Comprehensive Cardiovascular Care of the Elite Runner

Peter N. Dean, M..D
Assistant Professor of Pediatrics
Co-team Cardiologist, University of Virginia Athletics
Medical Director, Pediatric Exercise Stress Laboratory
University of Virginia
Outline

Case

Pre-participation
- History elements
- What known heart disease?
- Exam findings?
- Should we do ECGs?

Responding to symptoms
- Syncope
- Chest pain
- Palpitations
- Sudden cardiac arrest

Conclude the Case
Case

- 22 year old female cross country runner presents after episode of syncope
- Passed out ~1K into a 3K indoor event
- Had felt her heart racing faster than usual during warm ups and “didn’t feel like myself” at the beginning of the race.
- ~1K into event she felt dizzy and arms felt cold. She then fell “slowly” to the ground.
- No head trauma or injuries. Questionable true loss of consciousness
Pre-participation – Key Elements on History

- Symptom red flags:
  - Syncope (recurrent, atypical or with exercise)
  - Palpitations, inappropriate tachycardia or chest pain with exercise
  - Decreased exercise capacity recently
  - Unexplained seizures
- Previous cardiac testing?
  - Have you ever had an ECG or echocardiogram?
  - Ever been told you have a murmur or heart condition?
Pre-participation – Personal History of Heart Disease

- So what if they do have a heart condition?
- There is not much data out there regarding safety of participation
- More recently the field has shifted towards allowing participation
  - Long QT syndrome, hypertrophic cardiomyopathy, congenital heart disease, internal defibrillators (ICDs), etc
- Cardiologist comfortable with both diagnosis and sports
Pre-participation – Personal History of Heart Disease

- Risk vs benefit or “Shared decision making model”
Pre-participation – Personal History of Heart Disease

- If they participate:
  - Ensure good hydration and eating practices
  - Ensure medications compliance
  - Athletic trainers and team physicians should be appropriately updated in order to supervise the athlete and, if needed, respond to an emergency situation
  - Ensure routine follow up with cardiologist to monitor for changes
Pre-participation – Family History

- Vital portion of any pre-participation assessment
- Many heart conditions have autosomal dominant inheritance pattern
  - 50% of 1st degree relatives will have the disease
- Recent survey of parents of children and young adults who had suffered a sudden cardiac arrest, 40% had a known family history component present prior to the event
- Avoid medical jargon
- Don’t forget unexplained deaths, single car accidents, drownings, etc

Pre-participation – Family History

- Does not require automatic disqualification, but does require extra work

- What should happen:
  - Obtain as much information as possible about relative who died (autopsy, medical records, etc)
  - Are other 1st degree family members affected?
  - Obtain cardiac testing (exact type/amount depends on the family member’s history) of closest family members and/or patient
  - Genetic testing can be very helpful
Case

- **Family history**
  - Father died suddenly while running at age 40
  - Autopsy showed:
    - Aortic dissection of the aorta due to bicuspid aortic valve
    - He was also “tall and slender” with “morphological features of Marfan syndrome”
  - No other heart disease, sudden death or malignant arrhythmias
Pre-participation – Abnormal Physical Exam

- **Marfanoid body habitus** – Marfan Syndrome
  - Genetic connective tissue disorder that effects 1 in 5000 individuals
  - Causes tall stature, impacts the heart, joints, bones, lungs and eyes.
  - Cardiac manifestations:
    - Aortic aneurysms
    - Mitral valve prolapse
    - Can cause sudden death due to aortic dissection
Pre-participation – Abnormal Exam

- Marfan Syndrome
  - Findings can be mild in childhood
    - May patients may not be diagnosed until high school, college or early adulthood
  - Diagnosis made using cardiac findings, physical exam findings and genetics testing
- Marfan.org

https://www.marfan.org/dx/score
Pre-participation – Abnormal Physical Exam

- Murmurs?
  - Very common finding in healthy individuals but can also be a sign of structural cardiac disease.

