Cardiovascular Screening and the Pre Participation Physical

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Objectives

• To identify the causes of sudden death in athletes
• To discuss the prevalence of sudden cardiac death in athletes
• To describe the current American Heart Association recommendations for cardiac screening in athletes.
• To discuss current trends in cardiac screening for athletes
Causes of Sudden Death in Athletes

- Medical
  - Cardiac Arrest
  - Asthma
  - Diabetes
  - Heat stroke
  - Hyponatremia
  - Sickle Cell
- Trauma
  - Brain injuries
  - Cervical Spine Injuries
- Environmental
  - Lightning
- Other
Sudden Cardiac Death (SCD)

- 1:160,000 to 1:300,000 competitive athlete deaths per year due to CV disease in USA per Maron & Van Camp
- 1:28,000 for athletes aged 12 to 35 in Veneto region of Italy per Corrado 2006 study in JAMA
- 1:27,000 in children & young adults (ages 14-24) reported by Atkins et al in 2009 article in Circulation
- 1:9000 in US military recruits ages 18-35 by Eckart et al in 2004 article in Annals of Internal Medicine
Sudden Cardiac Death (SCD)

**STRUCTURAL**
- Hypertrophic Cardiomyopathy (HCM)*
- Coronary Artery Anomalies*
- Aortic Rupture/Marfan Syndrome*
- Dilated Cardiomyopathies*
- Myocarditis
- Mitral Valve Prolapse
- Atherosclerotic Heart Disease*
- Arrhythmogenic Right Ventricular cardiomyopathy (ARVC)*
- Post op Congenital Heart Disease

**ELECTRICAL**
- Long QT Syndrome (LQTS)*
- Wolf-Parkinson-White syndrome (WPW)
- Brugada Syndrome*
- Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)*
- Short QT syndrome*
- Complete Heart Block

**OTHER**
- Drugs and Stimulants
- Primary Pulmonary Hypertension (PPH)*
- Commotio Cordis


(*familial or genetic)
Sudden Cardiac Death (SCD)

Prevention

- Pre-participation Exam
  - AHA guidelines
- To do EKG or Not?
  - Europe vs. USA
Sudden Cardiac Death (SCD): the PPE

4th Edition published in 2010

Endorsed by:
- American Academy of Family Physicians
- American Academy of Pediatrics
- American College of Sports Medicine
- American Medical Society for Sports Medicine
- American Osteopathic Academy of Sports Medicine
- American Orthopedic Society for Sports Medicine
American Heart Association Twelve Point Screening: Medical History

**Personal History**

1. Exertional CP or discomfort
2. Unexplained syncope or near syncope
3. Excessive & unexplained dyspnea or fatigue associated with exertion
4. Previously recognized heart murmur
5. Elevated systemic blood pressure
American Heart Association Twelve Point Screening: Medical History

Family History

1. Premature (sudden & unexpected) death of ≥ 1 relative before the age of 50 due to suspected or confirmed heart disease

2. Disability from heart disease in a close relative ≤ 50 years old

3. Knowledge of hypertrophic or dilated cardiomyopathy, Long QT syndrome, Marfan syndrome or any clinically important arrhythmias in any family member
American Heart Association Twelve Point Screening: **Physical Exam**

1. Heart Murmur
2. Diminished or asymmetric femoral pulses
3. Physical Stigmata of Marfan Syndrome
4. Asymmetrical or elevated Brachial Artery Blood Pressure (>140/90mmHg)
So what’s the controversy??

