MECHANISM OF CARDIAC EVENTS IN COMPETITION: WHEN SCREENINGS PREVENT CATASTROPHE

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DISCLOSURE

- None

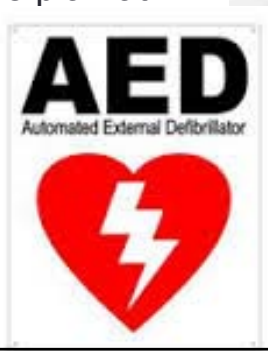
OBJECTIVES

- Understand importance of early resuscitation
- Review Incidence and Etiology of Sudden Death in Athletes
- Clues to detect Heart conditions in Athletes
- Eligibility and Disqualification recommendations for athletes with heart disease

Zeke Upshaw

Emergency action plan/resuscitation/CPR and AED

- If absence of P/Resp-initiate resuscitation
- Deploy AED and 911
- Emergency response plan at venue

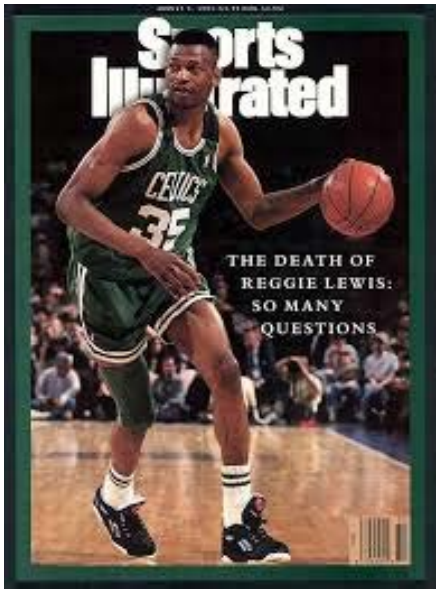


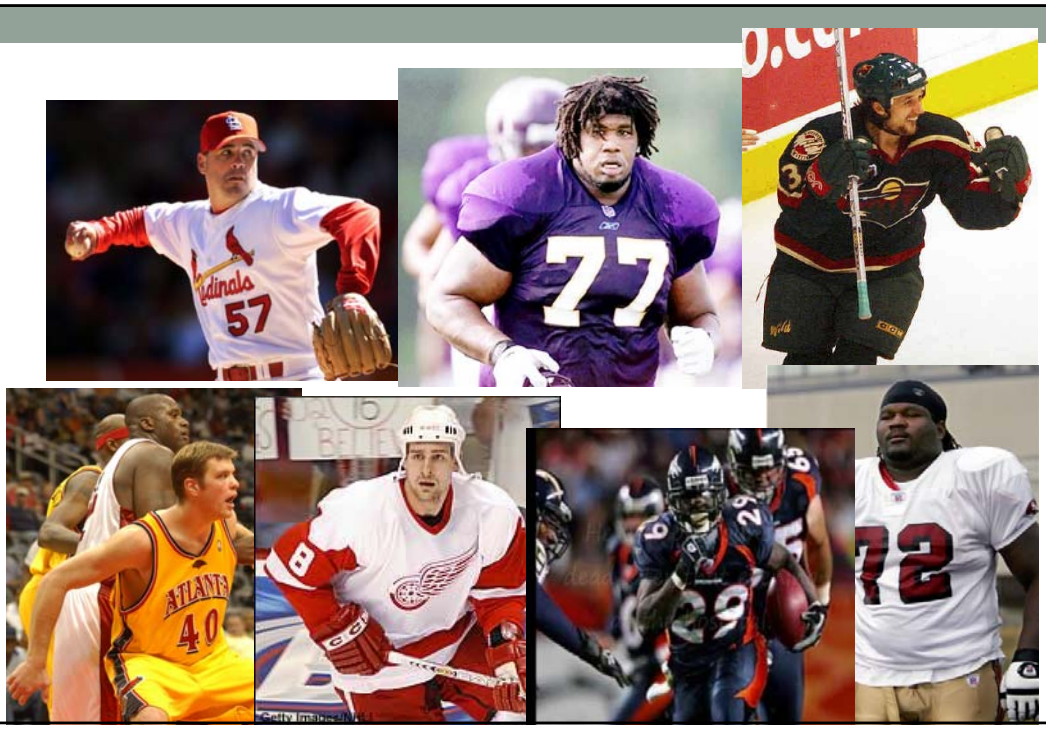
Sports-Related Sudden Death in the General Population

