Impaired Left Ventricular Systolic Torsion in Dilated Cardiomyopathy Characterized With Magnetic Resonance Tagging Method

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Background: Left ventricular (LV) torsion is a crucial component for effective LV squeeze- ing. However, the time course of torsion dynamics in dilated cardiomyopathy (DCM) remains unclear. Our objective was to characterize systolic torsion in DCM using myocardial magnetic resonance (MR) tagging method.

Methods: Twenty-six subjects were studied: 17 patients with DCM (ejection fraction [EF] 27 ± 9%) and 9 controls. MR tagged images were acquired at three levels (base, mid, and apex). Intersecting tag points on myocardium were tracked during systole, thereby determining serial angular displacements of each level relative to the short axis centroid (positive degrees indicated a clockwise rotation as viewed from the apex). LV torsion was defined as net angular difference between the basal and apical levels. Time to peak LV torsion was expressed with % systole obtained by dividing the time from end-diastole by a total systolic time.

Results: Peak rotational angle in DCM was impaired at both levels of the base (0.2 ± 3.3 vs. 2.7 ± 2.0 degrees, p < 0.05 vs. control) and apex (-5.0 ± 5.0 vs. -10.1 ± 3.3 degrees, p < 0.01 vs. control). LV torsion then peaked earlier and less in DCM than in controls (86 ± 22 vs. 104 ± 16% systole; 5.8 ± 3.6 vs. 13.7 ± 2.7 degrees, both p < 0.001), and correlated with LVEF (r = 0.78, p < 0.01).

Conclusion: In DCM, peak LV systolic torsion was also impaired, being proportional to global LV function. This is likely due to insufficient wringing behavior from the apical and basal opposing rotations.

Clinical and Magnetic Resonance Imaging Characteristics of Pathologically Confirmed Left Ventricular Thrombus in Patients With Cardiomyopathy

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Background: Development of left ventricular (LV) thrombus is a serious complication for patients with structural and functional heart disease. Determination of clinical and imaging characteristics of patients with heart disease who develop LV thrombi may provide important prognostic and therapeutic information. We sought to identify clinical and imaging parameters which may correlate with development of LV thrombus in patients with heart disease.

Method: Patients who underwent LV reconstruction with direct visualization of the LV cavity or had pathologic evidence of presence or absence of LV thrombus (autopsy or explanted heart) were included. Demographics and clinical history were obtained from the patient's electronic medical record. Preoperative cardiac magnetic resonance imaging studies were reviewed for LV size, function, and development of LV aneurysm.

Results: Population consisted of 136 patients (mean age 62.2; male 76 %) with heart disease (131 with ischemic heart disease and 4 with dilated cardiomyopathy). 47 (35%) had thrombus detected at surgery or by pathology. See table below for a summary of the clinical and imaging data. 2 patients had acute embolic events in the thrombus group. Also of note, coumadin and aspirin use was not different between groups.

Conclusion: Pathologically proven LV thrombus was found in approximately one third of the patients. Patients with LV thrombus had lower LV function while demonstrating a trend toward greater LV volumes and aneurysm development.

Clinical or Image characteristic

<table>
<thead>
<tr>
<th>No Thrombus (n=88)</th>
<th>Thrombus (n=47)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>24%</td>
<td>26%</td>
</tr>
<tr>
<td>Age</td>
<td>60.7 ± 9.4</td>
<td>62.4 ± 8.5</td>
</tr>
<tr>
<td>Aneurysm presence</td>
<td>60%</td>
<td>68%</td>
</tr>
<tr>
<td>End diastolic volume</td>
<td>287 ± 71</td>
<td>311 ± 111</td>
</tr>
<tr>
<td>End systolic volume</td>
<td>218 ± 68</td>
<td>260 ± 89</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>26.8 ± 8.6 %</td>
<td>22.7 ± 6.7%</td>
</tr>
<tr>
<td>Coumadin use</td>
<td>28%</td>
<td>29%</td>
</tr>
<tr>
<td>Aspirin use</td>
<td>64%</td>
<td>59%</td>
</tr>
<tr>
<td>History of stroke or peripheral embolic event</td>
<td>10%</td>
<td>9%</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>11%</td>
<td>9%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>61%</td>
<td>56%</td>
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<tr>
<td>Diabetes Mellitus</td>
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<td>31%</td>
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<tr>
<td>Hyperlipidemia</td>
<td>69%</td>
<td>60%</td>
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<tr>
<td>Tobacco use history</td>
<td>46%</td>
<td>64%</td>
</tr>
</tbody>
</table>

The Utility of High Frequency QRS Electrocardiogram in the Diagnosis of Cardiomyopathy

