901-46 Principal Component Analysis of Repolarization: A Novel Index of Complexity of Ventricular Repolarization in the Long QT Syndrome

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It is well known that dishomogeneous repolarization is arrhythmogenic; however techniques to quantify complexity of repolarization are scanty. Principal components analysis is a method to assess the degree of correlation between a family of waveforms. When applied to T waves, it defines the components of repolarization. Usually, the first component accounts for most of repolarization, whereas a dishomogeneous repolarization is indicated by a relevant contribution of the second and other components. We applied principal component analysis to algorithmically defined JT intervals in 491 ECG recordings obtained during 12-leads Holter monitoring (Mortara Inst.), in controls (ctrls:n = 8) and in Long QT Syndrome pts (LQTS:n = 13). A mean of 24 ± 3 ECG traces taken hourly during monitoring were used for each subject. The second/first component ratio (complexity) was 17 ± 5% in ctrls and 41 ± 15% in LQTS ($p < 0.001$). Dynamic measurement of JT interval complexity showed that in LQTS the 24 hrs Standard Deviation of second component was much higher than in control individuals (3 vs 13%; $p < 0.001$). For LQTS, multiple regression analysis showed no correlation between complexity of T wave and QTc interval or QTc dispersion. These data show that principal component analysis identifies large differences between LQTS and ctrls. LQTS pts present a higher complexity of repolarization and a larger circadian variability. This new index of dishomogeneity of ventricular repolarization is observer-independent and provides novel information not redundant with QT and QT dispersion.

ECHOCARDIOGRAPHY — NEW INSTRUMENTATION

901-47 Dynamic 3-Dimensional Echocardiographic Reconstruction of the Left Ventricle Using Color Doppler Myocardial Tissue Imaging Technique. In Vivo Experimental and Clinical Study

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Color Doppler Tissue Imaging (DTI) of the left ventricle (LV) is a recently developed technique with lower attenuation from the chest wall. Transthoracic (TTE) three-dimensional echocardiography (3-DE) is a non invasive technique that quantitates volumetric and functional data of the LV cavity. The aim of our study was to apply the new color DTI technique to a 3-DE computerized reconstruction methodology in order to obtain dynamic 3-DE images of the LV and to calculate volumetric and functional data. Using a TTE approach, first we performed an "in vivo" experimental study in a open chest pig model (n = 8). Than we applied this same TTE methodology in a clinical setting, in 25 pts with a variety of cardiovascular pathologies. The 2-DE images were then transferred to a conventional computer with 3-DE capabilities and a dedicated software with a polyhedral surface algorithm. LV volumes were calculated at end systole (ESVol/ml), endiastole (EDVol/ml) as well as the derived stroke volume (StVol/ml) and ejection fraction (LV% EF/%). LV parameters were calculated using both conventional TTE 3-DE and color DTI 3-DE. Mean values of these parameters, intra- (ObVar/%) and inter-observer variability (IOb Var/%) were obtained and are showed in the following chart:

	ESVol	EDVol	StVol	LV%EF	IObVar	ObVar
TTE 3-DE	92 ± 21	188 ± 25	96 ± 16	51 ± 10	9 ± 6	8 ± 4
DTI 3-DE	95 ± 20	194 ± 23	99 ± 16	51 ± 10	6 ± 4	4 ± 3
% Var	3%	4%	3%	1%	–	–
p Value	ns	ns	ns	ns		

We conclude that three-dimensional echocardiographic reconstruction of the left ventricle can be performed using the new color Doppler tissue imaging technique of the myocardial wall. The color Doppler three-dimensional reconstruction technique is done with a lower intra- and inter-observer variability for both ventricular volumetric and functional data.

