

Screening Young Competitive Athletes for Underlying Cardiovascular Disease in British Columbia, Canada – A SportsCardiologyBC Study



SPORTSCARDIOLOGYBC

Introduction:

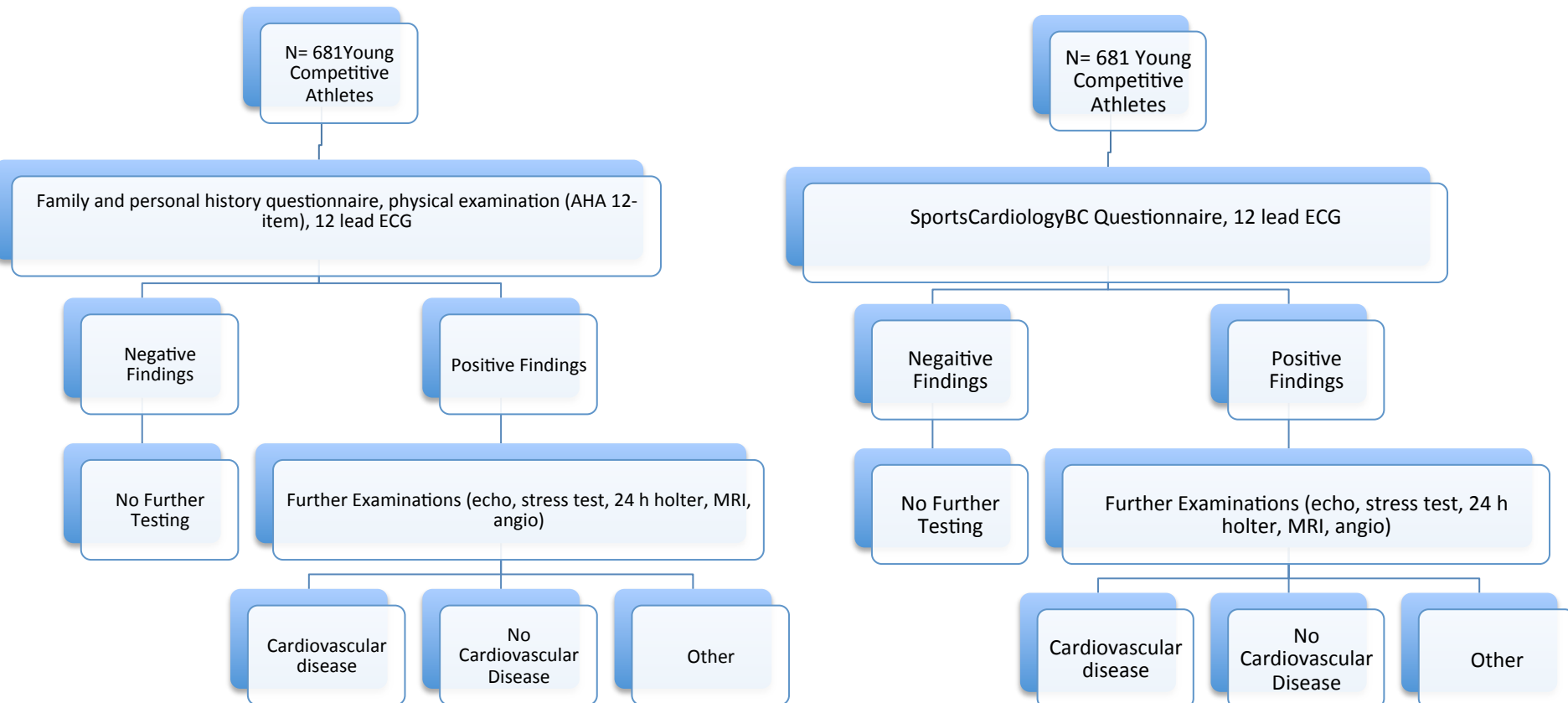
- Following the publication of a 25-year study out of Italy that showed a 90% risk reduction for SCD after the implementation of a systematic screening program, international attention towards the concept of screening has increased
- Implementation of screening remains a controversial issue, with the primary disparity lying in whether a 12-lead electrocardiogram (ECG) should be included in addition to a cardiovascular focused medical history and physical examination
- The purpose of this study is to determine the prevalence of cardiovascular diseases that can lead to SCD in a sample of young (12-35) competitive athletes in British Columbia

Methods



SPORTSCARDIOLOGYBC

- The first 681 participants were screened using the AHA 12-element recommendations for screening and resting 12-lead ECG
- The latter 681 participants were screened using a revised SportsCardiologyBC protocol and resting 12-lead ECG with no physical exam
- ECGs were interpreted by cardiologists using the “Seattle Criteria”





Results

- Of the 1,362 athletes evaluated, 93 (6.8%) required follow-up investigation.
- 11 (0.8%) cardiovascular disorders were found
 - Probable hypertrophic cardiomyopathy (HCM)
 - Long QT syndrome
 - 4 cases of Wolff-Parkinson-White Syndrome
 - Myxomatous mitral valve prolapse with mild regurgitation
 - Mild-moderate tricuspid insufficiency with pectus excavatum
 - Paroxysmal supraventricular tachycardia
 - Supraventricular tachycardia
 - Restrictive ventricular septal defect
- 11 participants are still under investigation for the presence of disease.
Notable queries include:
 - Atrial septal defect
 - HCM
 - Arrhythmogenic right ventricular dysplasia
 - Premature coronary artery disease



ECG Findings

Abnormal ECG Findings (suggestive of pathology)	Prevalence
Right ventricular hypertrophy pattern	n=2 (0.15%)
T-wave inversion	n=4 (0.29%)
Premature ventricular contractions	n=3 (0.22%)
Left atrial enlargement	n=1 (0.07%)
Long QT interval	n=4 (0.29%)
Complete left bundle branch block	n=1 (0.07%)
Ventricular pre-excitation	n=4 (0.29%)
Intraventricular conduction delay	n=1 (0.07%)
Biatrial abnormality	n=1 (0.07%)
Accelerated idioventricular rhythm	n=1 (0.07%)
Total abnormal ECG findings = 22 (1.7%) ECG Positive predictive value = 7/19 = 36.8% (3 athletes still under investigation with initial abnormal ECG)	



SPORTSCARDIOLOGYBC

Conclusions

- With 11 positive cases of underlying CVD found, and the investigation into several more athletes pending, screening for CVD in this population is likely a worthy endeavor
- The AHA 12-element preparticipation screening tool produced several false-positive results, prompting the research team to revise the protocol
- Considering the low proportion of ECG false-positive findings, as well as the improvement in positive predictive value over physical exam and ECG alone (36.8% vs. 10.2%), the resting 12-lead ECG should be considered an effective tool for screening

Questions? – dlithwick@sportscardiologybc.org

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



SPORTSCARDIOLOGYBC

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



SPORTSCARDIOLOGYBC

AHA 12-element Preparticipation Screen ¹
<i>Personal History</i>
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
<i>Family History</i>
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
<i>Physical Examination</i>
9. Heart murmur 10. Femoral pulses to exclude aortic coarctation 11. Physical stigmata of Marfan syndrome 12. Brachial artery blood pressure

*SportsCardiologyBC Questionnaire
<i>Personal History</i>
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)
<i>Family History</i>
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 _____?

¹Maron, Circ 2007

*A score ≥7 necessitates further cardiovascular evaluation

Evidence for Syncope Questions



SPORTSCARDIOLOGYBC

	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

Results and Major Findings



SPORTSCARDIOLOGYBC

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



SPORTSCARDIOLOGYBC

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