Best Practices in Pre Participation Screening for Athletes

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Outline

- Epidemiology
  - Causes of SCA/SCD in young athletes
  - Incidence of SCA/SCD
    - Less than 35 y/o
    - Over 35 years
- Screening PPE and Major Athlete Guidelines
- Role of healthcare provider in athlete care
- Value added by ECG in CV screening
- Some examples

Epidemiology

17 year old who collapsed while running

SCD in Athletes - classic teaching

- Only 150-200/yr
- Annual incidence 1/200,000
- Most common:
  - Basketball and football players in the USA
  - Soccer players in Europe
  - M:F ratio of 9:1
  - 90% of deaths occur during training or competition

Causes of SCD in 387 US Athletes

Coronary artery anomalies (14%)
Hypertrophic CM (26%)
Commotio Cordis (20%)
LVH - Indeterminate (7%)
Ruptured Ao Aneurysm (Marfan) (3%)
Myxomatous MV (2%)
Asthma (2%)
Heat Stroke (1.5%)
Drug Abuse (1%)
Hypertrophic CM

- Incidence: 1:500 in general adult population
- 1:1000-1:1500 in athletes?

Reference: ACC/ESC Clinical Expert Consensus Document on HCM. JACC 2003;42(9)

Anomalous coronary artery

Incidence and etiology of SCD in athletes

Screening (PPE, ECG, Echo)

Screening: Who is the athlete at highest risk for cardiac event?
Current USA Pre-Participation system

Primary care (FP, IM, PEDs)
sports med and team docs,
NPs, PAs, chiropractors

PPE: Family and personal history,
physical exam (AHA elements)

Negative
Eligible for competition:
Bethesdas
Further testing
Negative
Positive
Cardiologists

Bethesdas: Eligible for competition? If not, exercise Rx

Current Italian Pre-Participation system

Sports medicine specialists
with 4 years of specialized training
in screening

PPE at one of 19 national sports
centers: Family and personal
history, exam, 12 lead ECGs

Negative
ESC Guidelines: Eligible for competition
Further testing
ESC Guidelines: Eligible for competition?
Positive
Cardiologists

In USA

- Athlete CV care teams: Not as defined as ACS, or HF teams
- Current care models

In USA

Athlete with Symptoms
Athlete
trainer Or, school
name
Team
doctor or PCP
Referral to
cardiology

Athlete
undergoing PPE
(screening)
Team
doctor, PCP, CV-
specialist
Cardiology
evaluation
Referral to
CV specialist

Major USA athlete screening guidelines- AHA, 4th
PPE, Bethesda

Use of Major Athlete Screening
Guidelines (n=127 PCPs)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Unaware of</td>
<td>73.0 %</td>
<td>48.0 %</td>
<td>76.4 %</td>
</tr>
<tr>
<td>Aware of/do not use</td>
<td>6.4</td>
<td>16.3 %</td>
<td>12.6 %</td>
</tr>
<tr>
<td>Occasionally use</td>
<td>12.7 %</td>
<td>24.4 %</td>
<td>7.9 %</td>
</tr>
<tr>
<td>Consistently use</td>
<td>7.9 %</td>
<td>11.4 %</td>
<td>3.2 %</td>
</tr>
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</table>

Lawless et al. ACC14 Presented 3-31-14, Washington DC

How good is the H and P alone?

- In 1990s, H and P appeared to pick up only 3% of cardiac conditions
Results in Harvard athletes - PPE plus ECG, Baggish Ann Int Med, March 2010

- 510 collegiate athletes
- Measurements: ECG plus ECHO
- Increased sensitivity with ECG
- Conclusion: Adding ECG to medical history and physical examination improves the overall sensitivity

Corrado - JAMA, 2006

ECG screening: USA experience

- Youth - 44 million - NO
- High school - 3.3 million - NO
- NCAA - 450,000
  - 30-47% NCAA schools utilize ECG + PPE
  - ECGs for more than 10 years, 10% of athletes will require additional tests if 2011 reading criteria are applied
- Professional Yes - NFL, NBA, NHL, MLS, MLB
- Olympic (USOC) Yes

