

ORAL CONTRIBUTIONS

819 Contrast Echocardiography: New Studies in Stress EchocardiographyMonday, March 31, 2003, 11:00 a.m.-12:15 p.m.
McCormick Place, Room S101

11:00 a.m.

819-1 Regional Diagnosis in Patients With Unstable and Stable Angina Pectoris: Nicorandil Stress Myocardial Contrast Echocardiography and Magnetic Resonance Imaging

Takanori Yasu, Yasuyuki Kobayashi, Hiroshi Wada, Hiroyuki Kotsuka, Takaeshi Ishida, Yoshiaki Tsukamoto, Nobuhiko Kobayashi, Yuhki Hayakawa, Norifumi Kubo, Mikihisa Fujii, Osamu Tanaka, Msanobu Kawakami, Muneyasu Saito, Omiya Medical Center, Jichi Medical School, Saitama, Japan

Background: Regional diagnostic imaging in patients with unstable angina is a challenge for cardiologists. To determine whether or not nicorandil, a hybrid compound of K_{ATP} channel opener and nitrate, stress myocardial contrast echocardiography (MCE) and magnetic resonance imaging (MRI) are clinically useful in prediction of critical coronary arterial stenosis in angina pectoris (AP) including unstable AP, we conducted a prospective study.

Methods: Consecutive 101 patients with AP including unstable AP (n=50) without a history of ST elevation, previous myocardial infarction and coronary bypass surgery were enrolled. All the patients underwent nicorandil stress MCE and MRI. MCE was performed with gray scale ultra-harmonic mode (1.3 MHz/3.6 MHz) under maximum mechanical index during intravenous drip infusion of Levovist during rest and nicorandil stress (0.1 mg/kg iv). End-systolic triggering images (triggering interval of 1, 2, 3 and 4 beats) were recorded. Gadolinium-enhanced MRI was acquired at late-systolic phase during rest and nicorandil stress. Each myocardial region (left anterior descending artery, left circumflex artery, right coronary artery) imaged by MCE and MRI was evaluated before coronary arteriography (CAG) by two independent reviewers who were blinded to the clinical data. All the patients underwent quantitative CAG within five days after MCE and MRI.

Results: There was no adverse effects or angina during nicorandil stress MCE in any patients. Prediction rate by the nicorandil stress MCE (303 regions) and MRI of critical stenosis (70% in QCA) were 79% and 89% in sensitivity, 96% and 96% in specificity, and 91% and 93% in accuracy, respectively. In a subgroup of multivessel disease (n=26), sensitivity, specificity and accuracy by MCE were 86%, 94%, and 88%, respectively.

Conclusion: Nicorandil stress MCE and MRI are safe, useful and economical noninvasive techniques to assess myocardial regional perfusion in patients with AP including unstable AP, especially associated with multivessel lesions.

11:15 a.m.

819-2 Myocardial Contrast Echocardiography Is Superior to Tc-99m Single-Photon Emission Computed Tomography for the Diagnosis of Coronary Artery Disease in Patients Without Prior Acute Myocardial Infarction: A Multicenter Study

Roxy Senior, Wolfgang Lepper, Agnes Pasquet, George Chung, Rainer Hoffman, Jean-Louis J. Vanoverschelde, Manuel Cerqueira, Sanjiv Kaul, Northwick Park Hospital, Harrow, United Kingdom, University of Virginia, Charlottesville, VA

Background: We used dipyridamol stress to test the hypothesis that myocardial contrast echocardiography (MCE) is superior to ^{99m}Tc single photon emission computed tomography (SPECT) for the detection of coronary artery disease (CAD).

Methods: Fifty-five patients with no previous myocardial infarction underwent MCE (during continuous infusion of Sonazoid) and SPECT and were compared to quantitative coronary angiography (CAD was defined as >50% stenosis). Each patient was also examined for the anterior and posterior circulations. All images were analysed blindly and separately at non-recruiting centres.

