REVIEW

Cardiological contraindications in sports

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Abstract

Sudden death in sports is caused in most cases by heart disease. The aim of pre-participation screening is to identify individuals who require specific treatment to continue the sport or who should cease the practice of sport. Current scientific evidence is based on expert recommendations that in some cases are controversial and impractical. This review aims to give an updated approach and pragmatic recommendations in athletes with heart disease.

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PALABRAS CLAVE

Cribado pre-participativo; Recomendaciones; Muerte súbita cardíaca

Contraindicaciones cardiológicas para la práctica deportiva

Resumen

La muerte súbita en el deporte está causada en la mayoría de ocasiones por enfermedades cardíacas. El objetivo del cribado pre-participativo es poder identificar a los individuos que requieran un tratamiento específico para continuar el deporte o el cese de la práctica deportiva. La evidencia científica actual se basa en recomendaciones de expertos que en algunos casos son controversiadas y en ocasiones poco prácticas. Esta revisión tiene como objetivo dar un enfoque actualizado y pragmático de las recomendaciones en los deportistas con cardiopatía.

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Introduction

The cardiovascular benefits of moderate exercise are well established. However, exercise can occasionally cause sudden cardiac death in athletes with heart disease. In this context, sport disqualification of affected individuals has proven to be a useful strategy in the only study with this objective.

The recent update of the Bethesda conference provides recommendations C-level (expert opinion) for competitive athletes, but in some points differs from the European cardiomyopathies and valvular recommendations, arrhythmias and channelopathies, and congenital heart disease. The group of sports cardiology at the European Society of Cardiology included recommendations for non-competitive athletes, i.e.: those who practice recreational sport and physical activity in general, recommendations that had not been previously incorporated; also, in this publication a change of practical value is added at the time of giving a medical recommendation for conducting sports, changing the dynamic component of classification Mitchell (Table 1) by the percentage of heart rate (HR) maximum obtained in a stress test analysis of respiratory gases; or the equivalent in the Borg scale of perceived exertion (Table 2).

Definitions

The type of physical activity is of particular importance to the recommendation in the intensity of exercise. Here are some definitions to distinguish amongst different types of physical activity in which there is international consensus.

Physical activity

Any bodily movement produced by muscles contraction that increases the metabolic rate above resting level. Moderate activity is defined as an activity between 3-6 METs and vigorous when it is >6 METs.

Regular exercise

It is physical activity planned, structured and repetitive; which is performed for more than 30 min at least 3 days a week for the last 3 months with a moderate intensity; and it aims to maintain or improve physical fitness.

Recreational sport

Physical activities without the need to compete or that have not a greater intensity than desired by the partici-

