MYOCARDIAL VELOCITY IMAGING (DMI) – OTHER

161 Exercise tissue Doppler echocardiography with strain rate imaging in healthy young individuals: Feasibility, normal values and reproducibility
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1University of Jena, Jena, Germany; 2University of Mannheim, Mannheim, Germany; 3University Children’s Hospital Heidelberg, Heidelberg, Germany; 4University Children’s Hospital, Freiburg, Germany

Background: Purpose of this study was to determine the clinical feasibility and reproducibility of Tissue Doppler echocardiography with strain rate imaging (TDE/SRI) at rest and under physical exercise in healthy young individuals.

Material and methods: Forty-five healthy young persons (age 9-29 years) underwent echocardiography with TDE/SRI at rest and during bicycle exercise test (2 W/kg body weight for 5 minutes). Systolic (Vs) and early diastolic (Ve) velocities, systolic strain rate (SRs) and strain (S) were calculated as peak values in each segment of 2- and 4-chamber views (LV longitudinal) and of parasternal long- and short axis views (LV radial). Longitudinal function of right ventricular wall (RV longitudinal) was determined on 4-chamber views. Because no base-to-apex gradient was present, mean values for longitudinal strain and strain rate were computed for LV and RV, while systolic and early diastolic velocities were given for each ventricle as peak values from basal segments.

Results: Results are displayed in Table 1. Variability of observations is shown in Table 2.

Conclusions: 1. Tissue Doppler with strain rate imaging is a practical and robust method for assessment of regional longitudinal function of both ventricles and of local radial LV function at rest and under exercise. 2. Local myocardial relaxation (Ve) and contractility (SRs) increased significantly under physical exercise. These normal values obtained from healthy young subjects can serve as a reference database for further clinical studies.

Table 1

<table>
<thead>
<tr>
<th>LV radial</th>
<th>LV radial</th>
<th>LV longitudinal</th>
<th>LV longitudinal</th>
<th>RV longitudinal</th>
<th>RV longitudinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>rest</td>
<td>exercise</td>
<td>rest</td>
<td>exercise</td>
<td>rest</td>
<td>exercise</td>
</tr>
<tr>
<td>Strain (%)</td>
<td>26±14</td>
<td>31±13</td>
<td>23±7</td>
<td>24±9</td>
<td>31±14</td>
</tr>
<tr>
<td>SRs [s⁻¹]</td>
<td>2.36±1.1</td>
<td>4.02±3.98</td>
<td>2.13±0.97</td>
<td>2.92±1.09*</td>
<td>2.11±0.95</td>
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<tr>
<td>Vs [mm/s]</td>
<td>61±23</td>
<td>72±21</td>
<td>63±36</td>
<td>78±36</td>
<td>92±59</td>
</tr>
<tr>
<td>Ve [mm/s]</td>
<td>-61±27</td>
<td>-90±31*</td>
<td>-100±46</td>
<td>-129±42*</td>
<td>-94±47</td>
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</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>LV radial</th>
<th>LV radial</th>
<th>LV longitudinal</th>
<th>LV longitudinal</th>
<th>RV longitudinal</th>
<th>RV longitudinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>rest</td>
<td>exercise</td>
<td>rest</td>
<td>exercise</td>
<td>rest</td>
<td>exercise</td>
</tr>
<tr>
<td>Strain (%)</td>
<td>5±3</td>
<td>5±5</td>
<td>5±3</td>
<td>5±3</td>
<td>4±3</td>
</tr>
<tr>
<td>SRs [s⁻¹]</td>
<td>0.31±0.11</td>
<td>0.4±0.12</td>
<td>-0.21±0.11</td>
<td>-0.28±0.12</td>
<td>-0.31±0.12</td>
</tr>
<tr>
<td>Vs [mm/s]</td>
<td>10±8</td>
<td>14±10</td>
<td>9±8</td>
<td>9±7</td>
<td>10±8</td>
</tr>
<tr>
<td>Ve [mm/s]</td>
<td>10±8</td>
<td>16±10</td>
<td>8±6</td>
<td>9±6</td>
<td>10±8</td>
</tr>
</tbody>
</table>

*P < 0.05 vs rest

162 Strain echocardiography in the assessment of left ventricular function is not affected by age or sex in healthy subjects
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Background: One-dimensional strain echocardiography (deformation) is a new ultrasound based technique in the assessment of cardiac function. It has been proposed to be less influenced by myocardial traction and tethering, translational artefacts, and less preload dependent compared to tissue Doppler imaging. The aim of the present study was to evaluate how cardiac systolic strain was affected by age and sex in healthy subjects.

