Screening Young Competitive Athletes for Underlying Cardiovascular Disease – The SportsCardiologyBC Protocol

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Introduction:

• SportsCardiologyBC (SCBC) has screened 1,362 young (12-35) competitive athletes across British Columbia, Canada with 12-lead electrocardiogram (ESC recommended), history and physical examination (AHA 12-item questionnaire)

• Following recruitment of the initial 681 participants, the researchers found the questionnaire to be causing several false-positive results. Further, they found that the physical examination had a low utility to detect disease, and that physician time was limited and expensive.

• A new screening protocol was developed in which the physical examination was eliminated and a new questionnaire was created. The questionnaire includes positive and negative questions on symptoms in an attempt to differentiate what might be cardiac causes in the absence of a physician.
**Questionnaire Comparison**

### AHA 12-element Preparticipation Screen\(^1\)

<table>
<thead>
<tr>
<th>Personal History</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exertional chest pain/discomfort</td>
</tr>
<tr>
<td>2. Unexplained syncope/near-syncope</td>
</tr>
<tr>
<td>3. Excessive exertional and unexplained dyspnea/fatigue associated with exercise</td>
</tr>
<tr>
<td>4. Prior recognition of a heart murmur</td>
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<tr>
<td>5. Elevated systemic blood pressure</td>
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</tbody>
</table>

**Family History**

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Premature death (sudden and unexpected, or otherwise) before age 50 years due to heart disease in ≥1 relative</td>
</tr>
<tr>
<td>7. Disability from heart disease in a close relative &lt;50 years of age</td>
</tr>
<tr>
<td>8. Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long-QT syndrome or other ion channelopathies, Marfan syndrome or clinically important arrhythmias</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Heart murmur</td>
</tr>
<tr>
<td>10. Femoral pulses to exclude aortic coarctation</td>
</tr>
<tr>
<td>11. Physical stigmata of Marfan syndrome</td>
</tr>
<tr>
<td>12. Brachial artery blood pressure</td>
</tr>
</tbody>
</table>

### *SportsCardiologyBC Questionnaire*

**Personal History**

1. **Have you ever passed out or nearly passed out? (+4)**
   - Did this occur during exercise? (+3)
   - Was this associated with blurred vision? (+1)
   - Did you feel lightheaded/nauseous/weak before? (-1)
   - Were you in a hot or warm environment? (-1)
   - Have you experienced this more than two times? (-2)
   - Did you feel that your heartbeat was abnormal? i.e. was it racing or skipping beats? (+4)
   - If you passed out, were you tired after? (-2)
   - If you passed out and someone witnessed it, did they notice you were pale in colour? (-1)

2. **Do you regularly and consistently experience discomfort, pain, tightness or pressure in your chest? (+2)**
   - Does this pain occur during exercise or emotional stress? (+1)
   - Does the pain feel dull, achy, heavy and located in the middle of the chest and/or radiate to the jaw, neck, shoulders or arms? (+1)
   - Is the pain relieved within 5 minutes of rest? (+1)
   - Is the pain worsened with deep inspiration? (-1)
   - Is the pain worsened with arm movement? (-1)
   - Do you have asthma? (-2)

3. **Do you regularly and consistently experience excessive labored breathing or have unexplained shortness of breath during exercise? (+2)**
   - Do you feel a burning sensation in your throat? (-1)
   - Do you have difficulty swallowing or were constantly clearing your throat? (-1)
   - Do you feel nauseous at the same time? (-1)
   - Do you have asthma? (-2)

**Family History**

4. **Has any family member died of heart problems or had any unexpected sudden death before 50 years of age, including drowning or sudden infant death syndrome?**

5. **Does any family member have: hypertrophic cardiomyopathy, arrhythmogenic right ventricular dysplasia/cardiomyopathy, long QT syndrome, short QT syndrome, brugada syndrome, Marfan syndrome, catecholaminergic polymorphic ventricular tachycardia, or other?**

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\(^1\)Maron, Circ 2007

*A score ≥7 necessitates further cardiovascular evaluation*
## Evidence for Syncope Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Odds Ratio</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did this occur during exercise?</td>
<td>17.0</td>
<td>*As</td>
<td>*As</td>
</tr>
<tr>
<td>Was this associated with blurred vision?</td>
<td>*2.5</td>
<td>*As</td>
<td>*As</td>
</tr>
<tr>
<td>Did this occur following a period of prolonged sitting or standing?</td>
<td>0.3</td>
<td>**As</td>
<td>**As</td>
</tr>
<tr>
<td>Did you feel lightheaded/nauseous/weak before?</td>
<td>****2.9</td>
<td>******As</td>
<td>******As</td>
</tr>
<tr>
<td>Were you in a hot or warm environment?</td>
<td>***As</td>
<td>**As</td>
<td>**As</td>
</tr>
<tr>
<td>Have you experienced this more than two times?</td>
<td>*****24</td>
<td>*****As</td>
<td>*****As</td>
</tr>
</tbody>
</table>

*In patients with suspected or certain heart disease
**Tilt positive primary syncope
***Ventricular tachycardia as cardiac cause of syncope
****Neurally-mediated syncope
*****Arrhythmia as cardiac cause of syncope
******Ventricular tachycardia and atrioventricular block as cardiac cause of syncope
*******In patients without suspected or diagnosed heart disease

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1 Rosso, A. Del, Heart 2008
2 Alboni, Paolo, JACC 2001
3 Sheldon, R, EHJ 2007
4 Sheldon, Robert, JCE 2010
5 Oh, Jeong H, Arch Intern. Med. 1999
6 Calkins, Hugh, AJM 1995
Results and Major Findings

AHA/ESC Protocol:

- 681 participants
- 59 (8.7%) required follow-up investigation, with 3 still under investigation
- 5 confirmed to have cardiovascular disease:
  - probable hypertrophic cardiomyopathy, myxomatous mitral valve prolapse with mild regurgitation, mild-moderate tricuspid insufficiency with pectus excavatum, restrictive ventricular septal defect, supraventricular tachycardia
- 51 (7.9%) false-positive participants
- Positive predictive value = 5/56 = 8.9%

SportsCardiologyBC Protocol:

- 681 participants
- 31 (4.6%) required follow-up investigation, with 8 still under investigation
- 6 confirmed to have cardiovascular disease:
  - Long QT syndrome, paroxysmal supraventricular tachycardia, 4 cases of Wolff-Parkinson-White Syndrome
- 17 (2.5%) false-positive participants
- Positive predictive value = 6/23 = 26.1%

**Note – PPVs are subject to change with 11 participants still under investigation for the presence of cardiovascular disease**
Discussion and Conclusions

• Based on the increased PPV and lower absolute and relative number of false-positives, the SCBC protocol can be seen as a viable, feasible and effective screening methodology for this population.

• 5 ion channelopathies found in the latter 681 participants lead to a higher PPV for the ECG in this group, contributing to the improved effectiveness of the SCBC protocol.

• Concerns regarding false negatives with the elimination of the physician from the screening process are valid, therefore further studies with proper ascertainment of false-negative rates must be conducted to determine sensitivity and specificity.

Questions? – dlithwick@sportscardiologybc.org