Table 1 Classification of Mitchell for sports

<table>
<thead>
<tr>
<th>III. Static high</th>
<th>Martial arts&lt;br&gt;a</th>
<th>Bodybuilding&lt;br&gt;a,b</th>
<th>Boxing&lt;br&gt;a</th>
<th>Climbing&lt;br&gt;a,b</th>
<th>Alpine skiing&lt;br&gt;a,b</th>
<th>Cycling&lt;br&gt;a,b</th>
<th>Artistic gymnastics&lt;br&gt;a,b</th>
<th>Snowboarding&lt;br&gt;a,b</th>
<th>Speed-skating&lt;br&gt;a,b</th>
<th>Archery&lt;br&gt;a,b</th>
<th>Rowing&lt;br&gt;a,b</th>
<th>Sky jump&lt;br&gt;a,b</th>
<th>Triathlon&lt;br&gt;a,b</th>
<th>Caving&lt;br&gt;a,b</th>
<th>Waterpolo&lt;br&gt;a,b</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Static moderate</td>
<td>Motorsports&lt;br&gt;a,b</td>
<td>Athletics-speed&lt;br&gt;a,b</td>
<td>Running (middle distance)&lt;br&gt;a,b</td>
<td>Diving&lt;br&gt;a,b</td>
<td>Field events (jumping)&lt;br&gt;a,b</td>
<td>Basketball&lt;br&gt;a</td>
<td>Riding&lt;br&gt;a,b</td>
<td>Fencing&lt;br&gt;a,b</td>
<td>Handball&lt;br&gt;a</td>
<td>Ice hockey&lt;br&gt;a</td>
<td>Hockey skates&lt;br&gt;a</td>
<td>Motorcycling&lt;br&gt;a,b</td>
<td>Football&lt;br&gt;a</td>
<td>Swimming&lt;br&gt;a</td>
<td>Modern pentathlon&lt;br&gt;a,b</td>
</tr>
<tr>
<td>I. Static low</td>
<td>Billiards&lt;br&gt;a,b</td>
<td>Baseball&lt;br&gt;a</td>
<td>Running (long distance)&lt;br&gt;a</td>
<td>Bowling&lt;br&gt;a,b</td>
<td>Softball&lt;br&gt;a</td>
<td>Badminton&lt;br&gt;a,b</td>
<td>Golf&lt;br&gt;a,b</td>
<td>Ball&lt;br&gt;a</td>
<td>Cross country skiing&lt;br&gt;a,b</td>
<td>Bobsleigh&lt;br&gt;a,b</td>
<td>Pitch and putt&lt;br&gt;a,b</td>
<td>Double tennis&lt;br&gt;a,b</td>
<td>Football&lt;br&gt;a</td>
<td>Hockeys&lt;br&gt;a</td>
<td>Orienteering&lt;br&gt;a,b</td>
</tr>
<tr>
<td>Yoga&lt;br&gt;a</td>
<td>Olympic shot&lt;br&gt;a</td>
<td>Table tennis&lt;br&gt;a,b</td>
<td>Golf&lt;br&gt;a,b</td>
<td>Yoga&lt;br&gt;a</td>
<td>Volleyball&lt;br&gt;a</td>
<td>Hockey&lt;br&gt;a</td>
<td>Olympic shot&lt;br&gt;a</td>
<td>Hunting&lt;br&gt;a</td>
<td>Hockey&lt;br&gt;a</td>
<td>Orienteering&lt;br&gt;a,b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Dynamic low</td>
<td>A. Dynamic low&lt;br&gt;</td>
<td>B. Dynamic moderate&lt;br&gt;a,b</td>
<td>C. Dynamic high&lt;br&gt;a,b</td>
<td>B. Dynamic moderate&lt;br&gt;a,b</td>
<td>C. Dynamic high&lt;br&gt;a,b</td>
<td></td>
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</table>

*The dynamic component is calculated at the estimated maximum rate of oxygen consumption (VO₂ max; A: <50%; B: 50-75%; C: >75%); and the static component is related to the estimated percentage of maximum voluntary contraction reached (MVC; I: <10%; II: 10-30%; III: >30%).

a Contact sports with risk of body collision.

b Sports life-threatening if syncope.
Cardiological contraindications in sports

The activity or sport can be organized or informal, and can be spontaneous or structured for competition among participants or teams. However, any participant may stop participating or may decrease the intensity of his participation at any time, without pressure to continue.8

Competitive sport

Organized sport, competitive, and in which physical activities are governed by rules to keep a clean game. There is pressure to train or play at a high intensity regardless of whether that intensity is required or recommended for the participant. The source of that pressure may be the athlete himself, teammates, coaches or spectators.8

Elite

Competitive athlete training over 6 hours a week who regularly competes at regional, national or international level.12

Recommendations

The objective of this review is to summarize the main anomalies and heart disease that can be found in athletes and aims to give a recommendation and general pattern of steps to follow in the case of recommendation of the cardiological aptitude for sports taking the main groups of heart disease, i.e.: cardiomyopathies (table 3), valvular heart and aorta (table 4), arrhythmias and channelopathies (table 5), and congenital heart disease (table 6). For each of the alterations a recommended intensity is given depending on the type of recreational or competitive sport exercise. In order to simplify this indication a red color was granted when competitive sport is contraindicated and recreational sport is permitted if a low static component (Mitchell I) and is carried out at a lower intensity than 60% maximum heart rate or less than 5 Borg Scale; a yellow color is granted only when the competitive sport is allowed in sports classification of Mitchell IA (i.e.: golf, bowling) and recreational sport is permitted if it is a low-moderate static component (Mitchell I and II) and carried out at a lower intensity than 75% maximum heart rate or less than 6 Borg Scale. However, it is noteworthy that the decision should always be individualized and customized according to the severity of the disease, comorbidities of the subject, mode and sport that is practiced and, importantly, personal environment of the subject.