Results: On a coronary circulation basis (n=110), the sensitivity for MCE was significantly greater than that of SPECT for the detection of CAD (86% vs 43%, p<0.0001). The specificity of MCE and SPECT, however, were similar (88% and 93%, p=NS). Similarly, on a patient basis, the sensitivity of MCE was significantly greater than that of SPECT for the detection of CAD (83% vs 49%, p<0.05) with no significant differences in specificities. Furthermore, sensitivity of MCE was significantly (p<0.01) superior to SPECT for every level of coronary stenosis (50-75%, 76-90% >90%).

Conclusion: Dipyridamol MCE is superior to SPECT for the diagnosis of CAD in patients with no prior MI.

11:30 a.m.

819-3 How Valuable Is Real-Time Myocardial Contrast Echocardiography for Pharmacological Stress Testing?

K. Gaspar C. da Silva, Jr., Alain-Eric Dubart, Nicolas Ferrari, Grigorios Korosoglou, Mark Rosenberg, Joerg Zehelne, Helmut F. Kuecherer, University of Heidelberg, Heidelberg, Germany

Background: Little is known about the feasibility and diagnostic accuracy of real-time myocardial contrast echocardiography (MCE) as an adjunct to stress testing. **Aim:** This study was performed to test the agreement between MCE and ^{99m}Tc -Sestamibi-SPECT

in the evaluation of myocardial perfusion defects on a segmental level.

Methods: MCE (Optison, 8-10 ml/h) was performed at rest and during peak dipyridamol stress in 70 unselected patients (age: 63±9; gender: 54m, 16f; infarcts: 25 anterior, 10 inferior, 11 lateral; coronariopathies: 10 single, 32 multi vessel) with angiographically proven coronary artery disease undergoing SPECT imaging for clinical reasons. 4 patients were excluded due to extremely limited echographic windows. From 4- and 2-chamber MCE and comparable SPECT views, 12 myocardial segments were graded for regional opacification/uptake (0=absent, 1=low, 2=incomplete, 3=complete, 4=indeterminate) by two pairs of blinded observers. Segmental ischemia was defined as the reduction of opacification/uptake under stress by one degree. Concordance between MCE and SPECT and interobserver variability were assessed using kappa statistics.

Results: Of 792 analysed segments 143 were not adequate for reading by MCE, mostly confined to basal segments. Interobserver variability was good (kappa=0.76). Overall agreement between the two methods was poor (59%, kappa =0.25) when including unreadable segments but good (82%, kappa=0.63) when excluding those segments. Concordance on segmental level was highest in apico-lateral (85%) and lowest in basal segments (18%). Concordance between the methods was higher for diagnosing fixed defects (72%) and normal perfusion (88%), than for diagnosing reversible defects (65%). **Conclusion:** This study demonstrates that real-time MCE can detect perfusion defects during pharmacological stress and agrees reasonably well with ^{99m}Tc -Sestamibi-SPECT. However, diagnostic feasibility is limited in basal segments and caution should be exerted when diagnosing stress induced ischemia.

11:45 a.m.

819-4 Five Years of Adenosine Contrast Echocardiography: Lessons From 1,750 Consecutive Studies in a Single Center

Fernando Morcerf, Alvaro Moraes, Caio Medeiros, Marcia Carrinho, Flavio C. Palheiro, Marcia Castler, Renato Morcerf, Flavia Salek, Antonio Carlos Nogueira, Hospital Pro Cardioco Ecor, Rio de Janeiro, Brazil

Background: Detection of myocardial perfusion by echocardiography with intravenous injection of contrast agents is an emergent technique. Five years ago we started our experience in humans testing different protocols (varying the stressor agents, the ultrasound technologies and PESDA administration) in 160 pts with confirmed coronary artery disease (CAD). Due to our initial results we decided by the Adenosine Contrast Echocardiography (ACE) protocol. It is performed with continuous infusion (1-2 ml/m) of PESDA associated with triggered (fixed 1:1) 2nd harmonic imaging technology, at rest and after a bolus injection of adenosine (ADN). The aim was to report the safety, tolerance and results of this protocol in the clinical scenario of CAD.

