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Pre-Participation Screening, is it Worth it?: Europe vs. North America

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INCIDENCE & AETIOLOGY OF SCD

At times, however, the global debate has stalled because of a continuing disagreement on the incidence of SCD in young athletes

Drezner et al. BJSM 2009;43: 62-626
1/3 are associated with fibrosis

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Incidence of SCD in the USA

Chugh S et al. J Am Coll Cardiol. 2004;44:1268-75
Data from the U.S.A.

The study population was identified by targeted searches that used a variety of sources at the time each of these strategies became available during the duration of the study: (1) LexisNexis archival informational database with searchable access to authoritative news, business, legal, and public records (n=5 billion searchable documents available from thousands of sources), 2003 to 2006 (457 cases); (2) news media accounts systematically assembled through Burrelle’s Information Services (Livingston, NJ), with access to 18 000 US newspapers and international media sources daily, 1990 to 2006 (847 cases); (3) Internet searches, with access to online information via World Wide Web–based search engines (eg, 80 athletes who act on the controversy. assembled athletes who

Eighty-five athletes who survived cardiac arrest by virtue of defibrillation and/or cardiopulmonary resuscitation are considered to have experienced sudden death for the purpose of the present study. The cases occurred in various locations, including 75 at football games, 15 at basketball games, and 5 at baseball games. The average age of the athletes was 26 years; 29% were African American, and 15% were female. The causes of death included cardiac arrest (80 athletes), asthma (7 athletes), and drug abuse (5 athletes).

Chapel Hill), 1985 to 2006 (187 cases); (6) National Heart, Lung, and Blood Institute Pathology Branch archives, 1980 to 1990 (68 cases); and (7) reports submitted directly to the registry and the Minneapolis Heart Institute Foundation Web site (US National Registry of Sudden Death in Athletes, http://www.suddendeathathletes.org) or personal reports from physicians, attorneys, coroners/medical examiners, high schools/colleges, and patient advocacy and support organizations, 1980 to 2006 (92 cases).

Individual athletes were included in the registry when identified
Results: AED Utilization for SCA

• 36/1,710 (2.1%) schools reported a case of AED use for SCA within 6 months of survey completion (July 2006 – July 2007)

• 36 SCA victims:
  – 22 older non-students: spectators, teachers, staff, coaches, officials (mean age 57)
  – 14 high school student-athletes (mean age 16)

• Fatality rate: 1 in 28,000 (same as Italian incidence pre-screening and USA young general pop*: Atkins et al., Circ 2009;119;1484-1491)
Incidence of Young (<35 years) SCD

USA:
- <20 per year [VanCamp et al. MSSE 1995;27:641-647; Guidelines for Pediatricians Sports Shorts 2002;9]
- 66 per year (average over 6 years) = 0.6 deaths per 100,000 person-years [Maron et al. Circ 2009;119:1085-1092].

Lower than cancer, leukaemia, cystic fibrosis, automobile fatalities, and homicides.

Minnesota:
- 0.5 deaths per 100,000/year [Maron et al. JACC 1998;32:1881-1884]

Italy:
- 2.1 deaths per 100,000/year [Corrado et al. JACC 2003;42:1959-1963]
- 0.87 deaths per 100,000/year [Corrado et al. JAMA 2006;296:1593-1601]
- *ca. 0.4 deaths per 100,000/year post-screening
The True Incidence of SCD

‘Only a national government-subsidized program with mandatory reporting, a centralized database, and dedicated resources would be capable of establishing the precise incidence of sudden death in young athletes in the United States.’

