Pre-Participation Cardiovascular Evaluation: How to Keep Kids Safe?

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Sudden Cardiac Arrest
Sudden Cardiac Arrest

- Rare event … maybe not so
  Harmon KG et al. Circulation 2011 Apr 19;123(15):1594-600

- Huge impact in communities: urban, rural, professional, scholastic, recreational

- How to predict? How to prevent?

- Structured approach rather than emotional reactive measures?

Causes of Sudden Cardiac Death

Figure. Distribution of cardiovascular causes of sudden death in 1436 young competitive athletes. From the Minnesota Heart Institute Foundation Registry, 1980 to 2005. ARVC indicates arrhythmogenic right ventricular cardiomyopathy; AS, aortic stenosis; CAD, coronary artery disease; C-M, cardiomyopathy; HD, heart disease; LAD, left anterior descending; LVH, left ventricular hypertrophy, and MVP mitral valve prolapse.
Causes of Sudden Cardiac Death

5 Year Prospective Registry of NCAA Athletes

- Autopsy negative – 31%
- Coronary artery Anomaly – 14%
- LVH/HCM? – 8%
- HCM – 3%
- ARVC – 8%
- DCM – 8%

Harmon K et al. Circ Arrhythm Electrophysiol. 2014;7:198-204

A Prospective Study of Sudden Cardiac Death among Children and Young Adults


NEJM 2016;374(25):2441-2452
- PubMed search
- 13 studies in athletes and 15 in other populations under the age of 30 years
- SCD rates from 1/917,000 to 1/3,000
- SCD rate in studies with “higher quality methods” 1/80,000 to 1/40

**Br J Sports Med** 2014;48:1185-1192

- A total of 2,406 deaths in young athletes aged 19 ± 6 years in 29 diverse sports.
- Incidence in males exceeded females 6.5-fold (1:121, 691 vs. 1:787,392 athlete-years).
- HCM caused nearly 40% of male SCD events.
- CV deaths in AA and other minorities are nearly 5-fold higher compared to whites.
Sudden Cardiac Death

TABLE I. Staged Model of Sudden Cardiac Death in the Young

1) Existing cardiovascular abnormalities, such as:
   - Coronary anomalies, with stenosis (mainly ACAOS)
   - Hypertrophic cardiomyopathy
   - Dilative cardiomyopathy
   - Right ventricular cardiomyopathy
   - Channalopathy

2) . . . complicated by precipitating factors, such as:
   - Unusual cardiac workloads (competitive exercise)
   - Dehydration
   - Electrolyte imbalance
   - Overheating

3) . . . lead to sudden cardiac death.

ACAOS = anomalous origin of a coronary artery from the opposite sinus of Valsalva, with intramural but not intraseptal course

Symptoms and SCD

- 75% of cardiovascular etiology
- Usually during or shortly after exercise
- Dynamic exercise usually associated

However:
  - Exercise level/intensity previously performed without symptoms
  - Cases also occur at rest in athletes and non-athletes
Sudden Cardiac Death

In (older) adults: mostly ACVD, arrhythmia

Sudden Cardiac Death

In youth: not as simple!
Anomalous coronary artery depicting an interarterial course between the great vessels. (Courtesy of Dr. Debra Kearney)

Intramural course within the wall of the aorta. 50% of the thickness of the aortic wall is internal to the coronary and 25% is external. (From Angelini et al. Tex Heart Ins J 2002)

Major Player?

16 yo AA female athlete, runner, best time in 5K run a week prior, collapses at school on Thursday evening as she sprints from one corner to the other of the classroom to grab a basket.

EMS rhythm strip post defibrillation and effective CPR

diagnosis of ALCA
Mere Spectator?

17 yo white male athlete, basketball player and track runner, with CP, SOB and fatigue “different from asthma,” had cardiology evaluation due to Fam Hx of DCM

diagnosis of ARCA (5 mm IM course, stenotic ostium (1.5 mm))

How To Detect?
Clinical Evaluation

- Limited data (at best) to predict who is at risk of SCD
- Often asymptomatic (over 50%), with SCA as 1st presentation
- Symptoms of concern are common in daily outpatient practice
- Age range of patients we see are the population at risk for SCD
- Risk stratification is lacking

Harmon et al Circ Arrhythm Electrophysiol 2014
Maron et al NEJM 2003
Angelini et al JACC 2013