Play again

Table 7 shows the recommendations on the procedure to return to competitive sport (“play again”) after the differ-
### Table 4  Recommendations and aortic valve disease

| Aortic valve disease                                      | Yellow (Y)                                                                 | Red (R)                                                                 
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Aortic stenosis or pulmonary</td>
<td>Mild-moderate: maximum flow velocity 2.6-4.0 m/s</td>
<td>Moderate-severe: maximum flow rate &gt;4.0 m/s. Assess surgery</td>
</tr>
<tr>
<td>Mitral stenosis</td>
<td>Mitral area 1.0-1.5 cm² and maximum effort PSAP &lt; 50 mmHg</td>
<td>Mitral valve area &lt; 1.0 cm² or PSAP maximum effort &gt;50 mmHg. Rate surgery</td>
</tr>
<tr>
<td>Aortic or mitral insufficiency</td>
<td>Moderate-severe failure, LVDD &lt; 63 mm and LVEF &gt; 55%</td>
<td>Moderate-severe failure, LVDD &gt; 63 mm or LVEF &lt; 55% Assess surgery</td>
</tr>
<tr>
<td>Bicuspid aortic valve. Normo-functioning: all sports</td>
<td>Mild-moderate regurgitation or stenosis</td>
<td>Moderate-severe regurgitation or stenosis. Assess surgery</td>
</tr>
<tr>
<td>Mitral valve prolapse &lt;br&gt; Dilated aortic root &lt;br&gt; Aortic coarctation</td>
<td>If you have any risk criterion&lt;sup&gt;a&lt;/sup&gt; 40-45 mm or Z-score &gt; 3 or arm-leg gradient &gt; 20 mmHg, or hypertension effort</td>
<td>&gt; 45 mm</td>
</tr>
</tbody>
</table>

LVDD: left ventricle diastolic diameter; LVEF: left ventricle ejection fraction; PSAP: systolic pulmonary artery systolic pressure.

Yellow (Y): IA Mitchell competitive sport; recreational sport: low-moderate static component and intensity <75% FC maximum or < 6 Borg Scale.

Red (R): competitive sport is contraindicated; recreational sport: under static component and intensity <60% FC maximum or < 5 Borg Scale.

<sup>a</sup> Criteria mitral valve prolapse risk syncope, ventricular arrhythmia, family history of sudden death, severe mitral regurgitation.

### Table 5  Recommendations arrhythmias and channelopathies

| Arrhythmias and channelopathies                          | Yellow (Y)                                                                 | Red (R)                                                                 
<table>
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<tr>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Atrial fibrillation, atrial flutter. Yes anticoagulation, no collision sports. Ventricular arrhythmia</td>
<td>HR controlled effort and without structural pathology &lt;br&gt; VE &gt; 2000/24 hours and does not increase with the effort</td>
<td>HR uncontrolled effort or structural heart disease &lt;br&gt; No VT or sustained increase in effort &lt;br&gt; VE &lt;br&gt; HR &lt; 30 bpm or pauses &gt; 3 seconds or block that are not normalized with the effort</td>
</tr>
<tr>
<td>Sinus bradycardia, 2nd degree AV block Mobitz I (Wenckebach)</td>
<td>Asymptomatic&lt;sup&gt;a&lt;/sup&gt;, without heart disease and normalizes blocking the effort</td>
<td>Symptoms&lt;sup&gt;a&lt;/sup&gt;, or underlying heart disease</td>
</tr>
<tr>
<td>2nd degree AV block Mobitz type II or 3rd degree</td>
<td>Recreation: radiofrequency ablation: suggested</td>
<td>Competitive: radiofrequency ablation: indicated</td>
</tr>
<tr>
<td>Pre-excitation syndrome or paroxysmal supraventricular tachycardia</td>
<td>Only in sports without the risk of collision</td>
<td></td>
</tr>
<tr>
<td>ICD</td>
<td>Asymptomatic&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Symptoms&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Brugada syndrome</td>
<td>Asymptomatic&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Symptoms&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Long QT syndrome or short</td>
<td>Asymptomatic&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Symptoms&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Catecholaminergic ventricular tachycardia</td>
<td>Asymptomatic&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Symptoms&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

AV: atrioventricular; HR: heart rate; ICD: implantable cardioverter defibrillators; VE: ventricular extrasystoles; VT: ventricular tachycardia.

Yellow (Y): IA Mitchell competitive sport; recreational sport: low-moderate static component and intensity <75% FC maximum or < 6 Borg Scale.

Red (R): competitive sport is contraindicated; recreational sport: under static component and intensity <60% FC maximum or <5 Borg Scale.

<sup>a</sup> Symptoms: pre-syncope, syncope, resuscitated sudden death, malignant ventricular arrhythmia in Holter 24 hours or stress test.
ent cardiological therapeutic interventions that have been made. It is recommended, if the procedure has no complications, to start training progressively and scheduled in the days before competition.

Conflict of interests

Authors declare that they do not have any conflict of interests.
References


