Cyclic Changes in Myocardial Stiffness Over the Cardiac Cycle as Measured Using a New Ultrasound Method, Vibro-Acoustography: Findings in Normal and Infarcted Myocardium

Cristina Piscator, Peter Anagnostopoulos, Randall R. Kinnick, James F. Greenleaf, Mayo Clinic and Foundation, Rochester, Minnesota.

Vibro-acoustography (VAE) can detect hard inclusions based on the detection of local differences in material stiffness [Science 1998;280: 3560-3563]. We tested whether VAE can measure changes in myocardial stiffness during the cardiac cycle. Moreover, transmural stiffness, as measured in myocardial slabs in vitro, is proportional to wall stress. Therefore, VAE may potentially provide an estimate of regional wall stress, an important determinant of local oxygen consumption. Methods: VAE signals were recorded from anterior myocardial wall in 6 pigs, at baseline, during LAD occlusion, and after reperfusion. Infarcted myocardium was identified by TTC staining. Results: In normal myocardium, VAE signals were synchronous with left ventricular pressure (LVP), confirming previous findings (fig. a). Peak VAE occurred approximately simultaneously with peak LVP. The cyclic variation (CV) of VAE was higher in basal than apical segments (fig b). During ischemia and reperfusion, various patterns were observed in the ischemic region, either as a blunted or reversed CV (fig c) or with a delayed peak (fig d). Border viable zones had reduced or normal CV, occasionally accompanied by an early diastolic peak (arrow in fig. e). Nonischemic myocardium post-reperfusion exhibited normal or increased CV (fig f). Conclusions: Changes in VAE signal are consistent with changes in myocardial stiffness and wall stress caused by ischemia/reperfusion. VAE may open new avenues in the assessment of myocardial status.

Tissue Displacement Imaging: Second-Generation Tissue Doppler With Angle Correction and Quantitative Color-Coded Wall Displacement for Assessment of Regional Ventricular Function

Elif Sade, Donald A. Severny, John Gorcsan, III, University of Pittsburgh, Pittsburgh, Pennsylvania.

BACKGROUND: Routine echo assessment of regional left ventricular (LV) function is subjective. METHODS: To test the hypothesis that a new tissue Doppler (TD) system can quantify regional function, 15 patients with wall motion abnormalities and 16 normal subjects were studied. Custom software (ApliQ, Toshiba, Corp) was used for Doppler angle correction toward the LV cavity center, and conversion of velocity data to color-coded displacement images. RESULTS: There were 307 normal, 136 hypokinetic, 43 akinetic, and 13 dyskinetic segments. TD transmural segmental displacement was: Parasternal views: normal 5.9±2.9 mm; hypokinetic 2.5±1.2 mm, akinetic 0.0±1.6 mm, and dyskinetic -1.5±1.7 mm. Apical views: normal 10.5±2.5 mm; hypokinetic 3.2±2.1 mm, akinetic 0.0±2.2 mm, and dyskinetic -0.8±1.1 mm. Adjustment of the transducer or further addition of ultrasound gel was not required in any subject. The short axis of the left ventricle (LV) in its short axis and attached to the chest wall. The transducer was interfaced with a lightweight (33lb) echocardiography system which was placed on a mobile cart. The short axis of the left ventricle was displayed on a monitor and recorded on videotape. The CONTISON transducer produced excellent images during ambulatory echocardiography using a novel ultrasound transducer developed in our laboratory (CONTISON). Ambulatory ECG has been used to detect silent myocardial ischemia. The purpose of this study was to assess the feasibility of ambulatory echocardiography using a novel ultrasound transducer developed in our laboratory (CONTISON). Ambulatory Echochardiography Using a Novel Ultrasound Transducer: Preliminary Observations

Pranidita A. Chandraebratna, Siddhar Vajpeyianen, Mahajabeen Basheer, Gobeyehu Nigusse, LAC/USC Medical Center, Los Angeles, California.

BACKGROUND: Ambulatory ECG has been used to detect silent myocardial ischemia. The purpose of this study was to assess the feasibility of ambulatory echocardiography using a novel ultrasound transducer developed in our laboratory (CONTISON). METHODS: Ten normal subjects were studied. The 2.5 MHz transducer is spherical in its distal part and mounted in an external housing to permit steering in 360 degrees. The external housing was attached to the chest wall using an adhesive patch. The transducer was placed in the 3rd or 4th intercostal space at the left sternal border to permit imaging of the left ventricle (LV) in its short axis and attached to the chest wall. The transducer was interfaced with a lightweight (33lb) echocardiography system which was placed on a mobile cart. To permit portability, the echocardiography system was powered by a capacitor (UPS device). The subjects were then asked to walk along the corridor while pushing the cart. The short axis of the left ventricle was displayed on a monitor and recorded on videotape.

RESULTS: Continuous imaging of the left ventricular short axis was possible in all subjects. Adjustment of the transducer or further addition of ultrasound gel was not required in any of the subjects. The image was preserved and all segments of the left ventricular short axis were visualized during walking. The subjects did not experience any local discomfort from the CONTISON transducer.

Conclusion: The CONTISON transducer produced excellent images during ambulatory echocardiography. This technique could potentially be used to evaluate patients with chest pain syndromes.