study

Background. Noninvasive assessment of coronary flow velocity reserve (CFVR) with contrast-enhanced transonic echocardiography (CE-TTE) is an increasingly used method to evaluate the effects of epicardial coronary stenosis and coronary microvascular lature function. The purpose of this investigation was to analyze and review the Cagliari University experience in assessing CFVR with CE-TTE to define the feasibility, safety, adverse event profile, and complications rate of the test.

Methods. We evaluated CFVR in the left anterior descending coronary artery (LAD) with CE-TTE during adenosine infusion. The pulsed wave Doppler flow velocity was recorded in the LAD at rest and after maximum vasodilatation by adenosine infusion (140 mcg/kg/min in 5 minutes). We analyzed 1222 consecutive CE-TTE CFVR studies starting January 2000 to July 2002. The patients (372 females and 850 males: age: 62±1.6 years) were referred for CFVR studies for different reasons: 871 pts for follow-up after myocardial infarction (MI), 22 pts for hypercholesterolemia, 6 pts for systemic sclerosis, 47 pts for others.

Results. A complete CFVR study was achieved in 1200 pts (feasibility: 98.2%), also performed in the early phase of acute coronary syndrome. In the remaining 22 pts (1.8%) the study was interrupted because of failure to visualize LAD (7), hyperpnea (7), chest pain (6%), minor arrhythmias (3.6%), chest pain with EKG changes (1%). No major complications were observed during all studies.

Conclusion. Noninvasive assessment of CFVR in LAD by CE-TTE is a very feasible method with very low incidence of adverse events and complications. It can be used and safety performed in the evaluation of atherosclerotic LAD disease and in a broad spectrum of cardiac disease with microvascular impairment.

1043-49 Measurement of Renal Blood Flow Using Contrast-Enhanced Ultrasound in Patients With Renal Artery Stenosis


Method. We were measuring using CEU in 16 patients (8 males, 49±21 years) with unilateral renal artery stenosis, at rest and during intravenous injection of dopamine (2.5 μg/kg·min−1). In both kidneys, refilling rate (β) of microbubbles after high-power destruction was assessed using low mechanical-index Power Pulse Inversion (HDI 5000, ATL) during continuous infusion of microbubbles. In 6 patients, DTPA-renogram was performed for comparison.

Results. Microbubble velocity (β) in diseased kidney was significantly lower than the velocity in control kidney (0.45±0.24 vs 0.91±0.49, p<0.001). During increased renal blood flow with dopamine, significant difference in β was also observed between diseased and control kidney (0.75±0.28 vs 1.06±0.36, p<0.05). In 5 patients with abnormal DTPA-renogram, CEU showed marked reduction (50% in diseased kidney to 28%-66% of control kidney).

Conclusion. Abnormal renal blood flow can be measured using CEU in patients with renal artery stenosis. CEU may be useful in screening of renal artery stenosis.

1043-50 Nicorandil Preserves Collateral Circulation Even at Reduced Systemic Pressure In Comparison With Nitroglycerin: Real-Time Myocardial Contrast Echocardiographic Study

Akiko Iwata, Megumi Watanabe, Ayako Miki, Kentaro Otani, Juri Okazaki, Hide Hirose, Tautoumi Yoshida, Toshikiyo Asanuma, Fumiofumi Ishikura, Shinnaro Beppu, Osaka University, Suita, Japan.

Background. Collateral circulation of microvascular level is important for salvage of the myocardium at risk by coronary obstruction. Real-time myocardial contrast echocardiography (MCE) is useful to evaluate myocardial perfusion quantitatively. However, it has not been elucidated the effect of therapeutic agents on micro-collateral circulation, espe-

Poster: 1044 New Echocardiographic Approaches to the Evaluation of Cardiomyopathy

Sunday, March 30, 2003, Noon 2:00 p.m.
McCormick Place, Hall A
Presentation Hour: 1:00 p.m.-2:00 p.m.

1044-35 Relationship Between Doppler-Derived Left Ventricular Filling Parameters and Exercise Capacity in Patients With Hypertrophic Cardiomyopathy

Jong Won Lee, Jae K, Oh, Steve R. Ommen, James B. Seward, A. Jamil Tajik, Mayo Clinic, Rochester, MN.

BACKGROUND: Impaired left ventricular (LV) diastolic function is a prominent feature of hypertrophic cardiomyopathy (HCM). Conventional Doppler indices of LV diastolic function, however, do not correlate with exercise capacity in patients with HCM. Lacostatic mitral annular velocity (E) measured using Doppler tissue imaging (DTI) has been reported to be a preload independent index of myocardial relaxation and LV filling pressures can be estimated in HCM by combining mitral inflow (E) and E'. The purpose of this study was to
determine the relationship between E combined with conventional Doppler indices and exercise capacity in HCM.

METHODS: Fifteen patients with HCM (8 male, mean age, 52±14, 13 nonobstructive) underwent supine bicycle exercise (Ex) and two-dimensional and Doppler echocardiographic study at the same time. The mitral inflow velocities were traced and the following variables were derived: peak velocity of early (E) and late (A) filling and deceleration time (DT) of E velocity. E' was measured at septal corner of mitral annulus by DTI from apical 4-chamber view. E/E' correlated inversely with Ex duration (r = -0.55, p < 0.05). There was significant positive correlation between E and Ex duration (r = 0.60, p < 0.05).

However, no correlation was found between conventional Doppler indices and Ex duration.