Eloi Marijon, MD; Muriel Tafflet, PhD; David S. Celermajer, PhD, FRACP; Florence Dumas, MD; Marie-Cécile Perier, MSc; Hazrije Mustafic, MD; Jean-François Toussaint, MD, PhD; Michel Desnos, MD; Michel Rieu, MD; Nordine Benameur, MD; Jean-Yves Le Heuzey, MD; Jean-Philippe Empana, MD, PhD; Xavier Jouven, MD, PhD

- Majority (93%) of arrests witnessed but Bystander CPR < 1/3
- Survival to discharge best predicted by:
  - Bystander CPR
  - Time from collapse to CPR
  - Initial use of Defibrillator

Reggie Lewis





Annals of Internal Medicine ORIGINAL RESEARCH

Death and Cardiac Arrest in U.S. Triathlon Participants, 1985 to 2016

A Case Series

Kevin M. Harris, MD; Lawrence L. Creswell, MD; Tammy S. Haas, RN; Taylor Thomas, BS; Monica Tung, BA; Erin Isaacson, BS; Ross F. Garberich, MS; and Barry J. Maron, MD

- 135 deaths/cardiac arrests were compiled for the entire group
- Overall risk 1.74 per 100,000 participants
- 85% were male and the average age was 47 ± 12 years
- 40% of victims were first-time participants
- 44% of autopsies showed cardiovascular abnormalities

Figure 2

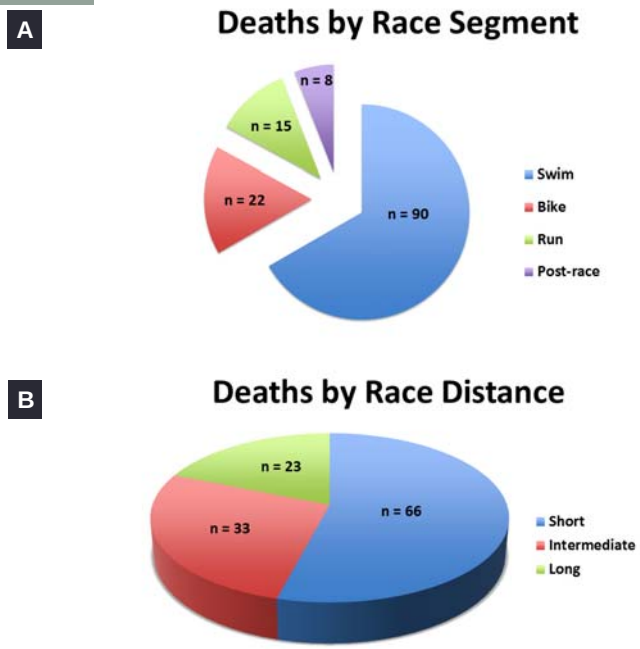
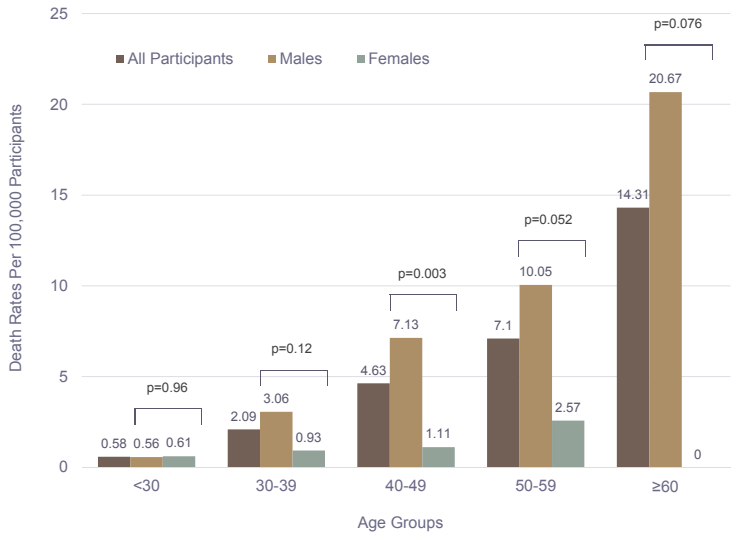


