cardiomyopathy on a GE/VingMed Vivid F/View® scanner. Hemodynamic conditions were altered by administration of either dobutamine and metoprolol or for a total of 29 steady hemodynamic states. Myocardial longitudinal peak SR during systole was measured off-line in the basal, mid and aneurysmal segments. Results: Peak systolic SRs in the basal segments (longitudinal shortening) were not different as expected (baseline -1.06 ± 0.31, range of all stages -0.44 to -3.90). These were significantly different from the aneurysmal segment results which were either near zero or positive (baseline 0.11 ± 0.11, range of all stages -0.03 to 1.6, p<0.001). Administration of both blood and dobutamine tended to increase and metoprolol decreased the negative (contraction) SR values in the basal segments but not in the aneurysmal segments. There was separability by SR between the basal and aneurysmal aneurysmal segments at all stages, defining an area with close correlation (r=0.93) to the size of the aneurysm measured post-mortem.

Conclusion: Myocardial strain and strain rate may present a new, noninvasive method for quantifying regional myocardial function. Like Doppler mitral inflow velocity, strain and strain rate show age-related changes. These normal values should assist in bringing strain and strain rate imaging into more widespread clinical use.

9:48 a.m.

1165MP-125 Strain Rate Imaging or Doppler Myocardial Imaging for the Detection of Regional Myocardial Ischemia During Stress Echocardiography: Which Method Is Superior?


Background: In the past, many attempts have been made to use Doppler myocardial imaging (DMI) to make the interpretation of stress echocardiograms less subjective, however, high interindividual differences in wall motion velocities as well as translation artefacts and particular velocity summation effects complicate the reading of such data. Strain Rate Imaging (SRI) is a new tissue Doppler based technique to identify regional myocardial dysfunction independent of translation and summation artefacts and therefore may be superior to DMI.

Methods: 13 patients with suspected coronary artery disease but normal regional myocardial function at rest underwent a standard dobutamine stress echo (DSE) examination. Tc-Sestamibi (MIBI) was administered simultaneously at peak stress for the quantification of the regional myocardial blood flow. Curved M-Mode (CMM) still images of tissue Doppler ultrasound derived longitudinal strain rate were used to display Wall Motion. Rate of change of longitudinal strain rate was calculated for each myocardial segment during the three phases of the R wave and averaged for each patient. SRI and CMM were compared side by side to identify differences in the wall motion evaluation. Result: SRI was significantly better able to distinguish between normal myocardial function and regions of myocardial ischemia as determined by MIBI analysis.

Conclusion: Because the CMM cannot distinguish between systolic vs diastolic wall motion, where systolic wall motion is affected by the rate of change of longitudinal strain rate, SRI is able to detect ischaemic changes in myocardial function in a far superior way than CMM. Additionally, SRI is able to distinguish between normokinesis, hypokinesis and akinesia.

9:00 a.m.

1165MP-126 Regional Myocardial Strain and Strain Rate Measurements by Tissue Doppler Echocardiography in 100 Normal Volunteers

Jing Ping Sun, Neil L. Greenberg, Craig H. Asher, Maria J. Garcia, William J. Stewart, James D. Thomas, The Cleveland Clinic Foundation, Cleveland, Ohio.

Background: Evaluation of regional myocardial function is an important goal in clinical cardiology. A new echocardiographic method of quantifying regional deformation has been introduced based on the principles of strain' and 'strain rate' imaging. This method has been validated in animal experiments and early clinical use. However, there are limited measurements in normal populations to use as data reference. Methods: In 100 (52 male, 42±15 years old) normal volunteers, strain and strain rate were measured by tissue Doppler image (GE/VingMed Vivid Five, Milwaukee, WI) on apical 4 and 2 chamber views. Each wall of the LV was divided into base, mid and apex and all measurements were averaged from three cardiac cycles. The study population was divided by age group (18-29 years, 22 persons; 30-39, 22; 40-49, 22, 50-59, 18; ≥60, 16). Results: Systolic strain and strain rate tended to decrease after age 50 years (p=0.08 and 0.03 respectively), with a more significant fall in diastolic E/A ratio of strain and strain rate after age 50 year (p<0.003). Ventricular septal wall data are shown in the figure.