AHA 2013

Cardiac Screening before Participation in Sports

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<thead>
<tr>
<th>QUESTION 1, OPTION 1</th>
<th>QUESTION 2, OPTION 1</th>
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<tbody>
<tr>
<td>Require Young Athletes to Undergo Cardiac Screening before Participation in Sports</td>
<td>Cardiac Screening for Young Athletes before Participation in Sports Should Include a History and Physical Examination Only</td>
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<tr>
<td>Sanjay Sharma, M.D.</td>
<td>Victoria L. Vetter, M.D.</td>
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<tr>
<th>QUESTION 1, OPTION 2</th>
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<tr>
<td>Do Not Require Young Athletes to Undergo Cardiac Screening before Participation in Sports</td>
<td>Cardiac Screening for Young Athletes before Participation in Sports Should Include a History, Physical Examination, and ECG</td>
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<tr>
<td>N.A. Mark Estes III, M.D.</td>
<td>Domenico Corrado, M.D., Ph.D.</td>
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Online Polling Results for Voters from the United States as Compared with Voters from Italy

Cardiac Screening before Participation in Sports — Polling Results

Mandatory Electrocardiographic Screening of Athletes to Reduce Their Risk for Sudden Death
Proven Fact or Wishful Thinking?
Arie Steinvil, MD,* Tamar Chushalceva, MD,* David Zeltser, MD,* Ori Rogowski, MD,* Amir Halkin, MD,† Yair Gally, Ph.D,‡ Haim Perlok, MD,§ Sami Viskin, MD†
†Tel-Aviv, Israel

JACC 2011;57:1291-1296
AHA 14-Element

Table 1. The 14-Element AHA Recommendations for Preparticipation Cardiovascular Screening of Competitive Athletes

Medical history
1. Chest pain/dyspnea/tightness/pressure related to exertion
2. Unexplained syncope/loss of consciousness
3. Excessive and unexplained dyspnea/lung congestion, associated with exercise
4. Prior recognition of a heart murmur
5. Elevated systolic blood pressure
6. Prior restriction from participation in sports
7. Prior testing for the heart, ordered by a physician

Family history
8. Premature death (sudden and unexpected, or otherwise) before 50 y of age attributable to heart disease in a 1st relative
9. Disability from heart disease in a close relative (<50 y of age)
10. Hypertrophic or dilated cardiomyopathy, long-QT syndrome, or other ion channelopathies, Marfan syndrome, or clinically significant arrhythmias; specific knowledge of genetic cardiac conditions in family members

Physical examination
11. Heart murmur
12. Fetal heart sounds to exclude aortic coarctation
13. Physical symptoms of Marfan syndrome
14. Fractured artery blood pressure (sitting position)

Limitations of Screening

- Anomalous coronary artery
- Developing heart – HCM spectrum
- Screening: one point in time – longitudinal F/U
- Psychological burden – real or myth?
- Cost of further evaluation/false positives
What Is Relevant?

- Chief complaint
- Symptoms (non/exertional)
  - Dizziness
  - Syncope
  - Seizures
  - Chest pain
  - Palpitations
  - Dyspnea
  - Limited activity
- Past medical history
- Family history
  - Early MI
  - Stroke
  - SCD
  - SIDS
  - CM
  - Arrhythmia
  - Genetic syndrome

Screening is Feasible – Best Approach

Education
- How to read ECGs, though AAOCA and Ao disease not picked up
- Best strategy for participation rather than not to play
- Risk stratification warranted
- Know the limitations

Cost Effectiveness
- Better ECG criteria
- Feasible, reliable hand held devices
- Targeted, precise evaluation for true CV disease
International Consensus Standards for Electrocardiographic Interpretation in Athletes

In press
Main Points

- Broad-based screening at all levels (not only competitive/elite): USA – history and PE, Italy and Israel – history, PE and ECG
- Recommended: AHA 14-point elements history and PE
- Adding ECG may be considered in small cohorts (schools, colleges/universities, communities)
- “International consensus standards for ECG interpretation in athletes”
Sudden Cardiac Arrest

- Risk of physical activity
- Main causes:
  - CAD – usually man > 35 years
  - HCM – younger ages (AAOCA ???)
- Rare in women (Roberts 2012)
- AEDs have improved survival
- Survival stats:
  - Street arrest 5-10%
  - Marathon arrest > 50%

EAP, CPR and AEDs

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities:

A Scientific Statement From the American Heart Association and American College of Cardiology

Mark S. Link, MD, FACC, Chair
Robert J. Myerburg, MD, FACC
N.A. Mark Estes III, MD, FACC
Main Points

• EAP at all sporting events, schools
• AED availability within 5 minutes of cardiac arrest
• Sites for athletes to be taken should be trained in advanced post-cardiac arrest management
• Advocacy – big in the US

State Advocacy – US

[Map showing states with CPR in Schools Legislation]

http://cpr.heart.org/AHAEC/CPRAndECC/Programs/CPRinSchools/UCM_475820_CPR-in-Schools-Legislation-Map.jsp
Don’t Forget the Benefit Side of the Equation for Participation in Organized Sports

Organized Sports Build:
- Leadership
- Teamwork
- Coping
- Goal setting
- Focus
- Cooperation
- Social skills

From Sharlene Day – thank you!

Thank you!