<table>
<thead>
<tr>
<th>Likely benign</th>
<th>Likely pathologic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft or “musical” in nature</td>
<td>Harsh in nature</td>
</tr>
<tr>
<td>Systolic ejection type early in systole</td>
<td>Holosystolic, continuous or diastolic</td>
</tr>
<tr>
<td>Heard at left upper sternal border</td>
<td>Heard anywhere in the precordium</td>
</tr>
<tr>
<td>No radiation to axilla, back or neck</td>
<td>Radiates to axilla, back or neck</td>
</tr>
<tr>
<td>Decrease with patient standing</td>
<td>Persists or worsens with patient standing</td>
</tr>
</tbody>
</table>
Pre-participation – Abnormal Physical Exam

- Extra heart sounds (gallop, clicks, etc)
  - Cardiomyopathy, bicuspid aortic valve, mitral valve prolapse
- Femoral pulses
  - Coarctation of the aorta (1:500)
- Loud P2
  - Pulmonary hypertension

- Don’t forget intake vitals – specifically blood pressure!
Pre-participation – ECG screening?

- Should we be doing ECG screening?

Long QT Syndrome
Pre-participation – ECG screening?

- Should we be doing ECG screening?

Hypertrophic cardiomyopathy
Pre-participation – ECG screening?

- But does it save lives?

Screened UK soccer players → 6.8 per 100,000 years


[http://www.onlinejacc.org/content/68/7/712](http://www.onlinejacc.org/content/68/7/712)
Pre-participation – ECG screening?

- If you are going to do it...
- Mandatory to have practitioners trained and experienced in interpretation of athlete ECGs
- Limits the false positives or excessive restriction
- Method of quickly and definitively working up the abnormal ECG
- Make it clear that ECGs do not exclude every form of sudden cardiac arrest
Case

Patient had ECG 1 year prior during routine UVA student athlete screening and was cleared.
Responding to Symptoms – Syncope

**Concerns**

- Hypertrophic cardiomyopathy
- Aortic stenosis
- Anomalous coronary artery
- Arrhythmogenic right ventricular cardiomyopathy (ARVC)
- Pulmonary hypertension
- Myocarditis
- Long QT syndrome
- Wolff-Parkinson-White (WPW) or other supraventricular tachycardia (SVT)
- Catecholaminergic polymorphic ventricular tachycardia (CPVT)
## Responding to Symptoms – Syncope

<table>
<thead>
<tr>
<th>Reassuring factors:</th>
<th>Red flags:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At rest or positional changes</td>
<td>During exercise</td>
</tr>
<tr>
<td>Hair braiding, post-micturition, hot shower, middle of night, etc</td>
<td>Recurrent episodes</td>
</tr>
<tr>
<td>Classic prodromal symptoms (dizziness, tunnel vision, pale, etc)</td>
<td>No prodromal symptoms</td>
</tr>
<tr>
<td>No preceding cardiac symptoms (such as chest pain or palpitations)</td>
<td>Wanting to go back into the game</td>
</tr>
<tr>
<td>Environmental factors (heat, not eating or drinking, dark urine)</td>
<td>Family history of heart disease or sudden unexplained death</td>
</tr>
<tr>
<td>No family history</td>
<td>Previous history of “seizures”</td>
</tr>
<tr>
<td>Normal physical exam</td>
<td>Abnormal physical exam</td>
</tr>
</tbody>
</table>
Responding to Symptoms – Syncope

• The workup
  • Exam
  • ECG
  • Echocardiogram
  • Exercise stress test – *with the goal to reproduce the event*
  • Holter/event monitor
  • Cardiac CT/MRI – *depending on how scary*
Long QT Syndrome
Normal

Hypertrophic cardiomyopathy
Responding to Symptoms – Chest pain

Chest pain

- Something acute?
- Are you having pain now?
- Abnormal vitals?
- Fever?
- Positional changes?
- Exam?
- ECG?
- Referral

This can be a little more complicated.
Responding to Symptoms – Chest pain

Chest pain

- Something acute? Are you having pain now?
  - Myocardial infraction
  - Pulmonary embolism
  - Pericarditis
  - Rib fracture
  - Mediastinal mass
  - Pneumothorax
  - Pneumonia
  - Sickle cell crisis

- Only during exercise?
  - Referral

- Intermittent and at rest and activity?
  - This can be a little more complicated