Figure 3



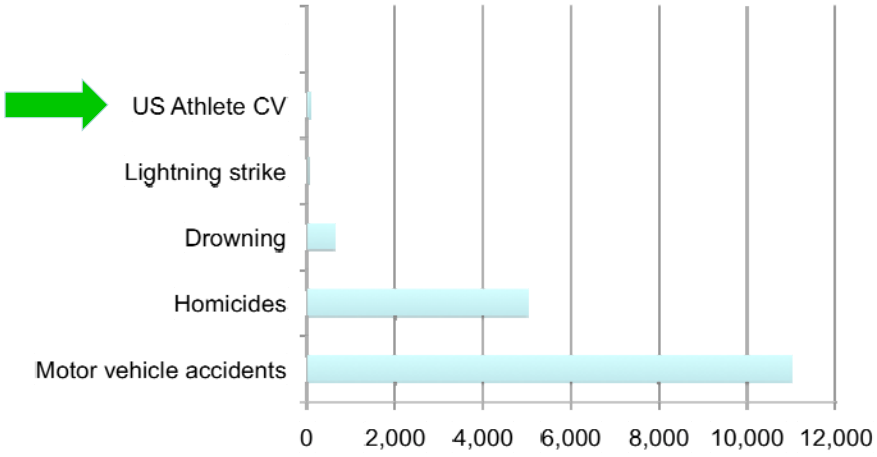
Take home implications

- Athlete: risk of competition
  - Be adequately trained, especially for swim
  - See Physician regularly
  - Pre race warm up
- Race/Medical director:
  - Remind athletes of risks and rest on buoy if needed
  - Water temperature/wet suit guidelines
  - Motor vehicle restrictions on roads
  - Expect worst case scenario, ie cardiac arrest with clear cut timely rescue plan, AED readily available
  - Medical staff available in watercraft and spotters on shore with communication

Table 4. Estimated Mortality Risks for Young and Middle-Aged Participants in Various Sporting Activities, Including Triathlon and Marathon

Study, Year (Reference)	Country	Study Years	Population	Age Range, y	Risk for Death
Marathon/triathlon					
Kim et al, 2012 (6)	United States	2000-2010	Marathon	22-65	1.0*
Redelmeier and Greenwald, 2007 (8)	United States	1975-2004	Marathon	Mean: 41	0.8*
Harris et al, 2017 (present study)	United States	1985-2016	Triathlon	15-80	1.74*
Young athletes					
Maron et al, 2016 (5)	United States	1980-2006	High school and college athletes	≤39	0.6†
Maron et al, 2013 (25)	United States	1986-2011	High school athletes (Minnesota)	12-18	0.7†
Van Camp et al, 1995 (26)	United States	1983-1993	High school/college athletes	13-22	Men: 0.75† Women: 0.1†
Maron et al, 2009 (27)	United States	1993-2004	High school/college athletes (Minnesota)		0.9†
Holst et al, 2010 (28)	Denmark	2000-2006	Danish athletes	12-35	1.2†
Harmon et al, 2011 (7)	United States	2003-2013	NCAA athletes	17-24	1.86†
Corrado et al, 2006 (29)	Italy	1979-2004	Young athletes (Veneto region)	12-35	1.9†
General athlete population					
Bohm et al, 2016 (30)	Germany	2012-2014	Sports participants (Germany)	10-75	0.12-0.15†
Marijon et al, 2011 (10)	France	2005-2010	Sports participants (France)	10-75	0.46†
Marijon et al, 2015 (31)	United States	2002-2013	Sports participants (Oregon)	35-65	2.17†

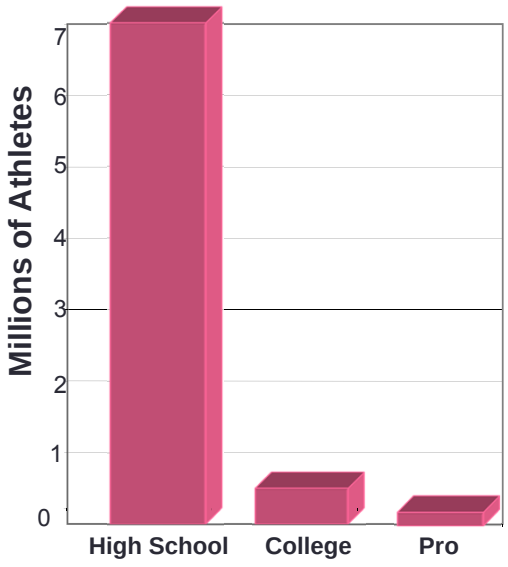
Frequency of Death due to all cause in those age < 25