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Background: High frequency (HF) QRS ECG (150-250 Hz) over entire QRS interval is known to be more sensitive than standard conventional ECG for detecting myocardial ischemia. However, the use of HF QRS ECG in patients with left ventricular mechanical dysfunction has been less extensively studied. Methods: We obtained 12-lead HF QRS ECGs in 29 patients with cardiomyopathy (EF < 40%) by echocardiography, mean ± SD 23.1 ± 6.6% and in 29 age- and gender-matched healthy controls using PC-based ECG.
software recently developed at NASA that is able to perform HF QRS analysis in real time on a beat-to-beat basis. Results: The mean number of HF QRS leads (out of 12) considered for reduced amplitude zones (RAZs) was 4.2. The median extent of moderate-severely-worst wall-motion abnormality was 2.6 ± 2.4 in the cardiomyopathy patients versus 2.6 ± 2.4 in the healthy controls (P < 0.001). In addition, an HF QRS ECG scoring system that takes into consideration both the total number of RAZs and the clustering of RAZs together in adjacent leads was 93.1% sensitive and 89.7% specific for identifying cardiomyopathy. The total amplitude of the HF QRS com-
plexes, as measured by summation root mean square voltages (RMSvS), also differed between the individuals with versus without cardiomyopathy (35.9 ± 12.1 vs. 43.8 ± 15.8 microvolts respectively, P < 0.02), although RMSvS was less effective in distinguishing the two groups than were RAZ scores because of large inter-subject variability in RMSvS. In the cardiomyopathy group, neither RAZ scores nor RMSvS directly correlated with echocardiographic EF. Conclusion. 12-lead HF QRS ECG employing RAZ analysis is a simple, sensitive and inexpensive screening technique for cardiomyopathy. It can be per-
formed at the same time on a beat-to-beat basis as conventional 12-lead ECG, using the exact same equipment. Although HF QRS ECG is highly sensitive for cardiomyopathy, its specificity may be com-
promised in patients with cardiac pathologies other than cardiomyopathy, such as uncomplicated coronary artery disease. Further studies are required to determine the usefulness of HF QRS for monitoring cardiomyopathy in a longitudinal fashion.

**T126-T17**

Whole-Body Electrical Bioimpendance Is Accurate in Noninvasive Determination of Cardiac Output: A Thermodilution Controlled, Prospective, Double-Blind Evaluation

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**Background:** The NICaSTM is a novel non-invasive apparatus based on whole body electrical bioimpedance for simple non-invasive continuous CO determination.

**Patients and Methods:** Patients were recruited while randomized in a study evaluating the efficacy of Tezosentan (a ETA/B endothelin antagonist) in patients admitted due to acute heart failure (CHF). Patients were randomized after having been hospitalized due to acute heart failure with dyspnea at rest. CI < 2.5 L/min/m² and PCWP > 20 mmHg. Study Protocol: At baseline and during treatment with study drug at the pre-specified time points of 0.5, 1.25, 3.4, and 6 hours from randomization CO was determined by both thermodilution and the NICaSTM2001 apparatus. At each time point CO was determined by thermodilution and NICaSTM2001 apparatus by a two independent, blinded operators.

**Results:** Out of 130 patients enrolled, in 93 CO was measured simultaneously by both methods. The average CI of the two thermodilution methods was 4.08 L/min/m². Precision and bias were 0.01 ± 0.6 L/min. There was a difference between the two methods in cardiac output readings. When Mean CI (of both methods) was < 2 L/min/m² CO readings were statistically significantly lower by NICaS while when CI was >3 L/min/m² CO readings were statistically significantly higher by NICaS. We have calculated the cardiac power index (Cpi=CI* mean arterial pressure), and found that low Cpi (indicating reduced myocardial contractile reserve) was related to higher recur-
rent CHF. However, Cpi based on NICaS CI measurement (NICaS Cpi) was a better pre-
dictor of recurrent CHF then thermodilution Cpi (Th Cpi), due to less accurate prediction in patients with high Cpi.

**Conclusions:** NICaS is a novel accurate non-invasive method for CO determination. The results of the present study suggest that NICaS is probably at least as accurate as thermodilution for CO determination.

**T126-T18**

Limitations of Exercise Cardiopulmonary Testing to Predict Heart Failure Prognosis in the Beta Blocker Era

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**Background:** Studies from the pre-beta blocker era indicated that exercise cardiopulmonary tests (CPX) predict prognosis in chronic systolic heart failure (HF). However, recent studies have questioned the usefulness of these data for predicting prognosis in patients treated with beta blockers.