23 y/o male pro football player; no symptoms; no fam Hx, normal PEx

A. Do not allow play until cardiac work up is complete
B. Allow play with no restrictions and no further work up
C. Do not know
18 y/o male soccer player; no symptoms; no fam Hx, normal PEs
A. Do not allow play until cardiac work up is complete
B. Allow play with no restrictions and no further work up
C. Do not know

ESC criteria, Corrado 2010

Stanford Interpretation scheme - 2011

Seattle Criteria BJSM 2013

What to expect if you screen with ECG - Group 2 changes more common in males, and Afro-caribbeans

Do not know, % Allow play, % No play, % p<0.002

Lawless, Winicur, Bellande AHA 2009


<table>
<thead>
<tr>
<th>ECG Abnormality</th>
<th>Criteria for further evaluation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>T wave inversion</td>
<td>Hyperkalaemia; hypercalcemia; hypomagnesemia; hypervitaminosis D, hypocalciuria or hypomagnesaemia</td>
<td>Left atrial enlargement</td>
</tr>
<tr>
<td>ST elevation</td>
<td>Right atrial enlargement; left idioventricular rhythm; abnormal right atrial pressure; right atrial hypertrophy</td>
<td>Right atrial hypertrophy</td>
</tr>
<tr>
<td>ST depression</td>
<td>Right ventricular hypertrophy; tachycardia; pre-excitation; left bundle branch block; right bundle branch block; left atrial hypertrophy; left ventricular hypertrophy</td>
<td>Left ventricular hypertrophy</td>
</tr>
<tr>
<td>Abnormal QRS complex</td>
<td>Hypertension; heart failure; valvular heart disease; congenital heart disease; coronary artery disease; myocardial infarction; pericarditis; myocarditis; cardiac tamponade; cardiac neoplasm; cardiac metastases; arrhythmia; hypothyroidism; hyperthyroidism; hypocalcaemia; hypercalcaemia; hypomagnesaemia; hypomagnesemia; hyperkalaemia; hypoalbuminaemia; hyperalbuminaemia; hypernatraemia; hypotanaemia; hyperosmolarity; hyponatraemia; hyperosmolarity; hyponatraemia</td>
<td>Hypertension</td>
</tr>
</tbody>
</table>

Table 1: Abnormal ECG findings in athletes

<table>
<thead>
<tr>
<th>Abnormal ECG finding</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST segment depression</td>
<td>Left ventricular hypertrophy</td>
</tr>
<tr>
<td>T wave inversion</td>
<td>Right atrial hypertrophy</td>
</tr>
<tr>
<td>ST elevation</td>
<td>Left atrial enlargement</td>
</tr>
<tr>
<td>ST depression</td>
<td>Hypertension</td>
</tr>
</tbody>
</table>

Note: These ECG findings are not diagnostic and may not be present in athletes. They are common in athletes and are often asymptomatic. They are usually seen in athletes with a strong family history of cardiovascular disease. They may be associated with certain sports and may be a marker of increased risk for sudden cardiac death. They are not specific to any particular sport and are seen in athletes of all ages and genders.
**Abnormal ECG:** q waves, ST depression, T waves

**History**
- Healthy
- No history of cardiac or respiratory symptoms at rest or with exertion
- Father died of MVA at age 47; otherwise negative cardiac family history
- No surgeries, medications

**Physical**
- 5' 11", 163 lbs
- BP 100/60 bilaterally; HR 70
- Normal heart sounds; no murmurs
- No change with valsava, squatting
- No Marfanoid features
- Routine ECG was performed

**ECG - per MLS cardiac screening policy**

**MRI**
- 4ch systole
- 4ch diastole
- Delayed enhancement
- SAO

**Bethesda Guidelines 2005, Maron**

**No play……… But, what level of exercise would you prescribe?**

Zac Herold – 17 y/o professional soccer recruit found to have HCM
Outcome

- Diagnosis: Non-obstructive Hypertrophic Cardiomyopathy
- Bethesda Guidelines for HCM: Class IA sports
- No Treatment other than Exercise Modification
- Retired from Soccer at age 17

Issue: Over-reading

20 y/o Dartmouth Nordic skiing athlete

- No symptoms
- No family history
- PPE and ECG upon entry to college - normal
- Play or no play?

