

POSTER SESSION

1140 Cardiovascular Magnetic Resonance Clinical Studies

Monday, March 18, 2002, 3:00 p.m.-5:00 p.m.

Georgia World Congress Center, Hall G

Presentation Hour: 4:00 p.m.-5:00 p.m.

1140-49 The Safety of Clinical Cardiovascular Magnetic Resonance Imaging: A Single-Center Experience in More Than 3,000 Cases

Matthias G. Friedrich, Jeanette Schulz-Menger, Oliver Strohm, Wolfgang Lankes, Thomas Poetsch, Rainer Dietz, Franz-Volhard-Klinik, Charite, Humboldt-Universitaet Berlin, Berlin, Germany.

Cardiovascular magnetic resonance imaging (MRI) is increasingly used in clinical cardiology, also in patients with decreased LV function, arrhythmia, or other risk factors. Thus, the assessment of safety is important to evaluate the clinical role of MRI.

Between January 1996 and March 2001 we included 3326 clinical cardiovascular MRI studies requested in our University cardiology department. The MRI department is equipped with emergency tools and a removable table. Cardiologists, experienced in resuscitation, are always present.

221 studies (6.6%) could not be performed because of severe claustrophobia (157/4.7%) or contraindications (56/1.7%). The remaining studies included 170 patients with severe symptoms such as dyspnea, angina during the last 6 hours and 21 clinically unstable patients suffering from acute myocardial infarction, acute aortic dissection, or unstable angina. In eight patients (0.24%) the study had to be terminated because of severe dyspnea. An adverse event occurred in three of 2008 studies (0.15%) with intravenous administration of Gd-DTPA, characterized by unspecific symptoms in one case, rash in another case and an allergic reaction with a drop in blood pressure in the third. In two patients, severe arrhythmia occurred during the study (complete AV block in one case and a non-sustained VT in another case), both during stress studies (2/155 = 1.7%) and both with a self-limiting course. No death or other disabling adverse event occurred.

We conclude that cardiovascular MRI can be performed in cardiologic patients with a high level of safety. When emergency equipment and skilled personnel is present, this technique can be offered to patients with an increased cardiovascular risk.

1140-50 Criteria for Concentric Left Ventricular Geometry Determined Using Magnetic Resonance Imaging

Michael L. Chuang, Carol J. Salton, Christopher J. O'Donnell, Kraig V. Kissinger, Daniel Levy, Warren J. Manning, Beth Israel Deaconess Medical Center, Boston, Massachusetts, NHLBI's Framingham Heart Study, Framingham, Massachusetts.

Left ventricular (LV) concentric geometry (CONC), which includes concentric remodeling (in persons without elevated LV mass) and concentric hypertrophy (elevated mass), is associated with increased cardiovascular risk and is echocardiographically defined by a wall thickness-to-cavity radius ratio (WTCR) ≥ 0.45 . Criteria for CONC using volumetric measures have not been defined. We compared a volumetric index, the LV mass to end-diastolic volume (EDV) ratio (MVR), to the linear WTCR for stratification of a population-based sample for CONC.

METHODS

Contiguous multislice breathhold cine MRI (Philips Gyroscan NT) was used to determine volumetric LV EDV, volumetric LV mass, basal anterior septal wall thickness and LV end-diastolic diameter in 292 adults (141 men, 151 women, aged 59 ± 9 yrs) without symptomatic cardiac disease from the Framingham Heart Study Offspring Cohort. Subjects were stratified by quartile of CONC using MVR and WTCR. Interquartile crossovers were tabulated. Subjects also were ranked by CONC and correlation between MVR and WTCR was determined. Finally, defining WTCR as "truth" for receiver-operator characteristic (ROC) analysis purposes, we determined the corresponding optimal cutoff for CONC by MVR.

RESULTS

WTCR criteria categorized 53 men (37.6%) and 25 women (16.6%) with CONC. Mean \pm SD MVR was 1.46 ± 0.29 in men and 1.34 ± 0.33 in women. There was single-quartile crossover in 84 (28.8%) subjects, 2-quartile in 32 (11.0%) and 3-quartile in 10 (3.4%), the remaining 166 (56.8%) subjects were stratified identically by WTCR and MVR. Correlation between MVR and WTCR for individual ranking of patients was $r = 0.32$, $p < 0.001$. MVR = 1.45 was identified as the optimal threshold for CONC by ROC analysis, with sensitivity = 53.4% and specificity = 72.9%.

