Prediction and Prevention of Sudden Death in the Athlete

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Strive to Revive 2019
Friday October 4th, 2019
Sudden Cardiac Death in Athletes

- Historical Perspective
- Epidemiology
- UPMC Case
- Screening
- Structural Heart Disease
- Performance Enhancing Substances
- AEDs
- Conclusions
Sudden Cardiac Death in the Sport
Historical Perspective

- **Pheidippides**
  Ran from Marathon to Athens to announce victory over the Persians.

  After running 24 miles (40 km) he dropped dead.

Martin, Ann NY Acad Science, 1977
To an athlete dying young

Reggie Lewis
1965-1993

Evidence Based Medicine

Townsman of a stiller town.

Antonio Puerta
1984-2007
Sudden Cardiac Death Athletes
Epidemiology

High school and college women  1/769,000
High school and college men  1/133,000
  High school men  0.66/100,000
  College men  1.45/100,000
Males> age 40  1/15,000
  Risk of SCD increases 8-56X with exercise

Sudden Cardiac Death in the Athlete
Deaths by Sport

Sudden Cardiac Death in the Athlete
Cardiac Condition and Race

% of Athletes

The general population has a higher risk of SCD in comparison with an athletic population.

Annual Causes of Death in U.S. Population Age 1-21 (CDC)
79,000,000

Accident: 14,000
Homicide: 5,000
SCD: 3,000
Suicide: 2,000
Cancer: 1,000
SCD-Sports: 500

(http://webappa.cdc.gov/sasweb/ncipc/leadcaus10.html)
27 year old marathon runner (US Olympic Team Qualifier) with 7 months of exertional palpitations and syncope
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UPMC Mercy HVI Team
Semsa Comor, Jackie Dustevitch, Stacey Tomer, Sue Davis, Alyssa Sukay
Julia Tornabene, Erica Byers, Kelsey Thimons
27 year old marathon runner (US Olympic Team Qualifier) with 7 months of exertional palpitations and syncope
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- Frequent LBBB, RAD PVCs
- Echo- Normal
- CT-Normal
- MRI with LGE- Normal
- EP study- Normal
- Spontaneous RVOT PVCs
- Ablation of RVOT PVCs
27 year old marathon runner (US Olympic Team Qualifier) with 7 months of exertional palpitations and syncope

- What would you do next?
- A) Beta blockers
- B) ICD-Transvenous
- C) ICD-Subcutaneous
- D) Observation
6 weeks post ICD
21 minutes on Bruce Protocol

1 minute into recovery
27 year old marathon runner (US Olympic Team Qualifier) with 7 months of exertional palpitations and syncope

- What would you do next?
- A) No athletics
- B) Recreational athletics
- C) Competitive athletics
- D) Add beta blocker and repeat ETT
6 weeks post ICD
21 minutes on Bruce Protocol-No "noise" on S-ICD

6 weeks post ICD
Isometric arm exercise
Causes of SCD in Athletes (<40 years)

- Congenital coronary anomalies (19%)
- Mildly increased cardiac mass (10%)
- Ruptured aorta 5%
- Tunnelled LAD 5%
- Aortic stenosis 4%
- Myocarditis 3%
- Dilated cardiomyopathy 3%
- ARVC 3%
- MVP 2%
- CAD 2%
- Other 6%

### Pre-participation athletic screening and athletic restriction in Italy, the United States and Israel

<table>
<thead>
<tr>
<th>Country</th>
<th>Years</th>
<th>Screening</th>
<th>Initial</th>
<th>Examiner</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>1981-2008</td>
<td>Mandatory</td>
<td>History, PE, ECG, ETT, Echo</td>
<td>Sports Medicine MD</td>
<td>Decreased</td>
</tr>
<tr>
<td>United States</td>
<td>1985-2006</td>
<td>Recommended</td>
<td>History, PE</td>
<td>MD Non-MD</td>
<td>No decrease</td>
</tr>
<tr>
<td>Israel</td>
<td>1985-2009</td>
<td>Mandatory</td>
<td>History, PE, ECG, ETT, Echo</td>
<td>Certified MD</td>
<td>No decrease</td>
</tr>
</tbody>
</table>
Is It Fair to Screen Only Competitive Athletes for Sudden Death Risk, or Is It Time to Level the Playing Field