Methods: 1750 consecutive pts (1085 male, 12 to 91 years), were submitted to the ACE protocol to investigate myocardial perfusion. At least 1 ampoule of 2ml/6mg of ADN was used for each echocardiographic view. Images were obtained at the standard apical 4-chamber and 2-chamber views. Myocardial perfusion was visually analyzed (2 independent investigators) in 3 perfusion beds (LAD, RCA and Cx arteries).

Results: The ACE studies were interpretable for all perfusion beds in 1735 pts (99%). PESDA infusion produced myocardial contrast and ADN bolus injection enhanced it further in at least 1 LV segment wall in all pts. 980 pts (56%) required 1 amp of ADN per view to achieve further increment of the wall contrast. 525 pts (30%) and 245 pts (14%) required 2 and 3 amp respectively to obtain the same result. A transient, asymptomatic 3rd degree AV block lasting less than 10s was noted in 31, 49 and 130 pts who had 1, 2 or 3 amp of ADN respectively (total of 210 pts-12%). 262 pts (15%) complained of light-headedness, 140 pts (8%) of headache, and, 105 pts (6%) of non-angina chest discomfort. All patients developed tachypnea. Symptoms lasted less than 30 s and did not required therapy or precluded further ADN injection if needed. All our previous papers, using coronary angiography as gold-standard in pts with high incidence of CAD, reported global accuracy superior to 90%.

Conclusion: ACE protocol with PESDA infusion is safe and very well tolerated by pts with suspected CAD.

Noon

819-5 Does It Really Make Any Difference Which Contrast Imaging Modality We Use in Conjunction With Stress Echocardiography on the Accuracy of the Test?

Melda S. Dolan, Jeanette St. Vrain, Jiri Sklenar, Denice Sheriff, Alan Maniet, Arthur J. Labovitz, Saint Louis University, St. Louis, MO, University of Virginia, Charlottesville, VA

Background: Several contrast imaging modalities have been utilized to assess myocardial perfusion. However, previous modalities were destructive to detect bubble responses. Recently non-destructive real time perfusion (RTMP), "Power Modulation" (PM) that displays myocardial micro-circulation and wall motion simultaneously become available. However limited data is related to new modality.

Methods: We evaluated real time perfusion with power modulation mode in patients during Dobutamine Stress Echocardiography (DSE) and compared it with ultraharmonic triggered imaging (UHTI). Patients were examined by two modalities with Optison infusion during Dobutamine Stress Echocardiography. Myocardial perfusion and wall motion and wall thickening were assessed quantitatively in 1092 segments. In a subgroup of patients who had nuclear imaging, accuracy of the 2 modalities were compared.

Results: Table

Slightly higher quantitative scores were obtained with real-time power modulation. Apical bubble destruction within cavity was minimal with power modulation. Likewise, swirling effects that interfere with lateral borders were minimized with Real Time power modulation. However, there was no significant difference between the 2 modalities with respect

to accuracy of Dobutamine Stress Echocardiography (81% vs 83%).

Conclusion: Real time perfusion provide perfusion information during stress echocardiography comparable to obtained with triggered imaging, even better for apical segments.

	ANTERIOR	SEPTAL	APICAL	LATERAL	INFERIOR	ACCURACY
RTMP-PM	104 + 8	88 + 11	85 + 12	73 + 14	91 + 8	83%
UHTI	92 + 21	79 + 17	66 + 10	61 + 12	89 + 13	81%
p	NS	NS	*0.01	0.07	NS	NS

POSTER SESSION

1116MP Moderated Poster Session...Contrast Echocardiography Prognosis for Improvement in Ventricular Performance Following Infarction of Intervention II

Monday, March 31, 2003, Noon-1:00 p.m.
McCormick Place, Hall A

Noon

1116MP-203 Intact Microvascular Integrity Predicts Improvement in Left Ventricular Function After Revascularization in Patients With Chronic Coronary Disease

Khim-Leng Tong, Todd Belcik, Saul Kalvaitis, Sanjiv Kaul, Kevin S. Wei, University of Virginia, Charlottesville, VA

Background: Identifying viability (V) in patients with left ventricular (LV) dysfunction and coronary artery disease (CAD) is important, as revascularization may improve LV function and outcomes. We hypothesized that the presence of microvascular integrity identifies patients with chronic LV dysfunction who will benefit from revascularization (R).

