Pheidippides’ ECG?

Magnitude of SCD in the US

SCD Landscape

Breast cancer

SCD-HeFT

AVID

MADIT

Causes of SCD (Age>35)

Huikuri et al. NEJM 2001

SCD due to CAD: Darryl Kile

Causes of SCD (age<35)

• #1: Hypertrophic CM
  - 1 in 500
  - Scarred and disordered myocardium
  - Confirmed HCM in 26.4% of SCDs
  - Probable HCM in 7.5% additional cases of SCD
• Diagnosis
  - PE
  - ECG
  - Echo

Maron NEJM 2003
Hypertrophic CM: Hank Gathers

Causes of SCD (age<35)

- #2: Commotio Cordis
  - Blunt blow to the chest 15-30ms before T-wave peak (vulnerable phase of repolarization)
  - Mean age 13 years old
    - Compliant chest wall
    - 19.9% of SCDs
    - Structural normal heart
    - Normal ECG
Causes of SCD (age<35)

- #3: Congenital Coronary Artery Anomalies
  - Artery arises from wrong aortic sinus
  - Classic presentation: CP or syncope with exercise
  - 13.7% of SCDs
  - Diagnosis:
    - Stress test
    - Echo
    - MRI
    - CT
    - Cath
    - Normal ECG
Athlete’s Heart

- **Triggers**
  - Endurance sports (rowing, cross country skiing, swimming)
  - Isometric sports (weightlifting, wrestling)

- **Cardiac changes**
  - Heart size and chamber enlargement
  - Increased LV wall thickness
  - Increased LA
  - Preservation of systolic and diastolic function

- Associated with abnormal ECG patterns
- Considered a benign adaptation to training
17 year old Swimmer

- Referred for Abnormal ECG
- Sees you for evaluation
  - No syncope
  - No symptoms of cardiac disease
  - No FH of SCD
  - Appears to be extremely physically fit
  - Rest of exam benign except for a soft systolic murmur

- Echo
  - Significant concentric LVH with maximal wall thickness of 14 mm (normal <12 mm)
  - Normal LV cavity of 48 mm
  - Normal systolic and diastolic function
  - Normal valves
- MRI normal except for wall thickening
- ETT normal
- 24 hour holter normal
- Now what?
After 8 week of Deconditioning

LVH regressed from 14 mm to 11 mm


ICD Size

ICDs and Exercise

Physician recommendations regarding avoidance of activities

- All more vigorous than golf or bowling
- All vigorous sports
- Contact sports
- Competitive sports
- Sports with risk of injury
- No restrictions

Percent of respondents

Lempert et al. JCE 2004
Pre-participation Screening in Italy

Flow diagram illustrating the proposed screening protocol for young competitive athletes

Corrado et al. JAMA 2006
**AHA Recommendation**

If age >35, add ETT if RF for CAD
If age >65, add ETT

Maron et al. Circulation 2007

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**AHA Cost Analysis for U.S.**

- 10M middle school and high school athletes
- Initial Screen
  - $25 for H&P
  - $50 for ECG
- Follow-up Screen
  - $100 for H&P
  - $400 for Echo
- Administrative Cost: 500M
- Total Cost: $2B
- $330,000 for every relevant disease diagnosed

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**Other Cost Effectiveness Analysis**

Cost effectiveness of pre-participation screening for prevention of sudden cardiac death in young athletes

Matheny T, Wheeler, MD, FACC, Paul A. McDowell-White, MD, MS, FACC, FAPA, Victor P. Froelicher, MD, PT, Ross A. Heymsfield, PhD, and Edward A. Araghi, MDCM (Hep). Division of Preventive Cardiology, Department of Medicine, Stanford University, Stanford, CA 94305

Annals of Internal Medicine 2010

Cost and yield of adding electrocardiography to history and physical for screening Division 1 intercollegiate athletes:

A 5-year experience

Matheny T, Wheeler, MD, FACC, Paul A. McDowell-White, MD, MS, FACC, FAPA, Victor P. Froelicher, MD, PT, Ross A. Heymsfield, PhD, and Edward A. Araghi, MDCM (Hep). Division of Preventive Cardiology, Department of Medicine, Stanford University, Stanford, CA 94305

Annals of Internal Medicine 2010

HRS 2011
AHA Recommendation

Maron et al. Circulation 2007

If age >35, add ETT if RF for CAD
If age >65, add ETT
Pre-participation Screening at UCSF

- 80 total volunteers
  - Half were RNs and MDs
- 40 volunteers for cardiac screening
  - 7 ECG machines
    - 10 ECGs per hour per machine
  - 2 Echo machines
    - 1.5 Echo’s per hour per machine
ECG Screening at UCSF

- **By the Numbers**
  - 2009: 155 athletes
  - 2010: 349 athletes
  - 2011: 327 athletes
  - 2012: 540 athletes
- 1371 total screened
- 1216 unique athletes
- 52 (4.28%) with abnormal ECG leading to Echo
- 8 (0.7%) not approved for sports and need further work-up by their own MDs

Findings

- 8 non-approved athletes
  - 2 WPW
  - 2 Long QT
  - 1 RVE with ASD
  - 1 LVH with syncope
  - 1 Bicuspid AV and PFO
  - 1 Orthopedic injury

Conclusions

- Most SCDs occur in otherwise healthy individuals
- Main cause of SCD
  - Over 35: CAD
  - Under 35: HCM, Commotio Cordis, Coronary Anomalies
- ICDs can be life-saving but will limit physical activity
- Young athletes screening:
  - H&P
  - ECG
- Master athletes (age >35) screening:
  - H&P
  - ETT (if RFs for CAD or age>65)
- Community based programs can find new disease and save lives
Resuscitation Success vs. Time

Chance of success reduced 7-10% each minute


Corrado et al. JAMA 2006