Maron and Estes Am J Cardiology 2018
36th Bethesda Conference: Task Force 9
Drugs and Performance Enhancing Substances

“You don’t win the Tour de France on mineral water” (Jacques Anquetil – 5 time winner)

Cycling deaths
1896 European Competition
1960 Olympics
1967 Tour
Lance Armstrong – 7 time consecutive winner
■ No increased risk of death
■ Increased shocks
■ Consider underlying heart disease
■ Sports participation with ICD-shared decision
1. ICD indications for competitive athletes should not differ from those applicable to the general population with appropriate diagnoses and clinical profiles (Class I; Level of Evidence C).

2. Recommendations should be based on existing evidence for benefit and risk and should include discussions of potential impact on sport-specific participation and performance (Class I; Level of Evidence C).

3. Participation in sports classified as IA for athletes with an ICD is reasonable if they are free of episodes of ventricular flutter or ventricular fibrillation requiring device therapy for 3 months (Class IIa; Level of Evidence C).
4. Participation in sports with higher peak static and dynamic components than class IA may be considered if the athlete is free of episodes of ventricular flutter or ventricular fibrillation requiring device therapy for 3 months. The decision regarding athletic participation should be made with consideration of, and counseling of, the athlete regarding the higher likelihood of appropriate and inappropriate shocks and the potential for device-related trauma in high-impact sports (Class IIb; Level of Evidence C).

5. The desire of the athlete to continue athletic competition should not represent the primary indication for use of an ICD (Class III; Level of Evidence C).
AEDs Available for Home Use With Rx

Automated External Defibrillators in the Public Domain
Am I Ready to Use One?
N.A. Mark Estes III, MD

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Task Force 12: Emergency Action Plans, Resuscitation, Cardiopulmonary Resuscitation, and Automated External Defibrillators

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

An AED is used on a victim of sudden cardiac arrest. After 911 has been called, the AED is turned on (1). The adhesive pads are then applied (2). The AED automatically analyzes the cardiac rhythm (3). If a life-threatening cardiac rhythm disturbance is present, a voice prompt from the AED advises that a button be pushed to deliver a shock (4).
AED Termination of VF

Jiří Fischer  Cardiac Arrest 2005
As evidence-based medicine has defined the clinical benefits of AED use, public policy, laws, funding programs, and court decisions have served the societal interest of promoting use of AEDs by minimizing legal liability.

The Automated External Defibrillator: Clinical Benefits and Legal Liability

Hannah E. Episcopo, BA
Fred S. Weinberg, JD
N. A. Mark Estes III, MD

Sudden cardiac arrest is the most common cause of death in the United States, accounting for an estimated 350,000 deaths annually, and it is a leading cause of disability and health care costs. Life-threatening cardiac arrhythmias such as ventricular tachycardia or ventricular fibrillation are necessary to incapacitate individuals with cardiac arrest, and survival depends directly on the time to defibrillation. Automated external defibrillators (AEDs) reduce the time to defibrillation and have improved survival rates. Although clinical benefits of AEDs are established, individuals, institutions, and organizations implementing AED programs have faced a complex and evolving legal and regulatory landscape. However, compliance with relevant regulations minimizes legal risks of AED ownership, use, or medical oversight. Health care professionals should be aware of the clinical benefits of AED programs and strategies for risk management.

Evidence Supporting AED Use

In an effort to improve survival from cardiac arrest, the American Heart Association has promoted the Chain of Survival concept, describing a sequence of prehospital steps that must be improved to improve survival after sudden cardiac arrest. These interventions include rapid access to emergency medical services by calling 911, prompt cardiopulmonary resuscitation after cardiac arrest, early defibrillation when indicated, and early initiation of advanced medical care. Early defibrillation has emerged as the most important intervention, with survival decreasing by 10% with each minute of delay in defibrillation.