*Are we doing enough???
The Italian Experience

• 1982 government instituted mandatory PPE with EKG for all athletes <35 years of age
  • Data compiled lead to 2005 Consensus Statement from European Society of Cardiology favoring EKG as part of the PPE

• 2006 Study by Corrado (JAMA) showed significant reduction in SCD in Veneto Region due to increased recognition of cardiomyopathies in screened athletes age 12-35.
  • Annual incidence of SCD was reduced by 89% with an incidence of 0.4/100,000

Corrado, JAMA 2006, Oct4:296(13);1593-603
The American Experience


Both Opposed to Screening with EKG

- Substantial false positive results
- Burden to athletes, their families and testing facilities
- Large population of athletes needing screening
- Cost benefit considerations
- Recommended that when CV abnormality is suspected the diagnostic strategy should focus on the exclusion of those conditions known to cause SCD.
The American Rationale

• The Numbers Game
  • 15 million athletes in USA vs. 6 million in Italy
  • In USA most SCD occurs in non athletes thus EKG screening would have to include all children

• The Reality of Sudden Cardiac Death
  • SCD occurs in fewer than 100 annually or 1 in 220,000

• The False Positives
  • Low specificity & positive predictive value
  • May require extensive noninvasive testing causing increased anxiety and cost

The American Rationale

- **The Cost**
  - AHA estimates ~ $2 Billion annually

- **The Athlete’s Civil Rights**
  - Mandatory screening with disqualification may be considered an infringement on individual liberty & the freedom to assume personal risks

- **The Logistics**
  - Who will do the screening & follow up?
  - USA does not have a “socialized” system

The Harvard Experience

- 3 yr study 2006-2008
- 510 college athletes
- Exam Consisted of:
  - History
  - PE
  - 12 Lead EKG
  - Trans Thoracic Echo
- History & PE alone compared to EKG & Echo

The Harvard Experience

H&P Alone:

• Mean time of 8 minutes to complete
  • 33 (6%) were “abnormal”
    • 21 (64%) on History
      • Prior Murmur (10)
      • Unexplained syncope (6)
    • 12 (46%) on Physical Exam
      • 10 with Murmur
      • 2 with BP issues

• Correct ID 5 of 11 (45%) of those with Abnormal Echos

• Failed to ID 6 (55%) including 1 with HCM & 1 with Myocarditis
  • Sensitivity of 45.5%; Specificity 94.4%
  • Positive predictive value of 15.0%
  • Negative Predictive value of 98.7%

The Harvard Experience

Echo Results:
- 387 (76%) structurally normal
- 110 (22%) “mild” abnormality due to remodeling
- 2 excluded for poor images
- 11 “abnormal” (2.2%)
  - 3 (0.6%) restricted from sports permanently (Pulmonic stenosis; HCM & Myocarditis)
- Overall Prevalence of abnormality that required restriction was 0.6% (3 of 508)

Baggish, Hutter et al, Ann of Intern Med;152:269-275
The Harvard Experience

**EKG Results:**

- **Mean of 3 minutes to complete**
  - 83 (16%) had at least one “abnormal” criteria
    - 48 (9%) had one abnormality
    - 35 (7%) multiple abnormalities
  - Of 83 with abnormal EKG, ECHO showed
    - 9 (11%) had structurally normal hearts
    - 72 (87%) had physiological remodeling
    - **5 (6%) had finding that warranted further studies**

Baggish, Hutter et al, Ann of Intern Med;152:269-275
EKG Results:

• EKG Screening detected 10 of 11 with Echocardiogram detected abnormality

• Combo of History, PE & EKG identified all 3 participants with abnormalities requiring restriction

• Combo of History, PE & EKG
  • Sensitivity of 90.9%; Specificity of 82.7%
  • Positive Predictive Value of 10.4%
  • Negative Predictive Value of 99.8%

Baggish, Hutter et al, Ann of Intern Med;152:269-275
The Harvard Experience

Conclusions:

- History, PE & EKG Integrated screening identified all 3 athletes with abnormalities requiring restriction
- History & physical alone failed to detect 2 of these “at risk” athletes
- Adding EKG to History & PE improved overall sensitivity & negative predictive value of athletic screening to 99.8%
- Could not draw conclusion on effects on the incidence of SCD

Baggish, Hutter et al, Ann of Intern Med;152:269-275
The Stanford Experience

- Researchers at University published two studies in March of 2010 regarding use of EKG in Pre-Participation Exam

  - Clinical Journal of Sports Medicine
  - Annals of Internal Medicine
The Stanford Experience #1

Sports Medicine department added EKG to PPE in 2007

- 658 recordings were obtained and placed into Stanford defined criteria of “normal” vs. “abnormal”
  - 222 (34%) had one major abnormality
    - LVH was most common (49%)
    - T wave inversion was next most common (7%) & more common in women
  - < 2% presented a pattern of malignant cardiac disease.