Maron et al. Circ 2009;119:1085-1092

UK National network of Cardiac pathologists 2008

Total members - 53
DGH +/- University – 31
Forensic – 10
Cardiac – 10
Paediatric/Congenital – 2
SCD in Young Athletes

SCD is the leading cause of sudden death in young athletes

- Incidence: 0.5-2/100,000 athletes/year
- Combined disease prevalence of all disorders that predispose young individuals to SCD: 0.3% [Maron et al. Circ 2007;115:1643-1655]
- Relative risk: 2.8 [Corrado et al. JACC 2003]
- Mean age at death in athletes 23 years-old (40% <18 years)
- More common in males than females (9:1)
- 90% deaths during or immediately after exertion
- Population, gender, race specific aetiology
Sudden Cardiac Death in Athletes
PRE-PARTICIPATION SCREENING
Pre-Participation Screening

AHA/ESC:
Compelling justification for screening on medical, ethical and legal grounds

Elaborate screening programmes not cost effective
Acceptable interventions to prevent fatalities
# Screening Protocols

<table>
<thead>
<tr>
<th>USA</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>History</td>
</tr>
<tr>
<td>Physical Exam</td>
<td>Physical Exam</td>
</tr>
<tr>
<td>ECG</td>
<td></td>
</tr>
</tbody>
</table>

_Corrado et al. Circulation (abstr.) 2004_
Identification of Cardiovascular Diseases associated with SCD in the Athlete
(Center for sports Medicine; Padua 1982-1996)

<table>
<thead>
<tr>
<th>Disease</th>
<th>History, Physical exam, 12-lead ECG (N=43)</th>
<th>History, Physical exam (N=10)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic CM</td>
<td>22 (51%)</td>
<td>5 (50%)</td>
</tr>
<tr>
<td>Arrhythmogenic RV CM</td>
<td>8 (19%)</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Dilated cardiomyopathy</td>
<td>4 (9%)</td>
<td>-</td>
</tr>
<tr>
<td>Marfan syndrome</td>
<td>3 (7%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>Long QT syndrome</td>
<td>2 (5%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>Obstructive atherosclerotic CAD</td>
<td>2 (5%)</td>
<td>-</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>1 (2%)</td>
<td>-</td>
</tr>
<tr>
<td>Subvalvular aortic stenosis</td>
<td>1 (2%)</td>
<td>1 (10%)</td>
</tr>
</tbody>
</table>

*Number of athletes that would have been identified on the basis of Hx and physical exam only

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Efficacy of Health Questionnaires and Physical Examination versus ECG

Wilson et al., *BJSM* 2007

1074 National and International junior athletes; 15.8 ± 0.7 years (10-27 years); 1646 school children; 16.1 ± 2.1 years (14-20 years)

<table>
<thead>
<tr>
<th>Patient Number</th>
<th>Gender</th>
<th>Abnormal ECG</th>
<th>Symptomatic</th>
<th>Family History of SCD</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Long QT syndrome – Type 1</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>WPW</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>WPW</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Long QT syndrome – Type 1</td>
</tr>
<tr>
<td>5</td>
<td>Female</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>RVOT-VT</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>WPW</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>ARVC</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Long QT syndrome – Type 1</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>WPW</td>
</tr>
</tbody>
</table>
Sensitivity of 12-lead ECG in Sudden Death victims of HCM

<table>
<thead>
<tr>
<th>Sudden death victims</th>
<th>Prior 12-lead ECG</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>51/53 (96%)</td>
<td></td>
</tr>
<tr>
<td>Abnormal ECG</td>
<td></td>
</tr>
<tr>
<td>(LVH associated with ST segment depression, q waves)</td>
<td></td>
</tr>
</tbody>
</table>