Conclusions: Myocardial strain and strain rate may present a new, noninvasive method for quantifying regional myocardial function. Like Doppler mitral inflow velocity, strain and strain rate show age-related changes. These normal values should assist in bringing strain and strain rate imaging into more widespread clinical use.

10:00 a.m.

1165MP-127 Angle-Corrected Color Strain Imaging and Its Application to Quantitative Assessment of Regional Contraction

Satoshi Nakatani, Jinyong Kim, Akihisa Hanataru, Yoshio Yasumura, Masakazu Yamagishi, Masafumi Kitakaze, Kunio Miyatake, National Cardiovascular Center, Suita, Japan.

Background: Myocardial strain rate, defined as the spatial differential of local velocities, is determined by tissue Doppler imaging. Although strain rate can reflect regional wall function independent of translation, it is susceptible to noise and only motion parallel to the ultrasound beam can be determined. Integration of strain rate by time yields myocardial strain that is more robust to noise. Therefore, it is expected that application of strain and calculation of the velocity component toward a contraction center can solve the above problems. We thus developed a prototype 2-dimensional angle-corrected tissue strain imaging system capable of displaying color-coded strain (ApqiQ, Toshiba Corp, Japan) and quantitatively assessed wall motion by myocardial strain.

Methods: 16 patients with various cardiac diseases (14 men, mean age 49±14 years) were studied using tissue Doppler imaging. Parastereal long-axis view was obtained and septal 2 segments and posterior 2 segments were analyzed. To correct the Doppler incident angle, a contraction center was set at the apical 1/3 in the left ventricular cavity. Then, tissue velocity and myocardial strain rate toward the center were calculated. Angle-corrected myocardial strain was obtained by integrating strain rate using 2-dimensional tissue Doppler tracking technique, and color-coded strain imaging was displayed (red = lengthening, blue = shortening).

Results: Angle-corrected color strain imaging could show strain map on 2-dimensional image, which well reflected wall motion. 62 segments were quantitatively analyzable (28 normokinesis, 19 hypokinesis, 15 akinesia). Myocardial strain of normokinetic, hypokinetic and akinetic segments were significantly different each other (11±2% for normokinesis, 38±27% for hypokinesis, p<0.0001 vs. normokinesis, and -3±15% for akinesia, p<0.0001 vs. normokinesis and p<0.005 vs. hypokinesis).

Conclusion: The newly developed angle-corrected myocardial strain imaging could show the color map of regional strain. Myocardial strain determined by the present system was useful to assess wall function quantitatively.

10:24 a.m.

1165MP-128 Should Both Regional Deformation and Velocity of Deformation Be Measured to Characterize Changes in Myocardial Deformation Induced by Alterations in Inotropic States and Heart Rate?

Frank Verheugen, Fadi Jamal, Piet Claus, Miroslaw Kowalski, Liv Hatle, Ivan De Scheerder, Frank Rademakers, Bart Bijnens, George R. Sutherland, University Hospital Gutscheinberg - Cardiology Department, Leuven, Belgium.

Background: We sought to investigate in a closed-chest pig model how the two regional deformation parameters peak systolic strain rate (maximal velocity of deformation in systole) and systolic strain rate (magnitude of deformation in systole) are related to stroke volume and contractility in the presence of a wide range of heart rates (HR) and positive or negative sympathetic pharmacological stimulation. Methods: In 20 closed chest pigs regional radial deformation of the posterior wall was quantified using ultrasound derived peak systolic strain rate and systolic strain measurements. A Contractility index was measured as the ratio of end-systolic strain to end-systolic wall stress. HR and contractility were varied by atrial pacing (AP=100-800/min, n=7), incremental dobutamine infusion (D=5-20 mg/kg/min, n=7) or continuous esmolol infusion (0.5 mg/kg/min + subsequent pacing (100-180/min) (2 groups)). Results: Baseline peak systolic strain rate and systolic strain averaged 5.0±0.4 l/s and 60±4 %, Peak systolic strain rate and the contractility index increased linearly with D (20 mg/kg/min, strain rate=9.8±0.7 l/s, p<0.0001 vs baseline) and decreased with E (strain rate=3.4±0.1 l/s, p<0.01). During pacing, peak systolic strain rate and the contractility

10:12 a.m.