Le, Wheeler et al, Clinical J of Sport Med 2010;20:98-105
The Stanford Experience #1

• Did not determine final diagnosis of all persons with abnormal EKG

• 21 of 24 participants with most abnormal EKG patterns had normal MRI & Echocardiograms

• “The rate of secondary testing mandates the need for an evaluation of the cost effectiveness for mass screening and the development of new athlete-specific EKG interpretation algorithms.”

Le, Wheeler et al, Clinical J of Sport Med 2010;20:98-105
The Stanford Experience #2

• Study objective was to determine cost-effectiveness of EKG+H&P vs. H&P alone

• **Competitive athletes in HS & College ages 14 to 22**

• Used decision model with 3 screening options
  • No screening
  • AHA focused H&P
  • H&P + EKG per European Society of Cardiology Consensus Panel

• Complex cost-benefit model used and based on data previously published by Corrado et al in Italy

The Stanford Experience #2

• EKG + CV Focused H&P saves 2.1 life-years per 1000 athletes screened at an incremental cost of $88 per athlete compared to CV focused H&P alone.

• Incremental cost-effectiveness ratio of adding EKG plus H&P vs. H&P alone was $42,900 per life year saved.

• Use of EKG & H&P reduces SCD & has an acceptable cost-effectiveness ratio of $76,000 per life year saved.

• Data based on single screening per student athlete engaged in interscholastic or intercollegiate high risk sports rather than annual screening

2014 published study trying to better define the incidence of SCD
- Rates varied from 1:917,00 to 1:3,000
- Studies with higher methodological quality consistently yielded incidence rates of 1:40,000 to 1:80,000
- Some groups, African-American men & basketball players were noted to be at higher risk

Conclusion: “incidence of SCD in athletes is likely higher than traditional estimates which may impact the development of more effective prevention strategies”

The American Dilemma: Time for change?

- Need central registry for reporting **ALL** cases of Sudden Cardiac Death
- Need to make sure that qualified personnel are doing PPE’s
- Need to make sure all States adopt a standard of care
- Need Standard protocols for EKG interpretation in athletes
  - European Cardiology Society
  - Stanford Criteria
  - Seattle Criteria
The American Dilemma: Time for change?

RESULTS: Fifty (98%) states required a PPE before participation. Most states (53%, n = 27) required a specific PPE form, whereas 24% (n = 12) of states recommended a specific form. Twenty-three states (45%) required or recommended use of the PPE-4 form or a modified version of it, and 27 states (53%) required or recommended use of outdated or unidentifiable forms. Ten states (20%) had not revised their PPE forms in >5 years. States permitted 9 different health care providers to administer PPEs. Only 22 states (43%) addressed all 12 of the PPE-4 personal and family history cardiovascular screening items, and 2 states (4%) addressed between 8 and 11 items. For the remaining 26 states, most (29%) addressed \( \leq 3 \) screening items.

CONCLUSIONS: Our results show that inconsistencies in PPE policies exist nationwide. Most states have been slow to adopt PPE-4 recommendations and do not adequately address the personal and family cardiovascular history questions. Findings suggest a need for PPE standardization nationwide and adoption of an electronic PPE process. This approach would enable creation of a national database and benefit the public by facilitating a more evidenced PPE.

Causwell et al, PEDIATRICS Vol. 135 No. 1 January 1, 2015 pp. 26 -32
One Final Thought from the AHA

“Although the American Heart Association does not endorse mandatory EKG screening for all competitive athletes, it does not discourage less ambitious screening initiatives in individual high schools, colleges & local communities…”

Thank You!!

Oh what to to, what to dooo?