CONCLUSIONS

Current linear-measurement criteria for CONC agree only modestly with the ratio of volumetric LV mass to EDV with respect to stratifying patients. Volumetric criteria for CONC and their prognostic value remain to be more fully defined, but the linear WTCR is not interchangeable with MVR, a natural volumetric index of concentric remodeling.

1140-51 Results of a Dose-Ranging Diagnostic Trial of Magnetic Resonance Angiography With MS-325, a Blood Pool Contrast Agent, for the Detection of Vascular Occlusive Disease in the Aortoiliac Region

Martin Leon, Emile Mohler, MS-325-09 Trial Group, Lenox Hill Hospital, New York, New York, University of Pennsylvania Hospital, Philadelphia, Pennsylvania.

BACKGROUND: MS-325 (EPIX Medical, Inc.) is a gadolinium-based blood pool contrast agent which provides substantial and durable enhancement of the arterial MR signal over that of the current extracellular gadolinium contrast agents. A dose-ranging diagnostic

trial has been completed to examine the accuracy of MS-325-enhanced MRA relative to non-contrast MRA for the detection of aortoiliac disease (AIOD).

METHODS: In this 25 center, double-blind study, 233 patients with known or suspected peripheral vascular disease were administered either placebo or MS-325 for MRA of the aortoiliac region in comparison to the standard of reference, X-ray angiography (XRA). Patients received placebo or one of five doses of MS-325. 2D-TOF MRA images were acquired immediately prior to MS-325 administration. MRA image sets were examined and interpreted by three blinded readers. Two independent blinded readers read and interpreted the XRA images. AIOD was defined as $\geq 50\%$ stenosis in the abdominal aorta, common iliac, external iliac, or common femoral arteries. The sensitivity, specificity, and accuracy were determined for each group prior to and following MS-325 administration.

RESULTS: The accuracy of MRA for diagnosis of AIOD prior to and with MS-325 enhancement as a function of dose for the blinded read is shown below.

CONCLUSIONS: At doses of 0.03 mmol/kg and above, MS-325 enhanced MRA provided an approximate 20% increase in accuracy over non-contrast 2D-TOF MRA for diagnosing clinically significant AIOD.

MRA Accuracy by Dose; Mean (Range)

	Placebo	0.005 mmol/kg	0.01 mmol/kg	0.03 mmol/kg	0.05 mmol/kg	0.07 mmol/kg
Patients	37	44	34	39	40	39
%	%	%	%	%	%	%
MRA Accuracy non-contrast	68 (65-72)	68 (61-74)	56 (47-66)	66 (61-72)	64 (55-77)	66 (56-82)
MRA Accuracy post-MS-325	0 (0-0)	72 (61-82)	75 (73-79)	88 (81-91)	90 (81-96)	83 (74-89)

1140-52 Is Magnetic Resonance Imaging a Reliable Tool for Quantifying Aortic Valve Stenosis?

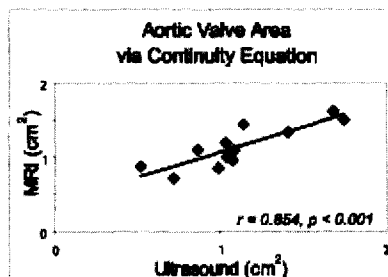
Shelton D. Caruthers, Rosa Lin, Mary P. Watkins, Peggy Brown, Katherine Lehr, LaTish McKinney, Gregory M. Lanza, Samuel A. Wickline, Washington University, St. Louis, Missouri, Philips Medical Systems, Best, The Netherlands.

Background: The reliability of Magnetic Resonance Imaging (MRI) in quantifying aortic stenosis is backed by limited literature. Applications of the continuity equation have received even less attention. Thus, we compared valve sizes calculated with velocity-time integrals (VTI) measured proximal and distal to valves and pressure gradients using Doppler ultrasound and phase contrast MRI.

Methods: In 12 patients, using the velocity encoding MR technique, quantitative flow images were acquired-oriented parallel to the aortic valve plane, positioned on the plane and 1.5cm above and below. From velocity and diameters measured on an offline workstation, VTI were calculated and used in the continuity equation to estimate the functional aortic valve area. Peak and mean pressure gradients were also calculated. All were compared, double-blinded, with ultrasound measurements taken just after the MR.