Methods: Fifty healthy subjects (mean age 63±12 years, 25 females) were investigated. The subjects were divided in two age-groups: Group 1 (42-58 years, n=20, 12 females) and group 2 (62-87 years, n=30, 12 females). Peak systolic longitudinal strain was measured at the basal levels of the left ventricular (LV) lateral, septal, anterior and inferior walls. Furthermore, right ventricular (RV) free wall strain was measured. Mean frame rate was 103±19 fps.

Results: Strain values ranged between -16 to -22±8±13% in the four segments of the LV, and -28±11% in the RV free wall. No difference in strain was found at any of the measured segments between group 1 and 2, nor did gender affect the strain values in a significant way in any segment. Systolic strain was measurable in 88% to 96% in the five different segments.

Conclusion: We show that ventricular strain at the basal levels of the LV and RV is independent of both age and sex, within an important clinical age span of 42-87 years, in healthy subjects. The results indicate that strain echocardiography is a feasible method to study cardiac function.

MYOCARDIAL VELOCITY IMAGING (DMI) – LV FUNCTION

163 Women have a higher regional systolic shortening than men: a strain rate imaging study in healthy subjects
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1University Hospital Gasthuisberg, Cardiology Dept., Leuven, Belgium

Background: Myocardial Velocity Imaging (MVI) allows the accurate measurement of regional longitudinal velocities, strain rate and strain. Normal values have been established by several groups, however no significant gender differences could be demonstrated for the measurement of strain rate and strain. The aim of this study was to evaluate gender differences in regional systolic velocities, strain rate and strain in a larger sample size than previously reported.

Methods: Colour Doppler Imaging data (GE, System 7) was acquired (> 140 fps) for the analysis of regional myocardial myocardial deformation. MVI parameters were analysed in 1305 segments from 95 male and 679 segments from 54 female hearts (age 17-79 y) using dedicated software (SPEQLE, Leuven, Belgium). The subjects were volunteers free of any known cardiovascular disease based on a thorough history, physical examination and a normal electrocardiogram. Peak systolic velocity, strain rate and strain were averaged over all segments per patient. LV size, volume, stroke volume, ejection fraction and cardiac output were calculated with standard grey scale M-mode echocardiography. An unpaired t-test was used to evaluate statistical significance (p < 0.05).

Results: As expected, male subjects were taller and heavier, had a higher end-diastolic LV size and volume, stroke volume and cardiac output. When corrected for body surface area (BSA), all these differences disappeared. Female subjects had a higher heart rate (shorter R-R interval) but a longer
ejection time. Ejection fraction was similar in both groups. Myocardial velocities (4.3±1.1 vs 4.07±1.19 cm/s) and strain rate (-1.58±0.28 vs -1.57±0.28 1/s) did not differ between male and female subjects, despite a difference in cardiac size. However peak-systolic strain was higher in women (-22.1±2.4 vs -21.0±2.6%, p=0.023). When corrected for BSA this difference increased.

Conclusions: This study in healthy subjects showed that women have a higher regional longitudinal peak-systolic strain than men while longitudinal myocardial velocities and strain rate are identical.