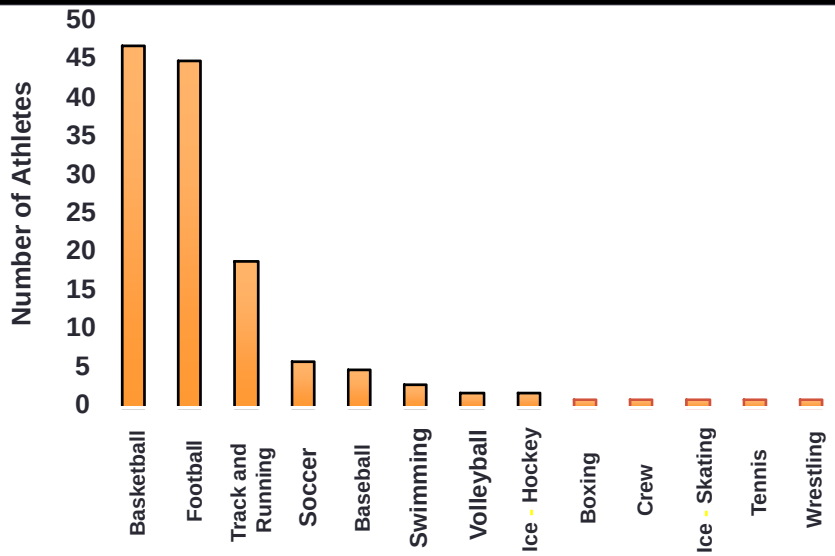
Preparticipation Cardiovascular Screening of Competitive Athletes

- Physical exercise is strongly encouraged for its cardiovacular benefits
- Sudden unexpected deaths, though rare, are tragic and counterintuitive
- There is a need for a screening process which detects the occult diseases

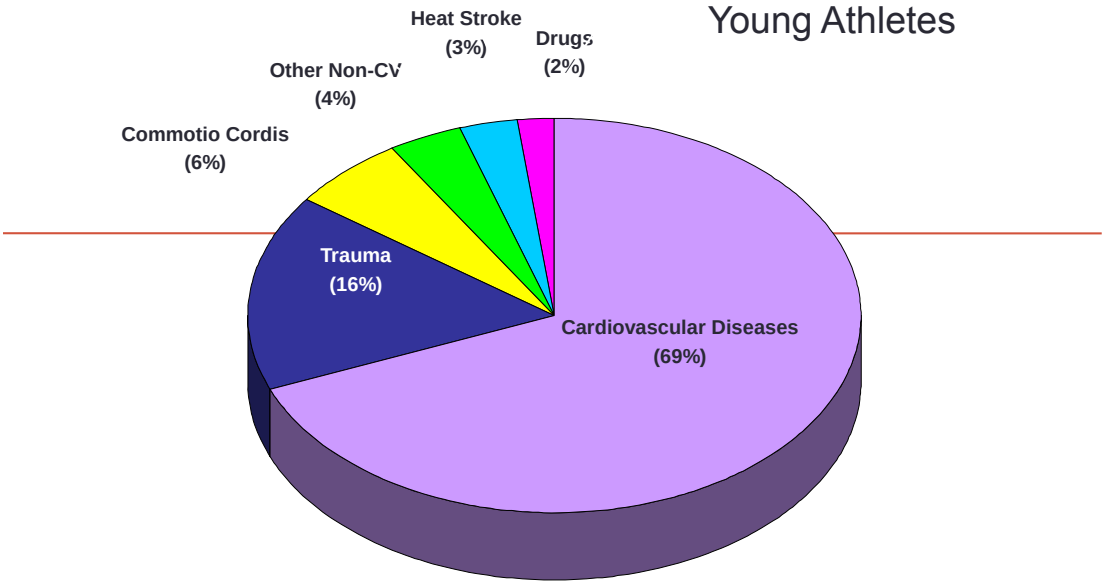
Participation Rates For Competitive Athletes in U.S.