Summary ECG issue

1. Lack of prospective randomized study to demonstrate efficacy
2. All criteria require prospective validation
3. Not ready for prime time in USA - especially for high schoolers
4. Be aware that no matter what type of screening is done, the risk of SCA/SCD is still there

Evaluating symptoms
Syncope

- Risk may depend upon the setting in which syncope occurs.
- 6.2% of athletes report at least one syncopal spell within prior 5 yrs (Colivicchi 2004).
- Not related to exercise (86.7%).
- Occurring immediately after exercise (12.0%).
- During exercise (1.3%) (1/3 had underlying cardiac disease).

In general population of patients ≤ 18 years with syncope:
- In cardiac syncope, symptoms during activity in 65%.
- In vasovagal syncope, symptoms during activity in 18%.

(Trotter, Kavey, PEDS 2013)

Purdue player

H and P:

- An 18y/o Div III AA basketball player presented to PPE with history of 3 episodes of chest pain - over 3 years.
- Two- Intense exercise in the heat.
- One- At rest.
- He returned to play after each episode without further symptoms.

Cardiovascular: Grade 1/6 systolic murmur at the LSB, resolved with standing and Valsalva.

Electrocardiogram

Imaging – Stress echocardiogram

Other Findings:
- Left ventricular ejection fraction 65% at rest, 85% with exercise.
- No outflow tract obstruction.
- Appropriate HR and BP changes.
- Asymptomatic during test.
Concentric left ventricular hypertrophy – no outflow tract obstruction
No myocardial perfusion abnormalities
No myocardial fibrosis (LV= left ventricular cavity, IVS= septum)

Cardiac MRI

24 Hour Holter monitor

7 beat run of monomorphic non-sustained ventricular tachycardia
No symptoms reported by the athlete - patient throughout entire period

Patient Presentation

A 19 y/o AA NCAA D1 offensive lineman presented with chest pain after conditioning
Vitals: BP 202/94; P 84; RR 20; T 98; O2 Sat 97%
General: Mild distress and diaphoresis

Laboratory Studies - Cardiac panel

<table>
<thead>
<tr>
<th></th>
<th>Admission</th>
<th>6 hours later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Troponin I (normal up to 1.5 ng/ml)</td>
<td>6.80</td>
<td>149.50</td>
</tr>
<tr>
<td>CPK MB (normal up to 10.0 ng/ml)</td>
<td>55.9</td>
<td>270.7</td>
</tr>
<tr>
<td>CPK (normal 24-195 U/L)</td>
<td>1119</td>
<td>3410</td>
</tr>
</tbody>
</table>

Coronary Angiogram

Thrombus Proximal LAD
No TIMI III flow noted distally
Secondary prevention of sudden cardiac arrest/death (SCA/SCD) - Use of AEDS

Current 36th Bethesda Guidelines - Use of AEDs

- "... rationale (for use) is clear and should be promoted"
- "Nonetheless, the availability of an AED at a sporting event should not be construed as absolute protection against a fatal outcome from a cardiac arrest"

Resuscitation rates in athletes

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Type of event</th>
<th>Total # of athletes</th>
<th>Resuscitation rate for young athlete</th>
<th>Resuscitation rate for older athlete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maron</td>
<td>2002</td>
<td>Commotio cordis</td>
<td>Total cohort = 128; Various types of treatment on the scene</td>
<td>Overall survival 1%; Increased to 17/68 (25%) if defibrillated within 3 minutes</td>
<td>N/A</td>
</tr>
<tr>
<td>Roberts</td>
<td>2005</td>
<td>Marathon</td>
<td>2 cases resuscitated by medical practitioners</td>
<td>1/8 (13%)</td>
<td>3/8 (38%)</td>
</tr>
<tr>
<td>Lawless</td>
<td>2006</td>
<td>Various sports</td>
<td>21 athletes resuscitated by team physician</td>
<td>3/8 (39%)</td>
<td>13/15 (87%)</td>
</tr>
<tr>
<td>Drezner</td>
<td>2006</td>
<td>Various sports</td>
<td>9 NCAA athletes resuscitated by athletic trainers</td>
<td>1/7 (14%)</td>
<td>7/5 in athletes/spectators/officials</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>21/84 (25%)</td>
<td></td>
<td></td>
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</table>

Resuscitation rates in athletes - 2014

- Much improved
- Now in 50-75% range
  - Commotio Cordis registry
  - Washington High Schools

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Thank you!