**Methods:** We performed CPX in 209 consecutive patients in 1996 with mild – moderate HF (mean EF 35%) between 19 ± 12 months for major clinical events (13 cardiac deaths and 15 urgent transplantsations) and assessed the prognostic impact of standard CPX data in 64 patients treated with beta blockers (event rate 12.5%) and in 145 patients not receiving beta blockers (event rate 13.8%).

**Results:** Both groups were similar for peak VO2, and peak VO2 corrected for lean body weight. Peak VO2 on patients on beta blockers had higher CI (10.9 ± 3.9 vs 10.4 ± 3.4 mL/kg/beat; p=0.04) and O2 pulse lean (16.4 ± 6.0 vs 14.4 ± 6.2 mL/beat; p=0.02) which may be important since O2 pulse lean was the strongest independent predictor of event-free survival (chi-square 12.4; p=0.001). Standard CPX data predicted prognosis considerably better in patients not taking beta blockers compared with those on beta blockers (table).

**Conclusion:** Standard CPX data need further refinement for providing risk stratification for HF in the beta-blocker era.

**T127-103**

Diastolic Dysfunction in Children and Young Adults With Marfan Syndrome

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**Background:** Recent evidence suggests that adults with Marfan syndrome (MFS) have diastolic dysfunction due to abnormal elastic recoil of the fibrillin-containing myocardial intesntium. We sought to assess diastolic function in a large group of children and young adults with MFS in order to determine whether diastolic dysfunction is present in all patients or it is an age-related phenomenon. We also sought to assess the relationship between LV ejection fraction and the diastolic performance. **Methods:** Echocar-
diographic review of all 20 patients with MFS diagnosed in accordance with the revised Gent criteria was performed. The last echocardiogram performed prior to initiation of car-
diac medical therapy was analyzed. Patients with more than trivial mitral or aortic regurgi-
tation, or with prior cardiovascular surgical intervention were excluded from the study. Echocardiograms on a group of 40 age-matched normal controls with no family history of MFS were used for comparison. The correlation between % predicted left ventricular end-diastolic diameter (LVEDd) % predicted aortic root size, and diastolic parameters [mitral valve (MV) inflow: MV E/A, MV deceleration time (DT), and isovolumic relaxation time (IVRT)] were determined.

**Results:** There was no difference in age (yr) (17.4 ± 11.7 vs 13.9 ± 9.0, p = 0.14), sex (male 60% vs 50%, p = 0.38) or body surface area (1.47 ± 0.38 vs 1.33 ± 0.39, p = 0.09) between MFS patients and controls. Patients with MFS had sig-
ificantly impaired diastolic performance with both impaired relaxation and increased wall stiffness as evidenced by prolonged DT (175 ± 69.2 ms vs 142 ± 27.5 ms, p = 0.007) and IVRT (72 ± 23 ms vs 54 ± 11 ms, p = 0.0003). MV E/A (18 ± 23 ml vs MV A (45 ± 10 ms), and MV E/A (1.8 ± 0.6 ms) in MFS patients were within normal limits. There was no relation-
ship between % predicted left ventricular end-diastolic size (% LVEDd) and diastolic performance (for MV E/A, r = 0.26 and 0.03; for IVRT, r = 0.13 and 0.17; and for DT, r = 0.09 and 0.06). **Conclu-
sion:** Diastolic dysfunction is aclinical feature of MFS even in a younger cohort of patients. Impairment of diastolic function may be secondary to abnormal myocardial elas-
tic recoil or altered loading conditions in the face of increased aortic wall stiffness.

**T127-104**

Evaluation of Electrocardiography, Signal Averaged Electrocardiography, Exercise Tolerance Testing, Echocardiography and Magnetic Resonance Imaging in Diagnosis of Arrhythmogenic Right Ventricular Dysplasia

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**Background:** Electrocardiography (ECG), signal averaged ECG (SAECG), exercise toler-
ance testing (ETT) Holter monitoring (Hol) and magnetic resonance imaging (MRI) are commonly employed in the evaluation of patients suspected of having ARVD. Each of these is widely available with the exception of MRI. We sought to determine if MRI pro-
vided incremental information to that obtained with the more widely available tests.

**Methods:** We evaluated 58 (26 male) patients referred for evaluation of possible ARVD. Each patient underwent ECG, SAECG, ETT, Hol and MRI. Each test was rated as posi-
tive or negative for ARVD. The diagnosis of ARVD was established by International Task Force Criteria. The sensitivity (Se) and specificity (Sp) for each test was calculated. Receiver operating curve (ROC) analysis was used to evaluate the combination of ECG, SAECG, Hol and ETT and their combination with MRI.

**Results:** The ECG (Se=66% Sp=78%) showed maximum utility in diagnosis of ARVD as compared to SAECG (Se=22% Sp=94%), ETT (Se=22% Sp=88%), Hol (Se=67%