Methods: 90 patients with LV ejection fraction (EF) < 40% were enrolled. 2D echo was performed at baseline, 3, 6, and 12 months. End-diastolic (EDV) and -systolic volumes (ESV) and LVEF were measured. Microvascular integrity was assessed from regional perfusion during continuous infusions of Definity and intermittent ultraharmonic imaging from apical 4-, 2- and 3-chamber views, and scored in each of 16 myocardial segments as 1 = no enhancement, to 3 = full enhancement. A perfusion score index (PSI) was derived from (Total perfusion score/number of segments visualized). Patients with PSI > median were defined as viable, and the others as nonviable.

Results: Patients were classified into 4 groups based on whether they had V or R: A (n=12, V+, R+), B (n=33, V+, R-), C (n=14, V-, R+), and A (V-, R-). After a mean follow-up of 6.6±3.7 months, LVEDV and LVESV decreased, and LVEF increased significantly in Group A (Table). All other patients had no significant improvement in those variables (Table).

Conclusion: The presence of microvascular integrity in patients with chronic CAD and LV dysfunction predicts improvements in LV function and volumes after revascularisation.

Variable	BL-LVEDV	FU-LVEDV	p-value	BL-LVESV	FU-LVESV	p-value	%Change LVEF
Gp. A	160±56	154±58	0.03	107±44	94±55	0.10	30±30
Gp. B	157±45	173±43	0.01	107±44	120±40	0.01	-11±20
Gp. C	207±40	194±67	0.33	132±45	135±57	0.73	10±26
Gp. D	202±52	214±45	0.04	153±41	166±45	0.04	-2.5±30
p-value	0.002	0.02		<0.001	0.001		0.006

12:12 p.m.

1116MP-204 Prediction of the Extent of Myocardial Necrosis and Contractile Reserve After Reperfusion Therapy Following Acute Myocardial Infarction: Comparison Between Myocardial Contrast Echocardiography and Contrast Enhanced Cardiovascular Magnetic Resonance

Rajesh Janardhanan, James CC Moon, Dudley J. Pennell, Roxy Senior, Northwick Park Hospital, Harrow, United Kingdom, Royal Brompton Hospital, London, United Kingdom

Background: Both myocardial contrast echocardiography (MCE) and contrast enhanced cardiovascular magnetic resonance (CMR) can identify myocardial necrosis following acute myocardial infarction (AMI). We sought to compare the relative accuracy of these techniques in the assessment of the extent of myocardial necrosis post AMI and its impact on contractile reserve.

Methods: Twenty-five patients with AMI underwent low power continuous MCE using IV Optison® and gadolinium-DTPA enhanced CMR 7-10 days after reperfusion therapy with thrombolysis. Segments that demonstrated little or no contrast opacification on MCE or more than 50% delayed hyperenhancement on CMR were deemed necrotic. Contractile reserve was evaluated 12 weeks later by an assessment of either resting systolic func-

tion or low dose dobutamine stress (for segments with persistent dyssynergy.)

Results: Agreement between MCE and CMR for the identification of viable versus necrotic myocardium was 80% (kappa = 0.61). The correlation between the two techniques for the detection of the number of necrotic segments was excellent (r = 0.84; p < 0.0001). The correlation coefficient between MCE and contractile reserve was 0.80 (p < 0.0001) and that between CMR and contractile reserve was 0.69 (p = 0.0003).

Conclusion: There was good correlation between MCE and CMR for the assessment of the extent of myocardial necrosis after AMI. Both techniques reliably predicted contractile reserve.

12:24 p.m.

1116MP-205 Myocardial Contrast Echocardiography Using Low Power Continuous Imaging Early After Acute Myocardial Infarction Accurately Predicts Late Functional Recovery

Rajesh Janardhanan, Jonathan Swinburn, Kim Greaves, Roxy Senior, Northwick Park Hospital, Harrow, United Kingdom

Background: Microvascular perfusion is a pre-requisite for ensuring viability early after acute myocardial infarction (AMI). For adequate assessment of myocardial perfusion, both myocardial blood volume and velocity need to be evaluated. Low power continuous myocardial contrast echocardiography (MCE) can rapidly assess myocardial blood volume and velocity.