901-48 Assessment of Transmural Velocity Gradients in Hypertrophic Hearts-A New Diagnostic Index for Hypetrophic Cardiomyopathy

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The aim of the study was to use Doppler myocardial imaging for the assessment of intramural function to subdivide patients with different aetiologies of left ventricular (LV) hypertrophy. Thus, we studied 19 subjects with hypertrophic cardiomyopathy (HCM), 21 with LV hypertrophy due to hypertension (HTN) and 25 age matched (mean 51 ± 11 years) normal subjects (N). The velocity gradient (VG) across the LV posterior wall was measured during the following sequential phases of the cardiac cycle: ventricular ejection (VE), isovolumic relaxation (IR), rapid ventricular filling (RVF) and atrial contraction (AC). *Results:* are expressed as mean ± SD ($cm/s^{-1}/cm^{-1}$).

	VE	IR	RVF	AC
HCM	$-1.9 \pm 1.5^{*\dagger}$	$-1.1 \pm 0.7^{\ddagger}$	$1.5 \pm 0.9^{*\dagger}$	$2.0 \pm 0.9^{\ddagger\S}$
HTN	4.5 ± 2.0	$-1.0 \pm 0.5^{\ddagger}$	3.8 ± 1.8	3.1 ± 1.4
N	5.0 ± 2.3	−0.5 ± 0.4	4.1 ± 1.6	2.8 ± 1.4

$^{*}p < 0.001$ vs. N; $^{\dagger}p < 0.001$ vs. HTN; $^{\ddagger}p < 0.05$ vs. N; $^{\S}p < 0.05$ vs. HTN.

In HCM hearts, during VE, RVF and AC, the VG was significantly lower then in HTN patients and N. During these phases despite the presence of hypertrophied myocardium in the HTN group there was no difference in VG when compared to the non-hypertrophied myocardium in N. *Conclusions:* These findings suggest that VG measurement should prove to be a useful new diagnostic index which consistently identifies HCM patients within the spectrum of hypertrophied myocardium.

901-49 Harmonic Imaging and Single Frame "Triggered Mode" Data Acquisition Enhance Delineation of Myocardial Perfusion Defects by Volume-Rendered 3-Dimensional Echocardiography

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Voxel-based 3-D echocardiography (3DE) can aid in accurate measurement of myocardial (contrast) perfusion defects. Ultrasound energy may reduce the "lifespan" of microbubbles attenuating the 3DE contrast defect. Triggered mode (TR) is a new way of image acquisition in which ultrasound energy is emitted and received for a single frame at specified time-point in the cardiac cycle. We examined whether TR enhances 3DE depiction of perfusion defects with both conventional (C) and harmonic (H) imaging. After coronary occlusion in 11 dogs, contrast 3DE was performed using both intravenous (IV) and aortic injections (AO) of 3 agents (FS069, Levovist and EchoGen). 3DE data was acquired (rotational method) using a H imaging scanner with a 2.5/5 MHz emit/receive transducer (Hewlett-Packard), designed to function in TR. Reconstructed 3D images were analyzed in 10 paraplane slices in each dog. *Results:* after 3DE with C imaging, AO but not IV defects could be visualized. Using H imaging both IV and AO defects were clearly visible but their borders could not be demarcated. The addition of TR (end-diastolic frame) to H imaging further enhanced delineation of defects permitting quantitation of the hypoperfused myocardial mass (range: 11.4 to 21 gms). From the IV approach 9/11 defects were accurately delineated using TR compared with 2/11 with non-TR ($p < 0.005$, Fishers exact). Further, the transmural extent of contrast defects could be seen. We conclude that TR is ideally suited to contrast 3DE by IV injections and, with harmonic imaging, enhances accurate depiction of contrast defects.

ECHOCARDIOGRAPHY — TRANSESOPHAGEAL IMAGING/DOPPLER

901-50 Mitral Regurgitant Jet Impingement Promotes the Reduction of Systolic Pulmonary Venous Flow: Computer Simulations

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Recent studies have demonstrated that pulmonary venous (PV) flow is only partially dependent on the degree of mitral regurgitation (MR). The role of local factors and in particular, perivenous jet impingement is not well know. Fluid dynamics informs us that as a jet impinges on a wall, its momentum is recovered as pressure. However it is unknown how close the jet must impinge

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