

POSTER SESSION

1037 New Technologies in Ultrasound

Sunday, March 07, 2004, Noon-2:00 p.m.
 Morial Convention Center, Hall G
 Presentation Hour: 1:00 p.m.-2:00 p.m.

1037-141 **Simplified Three-Dimensional Measurement of Left Ventricular Volume and Ejection Fraction Using Automated Contour Tracking Method in Patients**

Kenichi Sugioka, Takeshi Hozumi, Yasuhiko Takemoto, Hiroyuki Tsujino, Masahide Nishiura, Kotaro Arai, Yoshiaki Matsumura, Hiroyuki Yamagishi, Minoru Yoshiyama, Kazuhide Takeuchi, Junichi Yoshikawa, Osaka City University Medical School, Osaka, Japan

Background: Automated contour tracking (ACT) method allows automated detection of the left ventricular (LV) endocardial boundary of echocardiographic apical two-dimensional (2D) images. Application of ACT method to apical 4- and 2-chamber views and long-axis view provides simplified automated three-dimensional (3D) measurement of LV volumes and ejection fraction (EF). The purpose of this study was to evaluate the accuracy of this automated 3D measurement of LV volumes and EF with the ACT method in patients who underwent quantitative gated SPECT (QGS).

Methods: The study population was consisted of 37 consecutive patients who underwent QGS because of suspected ischemic heart disease (IHD). In every patient, apical 4- and 2-chamber views and long-axis view were obtained by 2D echocardiography. In each case, three sample points were placed on both sides of the mitral annulus and the LV apex, in the end-diastolic (ED) image of apical views. In the apical long-axis view, additional one point was placed on the basal septum in the ED image. The endocardial border was identified automatically, and extraction of the endocardial border of the LV cavity was completed in every frame throughout one cardiac cycle. ED and end-systolic (ES) 3D-LV volumes were calculated from these automated endocardial tracing. The automated 3D measurements of LV volumes and EF measurements were compared with those by QGS.

Results: In 30 patients of 37 patients (81%), adequate images were obtained for 3D-LV volumes and EF analyses. LV ED and ES volumes by the 3D-ACT method were correlated well with those by QGS ($y=0.82x+10.4$, $r=0.97$ and $y=0.84x+3.3$, $r=0.98$, respectively). The mean differences in LV ED and ES volumes between ACT and QGS were 6.4 ± 12.4 ml and 4.4 ± 9.1 ml, respectively (mean \pm SD). LVEF obtained by the ACT method was agreed well with that obtained by QGS ($y=0.89x+6.1$, $r=0.92$). The mean difference in EF was $-0.1\pm 6.0\%$.

Conclusion: The simplified automated 3D method with ACT provides accurate measurement of LV volumes and EF in patients with suspected IHD.

1037-142 **Post systolic Shortening Is Consistently Prevalent in Nonviable Myocardium in Patients With Acute Myocardial Infarction: Comparison With Contrast-Enhanced Magnetic Resonance Imaging**

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Background: The assessment of myocardial viability in patients after acute myocardial infarction (MI) is a major diagnostic challenge. Revascularization is likely to be more successful in those with viable (although functionally impaired) myocardium. However this is not easy to do non-invasively and currently magnetic resonance imaging (MRI) is the investigation of choice. Post systolic shortening (PSS) of Tissue Doppler echocardiography has been suggested as a useful marker of viable myocardium due to its reversibility after relief of acute and chronic ischaemia in both animal and clinical studies. Therefore, we wish to ascertain whether the degree of PSS correlates closely with the degree of hyperenhancement of corresponding segment in the gadolinium-based MRI.