Results: Measurements from the MRI flow images correlated with the same measurements from echo. Coefficients for the peak and mean pressure gradients were $r = 0.951$ and $r = 0.925$, respectively ($p < 0.001$). For VTI, $r = 0.958$ and $r = 0.909$ ($p < 0.001$) for the aorta and LV outflow tract. In these patients, aortic valve area, using echo, ranged from 0.5 to 1.8 cm². Correlating significantly ($r = 0.854$, $p < 0.001$), MRI values were 0.7 cm² to 1.6 cm² (see figure).

Conclusion: MRI can be used with the VTI approach to evaluate reliably and easily aortic valve area, comparable to Doppler, in patients with mild-to-severe valve disease.

**1140-57****Rapid Evaluation of Right Ventricular Volume and Mass Without Breath-Holding Using Real-Time Interactive Cardiac Magnetic Resonance Imaging System**

Shuichiro Kaji, Phillip C. Yang, Adam B. Kerr, Craig H. Meyer, John M. Pauly, Bob S. Hu, Kawasaki Medical School, Kurashiki, Japan, Stanford University School of Medicine, Stanford, California.

Background: Precise determination of the degree of right-sided volume overload is important in evaluating cardiac or pulmonary diseases. While magnetic resonance imaging (MRI) provides accurate assessment of right ventricular (RV) function, previous techniques have been relatively slow and required ECG gating. In contrast, a newly developed cardiac MRI system allows continuous real-time dynamic acquisition and display of any scan plane at up to 30 images/s without ECG gating or breath-holding. The purpose of this study was to validate RV measurements derived from the real-time cardiac MRI as compared with the well-validated conventional cine MRI. **Methods and Results:** Eighteen subjects underwent the real-time cardiac MRI and cine MRI in the short axis orientation on a standard 1.5T MRI scanner. Cine MRI were obtained with ECG and respiratory gating. Measurements were obtained of RV end-diastolic volume

(RVEDV), RV end-systolic volume (RVESV), RV ejection fraction (RVEF), and RV mass. The acquisition time for real-time cardiac MRI was significantly shorter than that for cine MRI (1±0 versus 13±2 minutes, p<0.001). Both techniques yielded good quality images allowing RV volumetrics. There was good agreement between real-time volumes and cine volumes. The RV measurements obtained with real-time cardiac MRI showed close correlation with those obtained with conventional cine MRI (RVEDV: r=0.94, p<0.001, RVESV: r=0.95, p=0.001, RVEF: r=0.66, p=0.05, RV mass: r=0.94, p<0.005). **Conclusions:** Compared with the conventional cine MR imaging, real-time MR imaging shows markedly reduced acquisition time in the assessment of RV volumes and mass. We conclude that real-time MR imaging system is a valuable technique that provides accurate assessment of RV volumes and mass in a time-efficient manner.

1140-68 Cardiac Cine Magnetic Resonance Imaging Identifies Anatomical and Functional Abnormalities in Patients With Arrhythmias of Right Ventricular Origin

Mihai Croitoru, Raja Muthupillai, John J. Seger, Ali Massumi, Alberto Lopez, Scott Flamm, St. Luke's Episcopal Hospital/Texas Heart Institute, Houston, Texas, University of Texas Health Science Center, Houston, Texas.

