Exercise Testing and Electrocardiographic Changes over Time in Patients with Arrhythmogenic Right Ventricular Cardiomyopathy

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Background: Arrhythmogenic right ventricular cardiomyopathy (ARVC) is an important cause of sudden death in otherwise healthy young individuals. Exercise testing (ET) is a part of the diagnosis in ARVC for its ability to unmask ventricular arrhythmia. However, the utility of the ET in the follow-up remains to be established. The aim of this study was to examine ET and electrocardiographic changes over time in patients with ARVC.

Materials and methods: Thirty eight patients with ARVC according to Task Force criteria (22 male; age 42±14 years) were investigated. A possible pathogenic desmosomal mutation was present in 24 individuals (63%). Patients who had a follow-up visit within 5 to 15 years after the first examination and at least two or more electrocardiograms (ECG), signal averaged electrocardiograms (SAECG) and ET (available individuals: 33, 18 resp 23) were included for analysis.

Results: Peak exercise capacity at baseline was 190±66 W (104±26 percent of predicted, adjusted for age, weight and gender). After a mean follow-up of 10.7 years work capacity had decreased to 151±61 W (91±23 %), p=0.008. Some ventricular ectopic activity was seen during ET in 14 patients (61%). T-wave inversion worsened in precordial leads on the ECG in 10 patients (p=0.23). Late potentials (≥1 pathologic parameter) in the SAECG were at baseline present in 9 patients (50%) and in 14 patients (74%) after a mean follow-up of 10.5 years (p=0.03).

Conclusion: Maximum work capacity in patients with ARVC decreases over time even when adjusted for the normal deterioration with age and regardless of treatment with β-blockers. A possible reason maybe the recommendation against intensive exercise. In addition, patients fear dangerous arrhythmia which may prompt them to choose a more sedentary lifestyle. Ventricular ectopic activity during ET is highly variable which prevents its use as a predictive parameter.
Table 1. Changes over time in exercise testing. Follow-up 5-15 years (mean 10.7 years) after the first examination. Changes over time analyzed using the non-parametric Wilcoxon Matched-pair Signed-ranks test (2 samples).

<table>
<thead>
<tr>
<th>(n=23)</th>
<th>Baseline</th>
<th>Follow-up after 5-15 years (mean 10.7 years)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>40 ± 11 (range 21-60)</td>
<td>50 ± 12 (range 32-69)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>13 (57%)</td>
<td>13 (57%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>10 (43%)</td>
<td>10 (43%)</td>
<td></td>
</tr>
<tr>
<td>Antiarrhythmic therapy</td>
<td>10 (43%)</td>
<td>19 (83%)</td>
<td></td>
</tr>
</tbody>
</table>

Mean±SD | Mean±SD |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Systolic BP at rest (mmHg)</td>
<td>124 ± 14</td>
</tr>
<tr>
<td>Diastolic BP at rest (mmHg)</td>
<td>78 ± 10</td>
</tr>
<tr>
<td>Maximum systolic BP during exercise testing (mmHg)</td>
<td>182 ± 25</td>
</tr>
<tr>
<td>Number of VPCs/minute before exercise testing*</td>
<td>0 (0-7)</td>
</tr>
<tr>
<td>Number of VPCs/minute during exercise testing*</td>
<td>0 (0-30)</td>
</tr>
<tr>
<td>Number of VPCs/minute during post exercise recovery*</td>
<td>3 (0-38)</td>
</tr>
<tr>
<td>Type of VPCs:¥</td>
<td></td>
</tr>
<tr>
<td>- No VPCs or isolated VPCs</td>
<td>12 (52%)</td>
</tr>
<tr>
<td>- VPCs in trigemini</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>- VPCs in bigemini</td>
<td>3 (13%)</td>
</tr>
<tr>
<td>- VPCs in pairs/couples</td>
<td>5 (22%)</td>
</tr>
<tr>
<td>- VT</td>
<td>3 (13%)</td>
</tr>
<tr>
<td>Maximum workload (W)*</td>
<td>190 ± 66</td>
</tr>
<tr>
<td>% of predicted maximum work load*</td>
<td>104 ± 26</td>
</tr>
<tr>
<td>% of predicted maximum heart rate*</td>
<td>89 ± 13</td>
</tr>
</tbody>
</table>

Antiarrhythmic therapy = amiodarone and/or β-blockers and/or sotalol, * = expressed in median (range), ¥ = expressed as number of patients (%), BP = blood pressure, VPCs = ventricular premature complexes, measured as absolute number of VPCs per minute at the minute with most VPCs, Type of VPCs is observed during exercise testing or during post-exercise recovery, VT = ventricular tachycardia (≥ 3 consecutive VPCs), * = changes over time analyzed using the student’s t-test for paired observations, predicted maximum work load adjusted for age, gender and weight and compared to reference values, Nordenfelt et al. (45). Predicted maximum heart rate calculated using the formula: Maximum heart rate = 220-age.