Methods: Standard echocardiography with Tissue Doppler echocardiography was performed in 43 first MI (24 anterior/19 inferior) patients (age 59.5 ± 11.5 yrs) within 6 days of acute onset using apical 4- and 2-chamber views. Basal, mid and apical segments of septal, lateral, anterior and inferior walls were analyzed offline and their peak systolic velocities (Sm) were measured. PSS was identified as positive velocity signal after aortic valve closure. The results were correlated to the infarct size on MRI. **Results:** PSS presented in 96.8% of hyperenhancement segments even with transmural infarct, and in 12.8% of remote segments without infarction. Infarct size validated by MRI was with mean value of $18.3\pm 11.2\%$. Mean Sm (3.8 ± 0.7 cm/s) and PSS (1.8 ± 0.6 cm/s) of infarcted segments correlated significantly with infarct size ($r = -0.31$, $p = 0.048$ and $r = 0.41$, $p = 0.006$, respectively). Whereas, ratio of PSS/Sm of infarcted segments correlated more closely with infarct size than PSS or Sm did ($r = 0.62$, $p < 0.0001$). **Conclusions:** PSS exhibits in almost all infarcted segments. Infarct size can be determined by PSS/Sm. Thus, PSS/Sm may be used to predict viable myocardium for selecting patients with reversible LV dysfunction who will benefit most from myocardial revascularization.

1037-143 **Positive Isovolumic Relaxation Velocity Is a Strong Marker of Critical Stenosis in the Coronary Artery of the Normally Contracting Heart: Detection by a Simplified Tissue Doppler Mapping Technique**

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Background: Positive isovolumic relaxation velocity (V_{IR}) detected by tissue Doppler echocardiography has been shown to indicate severely ischemic myocardium. We tested whether critical coronary artery stenosis in patients with apparently normal LV contraction may be detected using this methodology by a simplified tissue Doppler velocity mapping technique without provocation.

Methods: 61 subjects (male: female=42:19, age 64.6 ± 9.9 years) with suspected angina pectoris who underwent diagnostic coronary arteriography (CAG) were enrolled. Pulsed tissue Doppler measurements were done at the annular and mid-LV levels (4 points) in each standard apical plane (long axis, 4 chamber and 2 chamber views) prior to CAG. Positive V_{IR} was defined as an upward spike during the isovolumic relaxation period. % diameter stenosis of more than 90% was defined as the critical stenosis by CAG.

Results: 51 patients (84%) had critical stenosis. Overall, the presence of positive V_{IR} predicted the critical stenosis with the sensitivity of 81% and the specificity of 58%. Positive predicted value was 89% and negative predicted value was 44%. Sensitivities for the left anterior descending coronary artery (LAD) stenosis, the circumflex coronary artery (LCX) stenosis, and the right coronary artery stenosis were 86%, 93% and 65%, respectively. None of the subjects who did not have critical stenosis demonstrated positive V_{IR} .

Conclusion: Positive V_{IR} appeared to be a marker of the critical stenosis in LAD and LCX with high sensitivity. This simple methodology may be used as an adjunct to predict the presence of high grade coronary artery stenosis among patients with normal LV contraction complaining chest pain prior to coronary arteriography.

1037-144 **Left Atrial Volume and the Risk of Paroxysmal Atrial Fibrillation in Patients With Hypertrophic Cardiomyopathy**

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Background: Paroxysmal atrial fibrillation (PAF) is a common complication of patients with hypertrophic cardiomyopathy, often leading to heart failure and cerebral infarction. Therefore, the early detection of patients with hypertrophic cardiomyopathy at risk for developing PAF may be useful in treatment strategies. Enlarged left atrium (LA) determined by M-mode left atrial dimension (LAD) is a risk factor for subsequent AF. Whether LA volume (LAV) can predict PAF development has not been established. The purpose of this study was to evaluate the relation between LAV and the occurrence of PAF in hypertrophic cardiomyopathy. **Methods:** We studied 141 patients with hypertrophic cardiomyopathy and sinus rhythm at the time of examination. Chronic AF, other arrhythmia and permanent pacemaker implantation were excluded. 31 pts had evidence of PAF (PAF group). Comprehensive transthoracic echocardiographic study was performed and all patients had normal left ventricular function. LAV was measured off-line using biplane area-length method. The maximum LAV indexed to body surface area (BSA) [LAV/BSA] was also assessed.