Background: A definitive diagnosis of arrhythmogenic right ventricular dysplasia (ARVD) is made by histological demonstration of transmural fibrofatty replacement of right ventricle (RV) myocardium. Cardiac cine MRI (cMRI) is noninvasive and can offer information about RV myocardial infiltration as well as RV structure and function. It may also have a role in the diagnosis of RV outflow tract tachycardia (RVOT VT). **Objectives:** Identify the cMRI findings in patients with arrhythmias of RV origin. Assess the role of cMRI in the diagnosis of ARVD and RVOT VT by identifying abnormalities in global or regional RV structure, shape and function. **Methods:** We examined the cardiac cMRI scans of all patients with ventricular arrhythmias of RV origin (LBBB morphology) referred for possible diagnosis of ARVD between 02/1999 and 04/2001. Patients were included in one of 3 groups: rare PVCs (< 12000/24 hours), frequent PVCs (> 12000 PVCs/24 hours) and ventricular tachycardia (VT) **Results:** We identified 118 patients with arrhythmias of LBBB morphology (mean age 38 y, range 14-70 y, and 44% men). Of these 37 patients (30%) had VT, whereas 81 had PVCs (rare PVCs - 41%, frequent PVCs - 29%). The most common indications for testing were syncope, palpitations and asymptomatic arrhythmia. The cMRI showed fatty/fibrofatty infiltration of the RV in 9%, abnormalities of RV shape (thinning, dilatation) in 40% and abnormalities in RV motion (hypo-, a-, dyskinesis) in 40%. Abnormalities were most common in the infundibulum, followed by the apex and the base of the RV. Abnormalities were significantly more frequent in the patients with VT or NSVT (52%) than in patients with PVCs (rare PVCs- 15%, frequent PVCs -25%). Based on cMRI, a diagnosis of ARVC was made in 19% of patients and excluded in 71%. 12 patients (10%) had studies suggestive of RVOT VT (small areas of akinesis or dyskinesis limited to the infundibulum). **Conclusion:** Many patients with RV arrhythmias have abnormalities on cMRI. In these patients, cMRI is a useful tool in the diagnosis of ARVD and RVOT VT. A subgroup of patients with very frequent PVCs and abnormalities of RV structure or function may have a mild form of RV cardiomyopathy.

POSTER SESSION

1141 Studies of Myocardial Blood Flow and Physiology in Disease States

Monday, March 18, 2002, 3:00 p.m.-5:00 p.m.
Georgia World Congress Center, Hall G
Presentation Hour: 4:00 p.m.-5:00 p.m.

1141-59 Effect of Spinal Cord Stimulation on Cardiac Adrenergic Nervous Fiber Function in Patients With Angina and Normal Coronary Arteries

Gaetano A. Lanza, Alfonso Sestito, Sima Sandric, Filippo Crea, Francesco De Seta, Fulvio Bellocchi, Attilio Maseri, Istituto di Cardiologia and Medicina Nucleare, Università Cattolica del Sacro Cuore, Roma, Italy, Medtronic Italia, Roma, Italy.

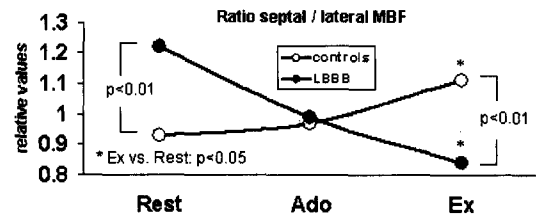
Background. 123-I-meta-iodo-benzylguanidine (MIBG) scintigraphy is helpful to assess the integrity and function of cardiac adrenergic nerve fibers. Cardiac MIBG uptake can be impaired in patients with angina and normal coronary arteries (NCA), and spinal cord stimulation (SCS) improves symptoms in these patients. In this study we assessed whether SCS improves cardiac adrenergic nerve function in patients with angina and NCA. **Methods.** We studied 7 patients (4 men, 59.3±11 years) with angina and NCA, who underwent SCS because of symptoms refractory to medical therapy. Patients underwent cardiac MIBG scintigraphy both during SCS and in the absence of SCS. The 2 tests were done in random order 3 weeks apart from each other. Global MIBG uptake, assessed on planar radionuclide images, was expressed as heart/mediastinum (H/M) ratio. Furthermore, on cardiac tomographic images the left ventricle was divided into 24 segments and a MIBG uptake score was assigned to each segment, according to the scale: 0=normal uptake; 1=mild defect; 2=moderate defect; 3=severe defect. A global MIBG uptake defect score was calculated for each patient as the sum of all segmental scores. A 99m-Tc-sestamibi exercise stress test was performed to assess myocardial perfusion within ±1 day from MIBG scintigraphy, both in presence and absence of SCS. **Results.** Abnormalities in MIBG uptake were found in 5 patients (71%), both in presence or absence of active SCS. The H/M ratio was 1.78±0.36 and 1.77±0.37 (p=0.74), and the MIBG uptake score was 18.6±25.9 and 18.4±25.5 (p=0.79), in presence and absence of

active SCS, respectively. Reversible exercise-induced perfusion defects were detected in 4 patients in the absence of active SCS. The perfusion defects improved in 2 of these patients during active SCS. **Conclusions.** Our data show that cardiac MIBG uptake abnormalities are present in a significant number of patients with angina and NCA. SCS had no significant effects on MIBG defects, suggesting that its clinical benefits may be unrelated to improvement in cardiac adrenergic nerve function. SCS, however, improved reversible myocardial perfusion defects in 2 patients, suggesting that it may have detectable anti-ischemic effects.

