Congenital and Exercise

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Physical activity in adolescents and adults with congenital heart defects; individualized exercise prescription†

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Background

- The number of adults is expected to grow at a rate of 5% per/year
- Until recently we told congenital patients that they cant exercise
- only a minority of CHD patients (19%) receives formal physical activity advice
- Children with CHD are more likely to be overweight because of physical inactivity compared with children without CHD
- On the other end of the spectrum, young patients may reject exercise limitations and engage in unsafe sporting practices
physical activity

recreational sports

competitive sports

elite

ESC guidelines

ESC guidelines

"our recommendations"
Algorithm for evaluating Congenital HD patients

- **Step 1:** History and physical examination
- **Step 2:** Assessment of five baseline parameters
- **Step 3:** Recommendation: type of exercise
- **Step 4:** CPET
- **Step 5:** Recommendation: relative intensity
- **Step 6:** Follow-up
<table>
<thead>
<tr>
<th>1. Ventricles</th>
<th>No systolic dysfunction</th>
<th>No systolic dysfunction</th>
<th>Mild systolic dysfunction</th>
<th>Moderate systolic dysfunction</th>
<th>Severe systolic dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No hypertrophy</td>
<td>Mild hypertrophy</td>
<td>Single ventricle physiology</td>
<td>Moderate hypertrophy</td>
<td>Severe hypertrophy</td>
</tr>
<tr>
<td></td>
<td>No pressure load</td>
<td>Mild pressure load</td>
<td>Systemic right ventricle</td>
<td>Moderate pressure load</td>
<td>Severe pressure load</td>
</tr>
<tr>
<td></td>
<td>No volume load</td>
<td>Mild volume load</td>
<td></td>
<td></td>
<td>Moderate/severe volume load</td>
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</tbody>
</table>

| 2. Pulmonary artery pressure | Low pulmonary artery pressure | Low pulmonary artery pressure | Mildly elevated pulmonary artery pressure | Moderately/severely elevated pulmonary artery pressure |

| 3. Aorta                    | No/mild dilatation        | Moderate dilatation       | Severe dilatation           | Dilatation approaching indication for repair |

| 4. Arrhythmia               | No arrhythmia             | No arrhythmia             | Mild arrhythmic burden      | Significant arrhythmic burden |
|                            |                          |                          | Non-malignant arrhythmia    | Malignant arrhythmia         |

| 5. Saturation at rest/during exercise | No central cyanosis | No central cyanosis | No central cyanosis | Central cyanosis |

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**Flowchart**

- **A** When all applicable
- **B** When at least one applicable
- **C** When at least one applicable
- **D** When at least one applicable
- **E** When at least one applicable

**Static component of sport**
- Up to high static
- Up to moderate static
- Low static

**Relative intensity of sport**
- **HIGH INTENSITY**
  - RPE Borg scale: 15-17
  - Training HR: 75%-90% of achieved MHR during CPET
- **MODERATE INTENSITY**
  - RPE Borg scale: 13-14
  - Training HR: 60%-75% of achieved MHR during CPET
- **LOW INTENSITY**
  - RPE Borg scale: 11-12
  - Training HR: <60% of achieved MHR during CPET

Solid lines indicate recommendation; if option for sports with high static component, reduce intensity (dotted lines).
**Variable definitions**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td><strong>Ventricles</strong></td>
<td></td>
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</tbody>
</table>
| Ventricular dysfunction   | No: EF $\geq 55\%$
Mild: $45\% \leq EF < 55\%$ (or normal systemic right ventricle)
Moderate: $30 \leq EF < 45\%$
Severe: EF $< 30\%$ (or impaired systemic right ventricle) |
| Ventricular hypertrophy   | Left ventricle:
No: septal/posterior wall thickness (cm): $\sigma^* < 1.1 \quad & < 1.0; LV mass (g): \sigma^* 88-224 \quad & \sigma^* 67-162$
Mild: septal/posterior wall thickness (cm): $\sigma^* 1.1-1.3 \quad & 1.0-1.2; LV mass (g): \sigma^* 225-258 \quad & 163-186$
Moderate: septal/posterior wall thickness (cm): $\sigma^* 1.4-1.6 \quad & 1.3-1.5; LV mass (g): \sigma^* 259-292 \quad & 187-210$
Severe: septal/posterior wall thickness (cm): $\sigma^* \geq 1.7 \quad & \sigma^* \geq 1.6; LV mass (g): \sigma^* \geq 293 \quad & \sigma^* \geq 211$
Right ventricle: qualitative echocardiographic evaluation |
| **Ventricular pressure overload** | No significant LVOT or RVOT gradient (peak systolic flow $< 2.6$ m/s), no obstruction in great vessels
2.6 m/s $\leq$ peak systolic velocity $< 3$ m/s for LVOT and RVOT obstructions and PPS; for coarctation of the aorta, arm-leg gradient $< 20$ mmHg
Mild pressure overload
3 m/s $\leq$ peak systolic velocity $\leq 4$ m/s for LVOT and RVOT obstructions and PPS
Moderate overload
Severe pressure overload
Peak systolic velocity $> 4$ m/s for LVOT and RVOT obstructions and PPS; for coarctation of the aorta, clinical gradient $\geq 20$ mmHg |
### Variable definitions

#### Ventricular volume overload
- **No volume overload**
  - Absent/mild valve regurgitation or shunt that do not cause significant chamber dilatation (parasternal views—long axis: LVEDD: 55–63 mm; LVESD 35–42 mm; RVEDD: 30–36 mm)

- **Mild volume overload**
  - Mild: dilated right or left ventricle by severe regurgitation, however with preserved systolic function

- **Moderate/severe volume overload**
  - Significant right or left ventricular dilatation with impaired ventricular function

#### Ventricle physiology
- **Single ventricle or double ventricle**
- **Systemic left ventricle or systemic right ventricle**

#### Pulmonary artery pressure
- **Low PAP**
  - No PH: TVRV $\leq$ 2.8 m/s, systolic PAP $\leq$ 36 mmHg, and/or no additional echocardiographic variables suggestive of PH

- **Mildly elevated PAP**
  - Possible PH: TVRV $>$ 2.8 m/s, systolic PAP $>$ 36 mmHg, and no signs of right ventricular systolic dysfunction

- **Moderately/severely elevated PAP**
  - High probability of PH: TVRV $>$ 2.8 m/s, systolic PAP $>$ 36 mmHg, and signs of right ventricular dysfunction

#### Aorta
- **No/mild dilatation**
  - Normal (≤30 mm) or borderline sizes (<35 mm) of the aorta

- **Moderate dilatation**
  - Aorta size $\geq$ 35 and <45 mm

- **Severe dilatation**
  - Aorta size $\geq$ 45 and <50 mm

- **Dilatation approaching indication for repair**
  - Aorta size $\geq$ 50 mm

#### Arrhythmia
- **No arrhythmias**
  - Absence of infrequent arrhythmias (<500/24 h) PVC if a Holter was done

- **Mild arrhythmic burden/non-malignant arrhythmias**
  - Frequent/coupled PVC and controlled atrial fibrillation/atrial flutter, which do not worsen with exercise

- **Significant arrhythmic burden/potentially malignant arrhythmias**
  - Atrial fibrillation/atrial flutter, which worsen with exercise

- **Non-sustained ventricular arrhythmias or sustained ventricular tachycardia**

#### Saturation at rest/during exercise
- **No central cyanosis**
  - Absence of clinical signs; transcutaneous saturations within the range of 96–100%, at rest and during exercise