164

Influence of ageing and gender on the ratio of early diastolic mitral inflow velocity to early diastolic annular velocity in normal population derived from quantitative 2-D colour tissue Doppler

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1South Manchester University Hospital, North West Regional Cardiology Centre, Manchester, United Kingdom

Purpose: The ratio of early diastolic mitral inflow velocity (E) to early diastolic tissue Doppler (TDI) annular velocity (E'), or E/E', is an index of diastolic function. Pulsed wave (PW) TDI measures peak E' and normal range for E/E' has been reported. Colour TDI measures mean E' with different normal range for E/E'. The aim of this study was to obtain normal range for colour TDI derived E/E'.

Methods: Seventy-four healthy controls (age range 24 to 86 years) underwent 2-D colour TDI. E' was measured at septal and lateral sites in apical 4-chamber view and E/E' was then calculated.

Results: Controls were classified into 5 age groups: <50, 50 to 59, 60 to 69, 70 to 79 years, and ≥80 years. Septal and lateral annular E' (mean standard deviation) were respectively (cm/s): 7.15±1.61, 5.85±0.65, 5.01±1.04, 4.40±0.75, 4.14±1.12 and lateral annular E' 9.84±2.15, 7.04±1.02, 6.62±1.80, 5.64±1.08, 4.59±1.15. Septal E/E' were 11.57±2.72, 12.77±2.53, 13.81±3.05, 15.25±2.42, 17.34±7.46 and lateral E/E' were 8.32±1.72, 10.68±2.34, 13.48±4.91, 15.49±5.55, 15.43±6.61. Mean values for septal and lateral E/E', subdivided according to gender are shown in figure1. Median septal E/E' was lower than lateral E/E' (p<0.001). Consequently, median septal E/E' was higher than median lateral E/E' for both septal and lateral E/E'.

Conclusion: Colour TDI derived E/E' is higher than published normal ranges obtained by PW TDI. It increases with age, and is higher in women. This should be taken into account while assessing diastolic function of heart.

165

Determinants of subclinical left ventricular dysfunction in premenopausal obese women

W. Kosmala1; R. Plaksej2; J. Kuliczkowska-Plaksej3; M. Przewlocka-Kosmala1; G. Bednarek-Tupikowska1; W. Michalek1
1Medical University, Cardiology Dept., Wroclaw, Poland

Several lines of evidence suggest that obesity may lead to left ventricular (LV) dysfunction. However, the exact pathomechanism and the influence of potential contributors remain still elusive.

Aim: To investigate LV function in premenopausal obese women with and without insulin resistance (IR) and to establish determinants of potential alterations in LV performance.

Methods: Women aged 28.2±4.7 with >30 kg/m² and without other comorbidities underwent echocardiographic LV strain/strain rate study as well as assessment of metabolic, inflammatory and biochemical markers including serum glucose, insulin, hs-CRP, lipoproteins, urinary albumin excretion (UAE). This population was divided into two groups -with and without IR estimated by the homeostasis model assessment.

Results: We found out significantly lower longitudinal systolic strain, peak systolic strain rate (SRs) and peak early diastolic strain rate (SRe) in IR women as compared with those without IR indicating both systolic and diastolic LV dysfunction. SRs was independently predicted by fasting insulin (beta=-0.30, p<0.003), UAE (beta=-0.38, p<0.0001), hs-CRP (beta=-0.26, p<0.006) and apolipoprotein B/apolipoprotein A1 (beta=-0.18, p<0.04), whereas SRe by fasting insulin (beta=-0.24, p<0.01), UAE (beta=-0.41, p<0.0001), apolipoprotein A1 (beta=0.31, p<0.001) and hs-CRP (beta=0.22, p<0.02).

Conclusions: LV dysfunction in premenopausal obese women is determined by the presence of IR and subclinical inflammation. Independent predictors of abnormalities of LV performance are fasting insulin, UAE, hs-CRP, apolipoprotein A1 and apolipoprotein B/apolipoprotein A1.

FUNCTION – OTHER

166

Longitudinal diastolic myocardial functions are affected by obesity in young people: a study of color tissue doppler imaging

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19 Mayis University, Cardiology Dept., Samsun, Turkey

Aim: Obesity is associated with increased cardiovascular morbidity and mortality. In this study, we compared left ventricular diastolic functions in young obese adults (body mass index=BMI ≥30 kg/m²) with those in young non-obese adults (BMI<30 kg/m²) by color tissue doppler parameters.