1141-60 Left Bundle Branch Block and Quantitative Regional Myocardial Blood Flow Patterns in Humans - Adenosine vs. Bicycle Stress in PET

Pascal Koepfli, Christophe A. Wyss, Patrick T. Siegrist, Gustav K. von Schulthess, Philipp A. Kaufmann, University Hospital, Zürich, Switzerland.

Background: Patients with Left Bundle Branch Block (LBBB) often have septal perfusion defects in exercise radionuclide myocardial perfusion scans, but less frequent using pharmacologic stress (adenosine, Ado). Decreased septal perfusion in LBBB due to delayed relaxation and shortened diastole has been hypothesized as cause of this phenomenon. **Aim:** To study the influence of LBBB on quantitative regional myocardial blood flow (MBF) at rest and during adenosine- vs. bicycle exercise-induced hyperemia (Ex). **Methods:** 15O-labelled H2O and Positron-Emission-Tomography (PET) was used to measure regional MBF (ml/min/g) at rest, during Ado (0.14mg/kg/min over 7 min) and immediately after supine bicycle exercise in 21 healthy male volunteers and 10 LBBB-patients without coronary artery disease. The ratio septal/lateral MBF was calculated for each condition. **Results:** Global and septal MBF was significantly higher in LBBB at rest and Ex. The ratio septal/lateral MBF was higher in LBBB than controls at rest, was not significantly affected by Ado in both groups, but increased by +19% (p<0.05) during Ex in controls, while it decreased by -31% (p<0.05) in LBBB-patients. **Conclusions:** During Ado induced hyperemia, almost homogenous MBF distribution was found in both groups. During Ex induced hyperemic MBF, however, there was a significant change in regional perfusion pattern in LBBB patients but not in controls. This results in an apparent relative septal underperfusion despite normal absolute flow values in LBBB.



1141-61 Verapamil Attenuates the Coronary Vasodilatory Response to Adenosine and A2A Adenosine Receptor Agonists

Laurent M. Riou, Mirta Ruiz, Jayson M. Rieger, Timothy L. Macdonald, Denny D. Watson, Joel Linden, George A. Beller, David K. Glover, University of Virginia, Charlottesville, Virginia.

Background: Verapamil is a widely used calcium channel inhibitor. We sought to determine its effect on the vasodilator properties of adenosine (Ado) and the A2A adenosine receptor agonist ATL-146e (ATL). **Methods:** in 4 anesthetized dogs, LAD coronary artery flow, arterial pressure (AP), heart rate and dP/dt were monitored. The hemodynamic responses to Ado (60 µg/kg) and ATL (1.0 µg/kg) were recorded in the absence and presence of varying doses of verapamil (0.002, 0.004, and 0.02 mg/kg/min). **Results:** Verapamil caused a dose-dependent decrease in AP, which fell from 124±10 to 99±9 mmHg at the highest dose tested (p<0.05), and no change in resting heart rate or dP/dt. As shown in the table, the increase in LAD flow following either Ado or ATL was progressively attenuated by increasing verapamil infusion rates. The mechanism for the observed attenuation in the coronary flow response is unknown, however reversal of the AP drop with calcium (3 mg/kg/min) did not improve the flow response to Ado or ATL (53±18% and 92±45%, respectively), indicating that the attenuation was not pressure dependent. **Conclusions:** Verapamil markedly attenuated the increase in coronary flow following Ado or an A2A Ado receptor agonist. The clinical implication is that submaximal stress may occur in patients on calcium channel antagonists that undergo pharmacologic stress perfusion imaging. Further studies are needed to elucidate the mechanism of this effect and its potential impact on clinical imaging following vasodilator stress.

Table 1: Percent Increase in LAD Flow with Vasodilator

Vasodilator	Verapamil Infusion Rate (mg/kg/min)			
	0 (Baseline)	0.002	0.004	0.02
ADO	214 ± 14 *	157 ± 16	123 ± 23	81 ± 19 †
ATL	341 ± 80 *	206 ± 65 †	187 ± 37	96 ± 11 †

* p < 0.05 vs Rest, † p < 0.05 vs Baseline