Methods: Fifty patients underwent low power continuous MCE using IV Optison® 7-10 days after AMI. Myocardial perfusion (contrast opacification assessed at 15 cardiac cycles after destructive images) and wall thickening were assessed at baseline. Regional and global left ventricular (LV) function was re-assessed 12 weeks after AMI.

Results: Out of the 297 dysfunctional segments, MCE detected no contrast enhancement at 15 cardiac cycles in 172 segments. Of these 160 (93%) segments failed to show improvement. MCE demonstrated homogeneous contrast opacification in 77 segments, of which 65 (84%) showed recovery of function. Furthermore, the greater the extent and intensity of contrast opacification at baseline, the better the LV function at 12 weeks (p<0.001, r = -0.91). Almost all patients with < 40% perfused, but dysfunctional myocardium failed to demonstrate functional recovery. Amongst clinical, biochemical, ECG and MCE parameters in the multiple regression analysis, only MCE (p < 0.001) and peak CK (p < 0.001) proved to be independent predictors of functional recovery.

Conclusion: Low power continuous MCE is an accurate and rapid bedside technique to identify microvascular perfusion post AMI. This technique may be utilized to reliably predict late recovery of function in dysfunctional myocardium after AMI.

12:36 p.m.

1116MP-206 Triggered Harmonic Power Doppler Imaging Predicts Functional Recovery After Revascularization in Patients With Left Ventricular Dysfunction

Constadina Aggel, Maria Bonou, George Roussakis, Costas Chatzos, Eleutherios Tsiamis, Stela Brili, Manolis Vavouranakis, Christos Pitsavos, Christodoulos Stefanadis, Pavlos Toutouzas, Hippokraton Hospital of Athens, Athens, Greece

Background: Unlike acute coronary syndromes the predictive value of rest Harmonic Power Doppler Imaging (HPDI) for post-revascularization outcome is still unclear. The aim of this study was to estimate the accuracy of HPDI in predicting reversibility of myocardial dysfunction after revascularization.

Methods: Thirty six patients (mean age 65±6 years) with ischemic left ventricular dysfunction underwent dobutamine stress echocardiography (DSE) and rest HPDI using intermittent imaging during Levovist infusion before bypass surgery and follow up rest echocardiography a mean of 3 months later. Triggering intervals of 1:4 (early) and 1:8 (delayed) cardiac cycles were used. Contrast score index (CSI) was used for perfusion analysis (0=absence, 0.5=partial, 1=normal perfusion).

Results: There were no major post-operative complications during follow up. Of 412 revascularized dysfunctional segments, 188 (46%) improved at follow up. DSE and any increase of HPDI signal provided similar predictive accuracy (79% and 74% in evaluating viable myocardium and comparable sensitivity (87% and 88%), positive (73% and 66%) and negative (79% and 74%) predictive value whereas DSE exhibited higher specificity (72%) than HPDI (61%, p<0.05). Delayed perfusion appeared higher sensitivity (63%), positive (58%) and negative (66%) predictive value than early perfusion (25%, p<0.001, 35%, p<0.001 and 49%, p<0.001, respectively) in predicting functional recovery. The presence of contrast enhancement within the revascularized area resulted in a significant improvement in CSI, mean wall motion score index (WMSI) and ejection fraction (%) compared with residual contrast defect (CSI: 0.8±0.2 vs. 0.5±0.2, p<0.01, WMSI: 1.9±0.3 vs. 2.3±0.2, p<0.01, ejection fraction 36±6 vs. 29±5, p<0.05). Significant correlation was observed between CSI and follow up WMSI (r = -0.67) and between CSI and follow up ejection fraction change (r = 0.65).

Conclusion: Triggered HPDI has high sensitivity in detecting hibernating myocardium and can accurately predict the potential for recovery of ischemic left ventricular dysfunction three months after revascularization.