Multiple studies and meta-analyses have demonstrated that early defibrillation improves survival for individuals with sudden cardiac arrest. Despite the evidence, many communities continue to have poor survival rates because of long response times of emergency personnel and delays in delivering effective therapy with defibrillation. To address these limitations in the chain of survival, the concept of public access defibrillation has been promoted to expand the use of an immediately available defibrillator to minimize the time between arrest and effective commencement of advanced emergency medical care.

The Public Access to Defibrillation Trial demonstrated that trained laypeople can operate AEDs safely and effectively to provide early defibrillation. In this prospective randomized trial, 931 communities were randomized to standardization resuscitation training with response by emergency personnel or a trained volunteer with an AED. Survival in the AED groups was nearly 30-fold greater. Of 129 cardiac arrests in the cardiovascular resuscitation plus AED communities, 90 patients survived. Of the 103 cardiac arrests in the communities trained only in cardiopulmonary resuscitation, 15 survived. In 21.5 months of follow-up, there were no adverse events related to AED use. No patient received an inappropriate shock or failed to receive a needed shock.

The Public Access to Defibrillation Trial demonstrated that training and equipping volunteers within a structured response system increases the number of survivors after out-of-hospital sudden cardiac arrest in public locations, and that trained laypeople can use the AED safely and effectively. Based on these findings, AEDs are increasingly being used in public and private locations.

Federal Policies and Legal Considerations

Federal law provides the basic framework for limiting liability for AED ownership, oversight, and use. Uniformly, expanded use of AED programs has been hampered by largely unfounded concerns regarding legal liability. To address liability concerns, state and federal Good Samaritan legislation has been developed specifically to protect responders using AEDs.

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Published Online: February 2, 2006—Vol 295, No. 5—DOI: 10.1001/jama.295.5.587
PAD Trial Location of Cardiac Arrest

PAD Investigators The Public Access to Defibrillation Study NEJM 2004;637-645
AEDs in the NCAA

% Institutions with AEDs

Div IA: 97%
Div IAA: 88%
Div IAAA: 84%
Div II: 77%
Div III: 81%

[N=486; average survival 11%; range 4-21% per year]

Low survival rate demands re-evaluation of emergency response planning for SCA in sport

Drezner; *Heart Rhythm* 2008
The Collapsed and Unresponsive Athlete
Management of SCA

- Suspect SCA in any collapsed and unresponsive athlete
- An AED should be applied as soon as possible for rhythm analysis and defibrillation if indicated

Drezner; *Heart Rhythm* 2007
Outcomes from Sudden Cardiac Arrest in US High Schools: A Two Year Prospective Study from the National Registry for AED Use in Sports

- 2,149 high schools
  - 87% with AED program
- 95% 2-year follow-up
- 59 cases of SCA on campus
- 79% male

Pie chart showing the distribution of victims:
- Students & Student-Athletes: 44%
- Adults: Visitors, Spectators, & Staff: 56%
Outcomes from Sudden Cardiac Arrest in US High Schools: A Two Year Prospective Study from the National Registry for AED Use in Sports

Resuscitation Details

- 93% witnessed
- 92% prompt CPR
- AEDs applied in 85% of cases
  - Provided by school: 41 (69%)
  - Provided by off-site EMS: 15 (23%)
  - Provided by on-site EMS: 3 (5%)
- 66% shock deployed
Survival Following SCA

Onsite AED vs. EMS H 4.0, p > 0.03
**Sudden Cardiac Death in Sports**

- Almost all young athletes dying suddenly have underlying heart disease—males are at greater risk than females.

- Current screening techniques lack sensitivity and specificity for detecting athletes at risk for sudden death.

- Performance enhancing substances are widely used and contribute to risk of death in athletes.

- AEDs are effective in improving survival in sports.

- Gaps in evidence need to be bridged.
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