Causes:
- Coronary artery disease
- Hypertrophic cardiomyopathy
- Aortic stenosis
- Anomalous coronary artery origin
- Pulmonary hypertension
- Arrhythmias?
## Responding to Symptoms – Chest pain

**Reassuring factors:**
- Occurs at rest
- Worsens with breathing or eating
- Sharp pain
- Localized to very specific area of chest
- Long duration of symptoms
- No other cardiac symptoms
- Normal physical exam (or reproducible pain on exam)
- No family history

**Red flags:**
- During exercise only (not at rest)
- Other associated cardiac symptoms (dizziness, syncope, palpitations, etc)
- Dull/pressure type of pain
- Family history of heart disease or sudden unexplained death
- Abnormal physical exam
Responding to Symptoms – Chest pain

- Exam and vitals
- ECG
- Echocardiogram
- Exercise stress test – *for patient/family reassurance*
- CTA/MRI/coronary angiography – *rare*
- Lab testing – *rare, typically in ED setting*
Responding to Symptoms – Palpitations/Tachycardia

**Reassuring factors:**
- Slow start at beginning of exercise
- Slow resolution at end of exercise
- No other cardiac symptoms (dizziness, syncope)
- Heart rate less than 180 bpm
- Environmental factors (heat, not eating or drinking)
- No family history
- Normal physical exam

**Red flags:**
- Abrupt start and/or stop
- Heart rates greater than 200 bpm
- Irregular heart rhythm
- Recurrent episodes
- Family history of heart disease or sudden unexplained death
- Abnormal physical exam
## Responding to Symptoms – Palpitations/Tachycardia

### Concerns
- Supraventricular tachycardia (SVT)
  - Reentry tachycardia (WPW, etc)
  - Ectopic atrial tachycardia
  - Atrial fibrillation
  - Atrial flutter
- Catecholaminergic polymorphic ventricular tachycardia (CPVT)
- Long QT syndrome
- Arrhythmogenic right ventricular cardiomyopathy (ARVC)

### Workup
- Exam
- ECG
- Exercise stress test – *to simulate the exercise they were performing*
- Holter/event monitor
- Echocardiogram – *if exam or ECG abnormalities*
Responding to Symptoms – Palpitations/Tachycardia

Wolff-Parkinson-White (WPW)
Supraventricular tachycardia
Responding to Symptoms – Cardiac Arrest

- You can’t find everything prior to event
- Education and training
  - Basic CPR and AED use
- AEDs in all training facilities and sporting venues
  - Knowing the location, unlocked
- Quick recognition of a cardiac arrest and initiation of CPR.
  - Do not hesitate, assess the ABC’s of emergency resuscitation and ensure a pulse is present
- Activation of emergency medical personnel
Case Presentation

- 22 year old female cross country runner presents after episode of syncope, ~1K into a 3K indoor event
- ECG (due to syncope mid race)
Case Presentation

- 22 year old female cross country runner presents after episode of syncope, ~1K into a 3K indoor event
- Echocardiogram (due to syncope mid race and family history)
Case

- 22 year old female cross country runner presents after episode of syncope, ~1K into a 3K indoor event
- Customized exercise stress test to simulate a race
  - Exercised for ~15 minutes
  - Peak workload was 11 mph with a 3% incline
  - Normal increase in blood pressure (peak 160/56)
  - Normal increase in heart rate (190 bpm)
  - No arrhythmias, no ST segment changes
Case

- 22 year old female cross country runner presents after episode of syncope, ~1K into a 3K indoor event
- CT angiogram (due to syncope mid race and family history):
Case

- Extensive testing did not reveal malignant heart disease
- No indication for further restriction
- Cleared for participation

- Follow up?
  - Likely indicated due to family history
Conclusion

Pre-participation
- History elements
  - Symptoms with exercise
- What known heart disease?
  - Very little evidence, shared decision making
- Exam findings?
  - Murmurs and Marfan's
- Should we do ECGs?
  - Controversial, need to be careful

Responding to symptoms
- Syncope
  - Concerning if mid-exercise, electrical or structural
- Chest pain
  - Look for structural/coronary problems
- Palpitations
  - Electrical problems
- Sudden cardiac arrest
  - AEDs
Thank you