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]
Personal History
1. Exertional chest pain/discomfort
2. Unexplained syncope/near-syncope
3. Excessive exertional and unexplained dyspnea/fatigue associated with exercise
4. Prior recognition of a heart murmur
5. Elevated systemic blood pressure
Family History
6. Premature death (sudden and unexpected, or otherwise) before age 50 years due to heart disease in ≥1 relative
7. Disability from heart disease in a close relative <50 years of age
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
Physical Examination
9. Heart murmur
10. Femoral pulses to exclude aortic coarctation
11. Physical stigmata of Marfan syndrome
12. Brachial artery blood pressure

***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_____?

[1]Maron, Circ 2007

*A score ≥7 necessitates further cardiovascular evaluation

Evidence for Syncope Questions

	Odds Ratio	Sensitivity	Specificity
Did this occur during exercise?	**17.0** as predictor for cardiac syncope[1]		*As predictor for cardiac syncope[2] – **96%**
Was this associated with blurred vision?	***2.5** as predictor for cardiac syncope[2]		*As predictor for cardiac syncope[2] – **85%**
Did this occur following a period of prolonged sitting or standing?	**0.3** as predictor for cardiac syncope[1]	**As predictor for vasovagal syncope[3] – **69.4%**	**As predictor for vasovagal syncope[3] – **62.5%**
Did you feel lightheaded /nauseous/ weak before?	*****2.9** as predictor for vasovagal syncope[2]; **0.4** as predictor for cardiac syncope[1]; *******7.1** as predictor for cardiac syncope (absence)[5]	******As predictor for cardiac syncope[6] – **4%**	**As predictor for vasovagal syncope[3] – **80.7%**
Were you in a hot or warm environment?		***As predictor for cardiac syncope[4] – 2.6%	**As predictor for vasovagal syncope[3] – **90.9%**
Have you experienced this more than two times?	********24** as predictor for cardiac syncope[6]; *******2.8** as predictor for vasovagal	******As predictor for cardiac syncope[6] – **77%**	******As predictor for cardiac syncope – **88%**

*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

[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

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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 regurgitaiton, 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