Material and methods: There were 18 adults with BMI 730 kg/m² (mean age 29.4±4 years) and 18 adults with BMI<30 kg/m² (mean age 28.2±2 years). All cases were between 20 and 35 years old. Mean BMI was 38.8±4.6 kg/m² in the obese group whereas that was 24.3±4 kg/m² in the non-obese group. For color 2-dimensional tissue Doppler imaging, sample volumes were placed on the mid left ventricle in the inner half of the myocardium at the septum, lateral, inferior, and anterior walls. The peak early diastolic strain rate (E-SR), peak late diastolic SR (A-SR), peak early diastolic tissue velocity (E-TV) and peak late diastolic TV (A-TV) values were measured. In addition, E-SR/A-SR and E-TV/A-TV ratios were calculated.

Results: E-SR, A-TV, E-SR/A-SR and E-TV/A-TV values were significantly different between the groups (Table 1). Although there was a trend towards higher A-SR and lower E-TVs in the obese adults, they were not reaching the statistical significance (Table 1).

Conclusion: Obesity in young people causes significant alterations at left ventricular longitudinal diastolic myocardial function parameters evaluated by color tissue doppler imaging. These results may indicate early changes in cardiac structure and function in young obese adults.

Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Obese Adults (n=18)</th>
<th>Non-obese Adults (n=18)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-SR (1/sec)</td>
<td>2.1±0.7</td>
<td>2.6±0.6</td>
<td>0.05</td>
</tr>
<tr>
<td>A-SR (1/sec)</td>
<td>1.3±0.3</td>
<td>1.1±0.3</td>
<td>NS</td>
</tr>
<tr>
<td>E-TV (cm/sec)</td>
<td>7.9±2.0</td>
<td>9.3±1.5</td>
<td>NS</td>
</tr>
<tr>
<td>A-TV (cm/sec)</td>
<td>4.8±1.6</td>
<td>3.3±1.3</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>E-SR/A-SR</td>
<td>1.5±0.5</td>
<td>2.5±0.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>E-TV/A-TV</td>
<td>1.8±0.6</td>
<td>3.2±1.4</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

NS=not significant
Influence of aging and gender on the ratio of early diastolic mitral inflow velocity to early diastolic annular velocity in normal population derived from quantitative 2-D colour tissue Doppler

W. Khan1; A. Borg1; S. Deepak1; D. Fox2; S.G. Williams1; N.H. Brooks3; S.G. Ray4

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Conclusion: Colour TDI derived E/E' is higher than published normal ranges obtained by PW TDI. It increases with age, and is higher in women. This should be taken into account while assessing diastolic function of heart.

Determinants of subclinical left ventricular dysfunction in premenopausal obese women

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Aim: To investigate LV function in premenopausal obese women with and without insulin resistance (IR) and to establish determinants of potential alterations in LV performance.

Methods: Women aged 28±2.4 with >30 kg/m2 and without other comorbidities underwent echocardiographic LV strain/strain rate study as well as assessment of metabolic, inflammatory and biochemical markers including serum glucose, insulin, hs-CRP, lipoproteins, urinary albumin excretion (UAE). IR was determined by fasting insulin (beta =-0.30, p<0.003), UAE (beta =-0.36, p<0.0001), hs-CRP (beta =-0.26, p<0.006) and apolipoprotein B/apolipoprotein A1 (beta =-0.18, p<0.04), whereas SRe by fasting insulin (beta =-0.24, p<0.01), UAE (beta =-0.41, p<0.0001), apolipoprotein A1 (beta =0.31, p<0.001) and hs-CRP (beta =-0.22, p<0.02).

Conclusions: LV dysfunction in premenopausal obese women is determined by the presence of IR and subclinical inflammation. Independent predictors of abnormalities of LV performance are fasting insulin, UAE, hs-CRP, apolipoprotein A1 and apolipoprotein B/apolipoprotein A1.