Data from the USA
Italian Model
Endorsed by

ESC
IOC
FIFA
UCI

Personal and family history
Physical examination

Young competitive athlete

Negative findings
Eligibility for competition
No cardiovascular disease

Positive findings
Further examination
Cardiovascular disease

Management according to established protocols

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COST EFFECTIVENESS
## WHICH SCREENING PROTOCOL

<table>
<thead>
<tr>
<th>Condition</th>
<th>History</th>
<th>Examn</th>
<th>ECG</th>
<th>Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCM</td>
<td>Pos/Neg</td>
<td>Pos in 25%</td>
<td>Positive</td>
<td>Pos</td>
</tr>
<tr>
<td>ARVC</td>
<td>Pos/Neg</td>
<td>Negative</td>
<td>Positive</td>
<td>Neg/Pos</td>
</tr>
<tr>
<td>WPW</td>
<td>Pos/Neg</td>
<td>Negative</td>
<td>Positive</td>
<td>Neg</td>
</tr>
<tr>
<td>LQTS</td>
<td>Pos/Neg</td>
<td>Negative</td>
<td>Positive</td>
<td>Neg</td>
</tr>
<tr>
<td>Marfan</td>
<td>Pos/Neg</td>
<td>Positive</td>
<td>Negative</td>
<td>Pos</td>
</tr>
<tr>
<td>CAA</td>
<td>Pos/Neg</td>
<td>Negative</td>
<td>Negative</td>
<td>Neg</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>Pos/Neg</td>
<td>Pos/Neg</td>
<td>Pos/Neg</td>
<td>Pos</td>
</tr>
</tbody>
</table>

INCREASING COST
Screening of Young Athletes for Cardiovascular Diseases
(Center for Sports Medicine, Padua 1979-2004)

Athletes screened
42,386

Positive findings
3,914 (9%)

Heart diseases
879 (2%)

Potentially lethal heart diseases
91 (0.2%)

False positive
≈ 7%

False positive
≈ 9%

Corrado et al JAMA 2006; 296: 1593-1601
Enhanced Sensitivity of ECG

ECG abnormalities in the athlete

(Chain)

Common (up to 80%)

- Sinus bradycardia;
- First degree AV block;
- Notched QRS in V1 or incomplete RBBB;
- Early repolarization;
- Isolated QRS voltage criteria for left ventricular hypertrophy

(Chain)

Uncommon (<5%)

- T-wave inversion;
- ST-segment depression;
- Pathological Q waves;
- Left atrial enlargement;
- Left axis deviation/left anterior hemiblock;
- Right axis deviation/left posterior hemiblock;
- Right ventricular hypertrophy;
- Complete LBBB or RBBB;
- Long or short QT interval;
- Brugada-like early repolarization;
- Ventricular arrhythmias

family and personal history, physical examination, 12-lead ECG

- negative family history, no symptoms, and normal physical findings
- normal ECG or group 1 ECG abnormalities
- eligibility for competition
  - no evidence of cardiovascular disease

- positive family history, symptoms, or abnormal physical findings
- group 2 ECG abnormalities
  - further examinations (echo, stress test, 24-h Holter, cardiac MRI, angio/EMB, EPS)
  - diagnosis of cardiovascular disease
  - management according to established protocols

Corrado et al. *Eur Heart J* (in press)
Novel Diagnostic Tools
CRY Screening Programme (UK)

History, examination and 12-lead ECG

Normal 96%
Continue to play

Abnormal 4%
Suggestive of structural or electrical disorder

99.8%

ETT, Holter, CMR, Tilt
2%
Echo shows congenital anomalies

SERIOUS CARDIAC DISORDER 0.2%

Wilson et al., BJSM 2007; Wilson et al. BJSM 2009 (under review)
EFFICACY OF PRE-PARTICIPATION SCREENING
TIME-TREND OF SUDDEN CARDIAC DEATH INCIDENCE IN ATHLETES VS NON-ATHLETES

Veneto Region of Italy 1979-2002

Corrado et al JAMA 2006;296:1593-1601
Data from the USA
THE ROLE OF PRE-PARTICIPATION SCREENING

(1) Identification and prevention of SCD

(2) Standards for disqualification

(3) Reassurance individuals, peers, parents, sports, general population

(4) Education

(5) Improved quality of care for the athlete

(6) Research and development
The EU Screening Protocol

- Meets the WHO criteria for screening
- Evidenced based
- Efficacious
- Low/decreasing false positive
- Cost effective
- Evolving
- Limitations

* must be conducted in an expert environment
An absence of evidence is not evidence of absence

Thank You