Results: Age and ejection fraction were not significantly different between PAF group and no PAF group. LAD, maximum LAV and LAV/BSA were significantly increased in PAF group compared to those in no PAF group (LAD; 4.09 ± 0.57 vs. 3.67 ± 0.60 cm, $p=0.0006$, maximum LAV; 73.0 ± 19.7 vs. 47.4 ± 14.8 ml, $p<0.0001$, LAV/BSA; 43.4 ± 12.0 vs. 29.4 ± 8.8 ml/m², $p<0.0001$). Among the echocardiographic variables, only maximum LAV and LAV/BSA were significantly associated with the occurrence of PAF. Cutoff value of 56.0ml for LAV and 34.0 ml/m² for LAV/BSA gave the best balance between sensitivity and specificity in differentiating the no PAF group and PAF group.

Conclusion: LA volume can be used as a useful marker for identifying patients with hypertrophic cardiomyopathy likely to develop PAF.

1037-145 **Ultrasound Myocardial Tissue Characterization Allows Early Detection of Cardiac Involvement in Patients With Sarcoidosis**

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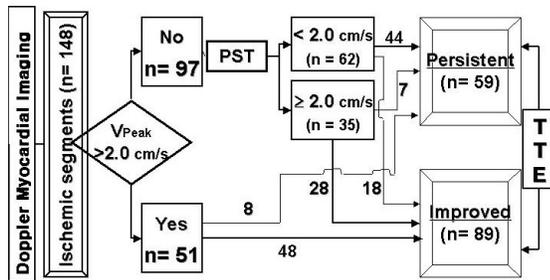
Backgrounds: Although cardiac involvement is an important prognostic factor in patients with sarcoidosis, early detection of cardiac sarcoidosis is difficult. Cyclic variation of myocardial integrated backscatter (CV-IB), which provides noninvasive measurement of acoustic properties of the myocardium, may detect early myocardial involvement even in patients without apparent abnormality by 2-dimensional echocardiography (2DE). The purpose of this study was to clarify the value of CV-IB analysis for early detection of myocardial involvement in patients with sarcoidosis. **Methods:** The study patients consisted of 22 consecutive biopsy-proven patients with systemic sarcoidosis who did not have any abnormal findings on conventional 2DE. Cardiac sarcoidosis was diagnosed by radiocesium testing including thallium-201 scintigraphy, gallium-67 scintigraphy and cardiac fluorine-18-deoxyglucose positron emission tomography. The magnitude and delay of the CV-IB (Sonos 5500 ultrasound system, Phillips Medical Systems) were analyzed in the basal septum, mid septum, basal posterior, and mid posterior wall of the left ventricle in all subjects. When cyclic variation showed asynchrony, we expressed its magnitude as negative values. **Results:** The patients were divided into 2 groups: 8 patients with cardiac involvement and 14 patients without cardiac involvement. In the basal septum of the left ventricle, marked reduction in the magnitude (1.8 ± 4.4 vs. 6.6 ± 1.3 , $P = 0.012$) and

increase in the time delay (1.3 ± 0.5 vs. 1.0 ± 0.1 , $P = 0.038$) of CV-IB were observed in patients with cardiac sarcoidosis. In examining the sensitivity of this test for detecting of cardiac involvement in patients with sarcoidosis, the magnitude of CV-IB in the basal septum was able to discriminate 75% of patients with cardiac involvement from patients without cardiac involvement, whereas 2DE parameters were not able to discriminate between these two groups. **Conclusion:** Decrease in CV-IB in the basal septum exists in patients with cardiac sarcoidosis even in the absence of 2DE abnormalities. Analysis of CV-IB may be a useful method to detect early myocardial involvement in patients with sarcoidosis.

1037-146 Velocity Data of Doppler Myocardial Imaging as a Predictor of Functional Recovery After Successful Revascularization

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Background: Doppler myocardial imaging (DMI) is useful to investigate regional myocardial function. However, it was not tested whether velocity data of DMI could predict functional recovery after revascularization. **Methods:** Fifty-two patients (41 males, 60 ± 9 yrs) with regional wall motion abnormality (RWMA) at left anterior descending artery (LAD) territory underwent rest DMI before revascularization and a repeat resting echocardiography ≥ 3 months later. Peak systolic velocity (Vpeak) and PST velocity (Vpst) were measured in anterior septum, apical inferior, and anterior wall. **Results:** Among 156 ischemic segments, velocity analysis was feasible in 148 segments (95%). Follow-up echocardiography at 3.5 ± 1.4 months revealed improved RWMA in 89 segments (Group A) and no changes in 59 (Group B). Group A showed significantly higher Vpeak and Vpst than Group B (2.19 ± 1.64 vs. 1.23 ± 0.96 cm/s; 1.57 ± 1.50 vs. 1.01 ± 0.76 cm/s, respectively). ROC curve of Vpeak showed the best cut-off value to predict myocardial functional recovery in 2.0 cm/s with sensitivity 48% and specificity 86%. Considering the negative correlation between the two ($r = -0.345$, $p = 0.002$), Vpst 2.0 cm/s was useful in patients with Vpeak < 2.0 cm/s. The algorithm using both Vpeak and Vpst could predict myocardial functional recovery with sensitivity 85% and specificity 75%. **Conclusion:** Velocity data of DMI at rest in ischemic myocardial segments are useful to predict functional recovery after successful revascularization.



1037-147 Validation Study of Strain Rate in Comparison to Tissue Velocity for Determining Endocardial, Epicardial and Global Left Ventricular Function: An In Vitro Study in Isolated Porcine Left Ventricles

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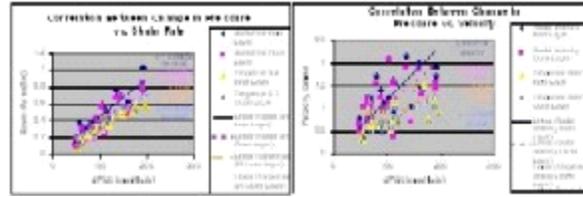
Background: This study aimed to validate the accuracy of tissue velocity and strain rate (SR) methods for determining endocardial and epicardial layer function in the left ventricle (LV) and to determine if regional myocardial deformation can be used to predict global LV function.

Methods: Three extracted hearts from pigs 26-32 kg were used. The LV was dissected out and a latex balloon was inserted into the LV via the aorta. The balloon was attached to a closed circuit pump for deflation (systolic) and inflation (diastolic) movement. Two pairs of calibrated sonomicrometers were placed radially and longitudinally in the scanned field. A GE/VingMed System FIVE with a 5 MHz probe was used to obtain 2D, SR, and tissue velocity images. Data for stroke volumes 20-35 cc and heart rates of 30-70 bpm were recorded.

Results: Peak SR showed a better correlation with peak dP/dt than peak tissue velocity. There was a significant difference of SR between inner and outer layer in radial (inner: 0.48 ± 0.22 s⁻¹; outer: 0.40 ± 0.23 s⁻¹, $p < 0.001$), but not in tangential directions. Doppler derived SR correlated well with the sonomicrometer derived SR for both radial and tangential directions (radial $r = 0.91$, tangential $r = 0.99x$).

Conclusion: SR correlated better with dP/dt than tissue velocity for assessing global LV function. Also, SR was more sensitive to the difference between endocardial and epicar-

dial layers in the radial view while tissue velocity was more sensitive to the difference between layers in the tangential view.



1037-148 Noninvasive Diagnosis of Acute Coronary Syndrome Among Patients With Chest Pain by Echocardiographic Detection of Postischemic Regional Left Ventricular Delayed Relaxation Using Color Kinesis

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Background: Differential diagnosis of acute coronary syndrome (ACS) from chest pain syndrome without coronary artery disease (CPS) is important for the management of ACS. Regional left ventricular (LV) diastolic dysfunction may persist without systolic dysfunction after an episode of transient severe myocardial ischemia in ACS. Color Kinesis (CK) is an echocardiographic technology that facilitates the evaluation of regional LV wall motion. **Methods:** Consecutive 57 patients (46 men, 11 women; mean age: 60 ± 14 (means \pm SD) years) with suspected ACS who had recent chest pain but no definitive ECG changes, apparent LV systolic dysfunction or other ischemic signs, were studied. The CK study was performed prior to coronary arteriography. The CK-diastolic index (CK-DI) determined as the calculated LV segmental filling fraction in the short-axis view during the first 30% of the diastolic filling time, was used to identify regional delayed diastolic LV endocardial outward motion. In the 40 normal subjects the CK-DIs were 75 ± 12 , 78 ± 14 , 73 ± 10 % in the territories of the left anterior descending branch (LAD), the left circumflex branch (LCX) and the right coronary artery (RCA), respectively. **Results:** After coronary arteriography, 33 patients were diagnosed as having unstable angina (UAP) (Braunwald IB: 5, IIB: 9 and IIIB: 19) and the other 24 as having CPS. Regional LV delayed relaxation (CK-DI $< 50\%$) had been detected using CK in the perfusion territories of the coronary arteries with culprit lesions in 31 (94%) of UAP, whereas it had been noted in 3 (12%) of CPS (sensitivity 94% and specificity 88%). In UAP the CK-DIs were 37 ± 13 (n=25), 46 ± 9 (n=9), 32 ± 9 (n=6) % in the culprit lesions of LAD, LCX and RCA, respectively, and 68 ± 8 (n=59) in the segments corresponding to the nonculprit lesions. The diastolic asynchrony disappeared in UAP 2 weeks after successful revascularization in 30 of 33 (91%), suggesting diastolic stunning. **Conclusion:** Postischemic regional LV delayed relaxation or diastolic asynchrony was frequently detected using CK in UAP. Analysis of CK images allows noninvasive identification of the coronary artery with culprit lesion by the detection of diastolic asynchrony, differentiating UAP from CPS.

POSTER SESSION

1038 Computed Tomography: Morphology, Function, and Perfusion

Sunday, March 07, 2004, Noon-2:00 p.m.
Morial Convention Center, Hall G
Presentation Hour: 1:00 p.m.-2:00 p.m.

1038-149 Diffuse Pulmonary Pathology of Rapidly Progressive Pulmonary Vein Stenosis by Computed Tomography

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Background: Intrinsic stenosis of the pulmonary veins (PVS) is a rapidly progressive disease associated with intraluminal proliferation of myofibroblasts in pulmonary veins and possibly within the wall of the left atrium. PVS can occur as a complicating feature of complex congenital heart disease (CHD) or in isolation. Recent experience suggests that there is associated intrinsic pulmonary pathology. We sought to explore the use of CT to characterize this disorder.

Methods: We retrospectively reviewed 9 CT exams in 5 patients with PVS (age 3-24 months, 3 with CHD) enrolled or considered for an experimental chemotherapy protocol. PV pathology, left atrial wall thickness and parenchymal lung findings were described and correlated with findings at cardiac catheterization (9) and biopsy (8). Each pulmonary vein was categorized as normal, stenotic with wall thickening, or totally occluded.

Results: Of 45 veins, 10 were scored as normal, 20 stenotic with wall thickening and 15 totally occluded and there was good correlation with angiography (10, 18, and 17 veins respectively). Left atrial wall thickening, detected in all 5 patients, measured 3.6-4.4 mm and fibroelastosis and myofibroblastic proliferation were present at path. Of 35 veins that were stenotic or occluded, diffuse ground glass opacity and interlobular septal thickening was detected in 27 and 26 corresponding lobes of lung. Exudates, septal fibrous thickening and lymphatic engorgement were present at path. Small subpleural blebs on CT in 2 patients correlated with interstitial emphysema at path. All patients had diffuse mediastinal induration, pleural thickening and abnormally arborizing peripheral vessels, which correlated with angiomatoid collateral vessel proliferation. Perihilar areas of marked inter-