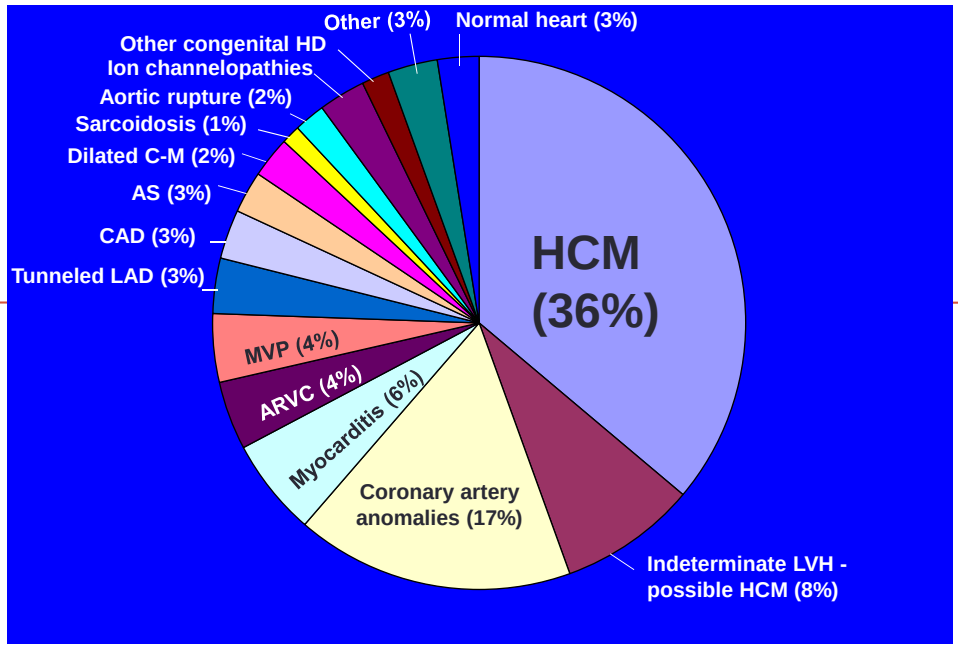
Sudden Cardiac Death in Competitive Athletes: Sports



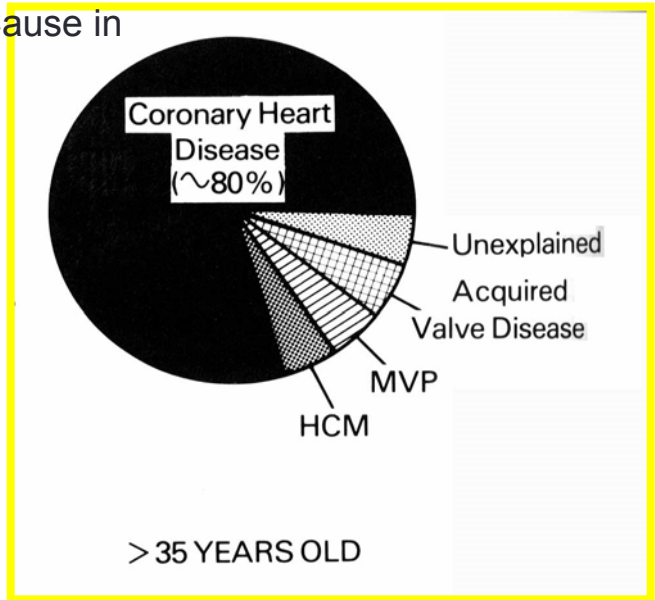
Causes of Death in Young Athletes



Cardiac Causes of Sudden Death in Young Athletes



Sudden Death Cause in Older Athletes



Maron BJ. Circulation 1980;62:218-229.

What symptoms should raise alarm at screening?

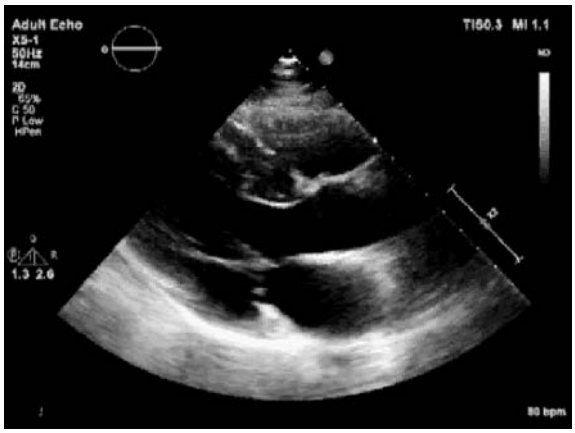
- Chest pain
  - CV disease prevalence varies by age but critical to recognize in the young
  - Non cardiac causes common
  - Anomalous coronary disease may present with exertional dypsnea
  - Older athletes, CAD common and may present with warm up angina
  - Need maximal exercise test
- Syncope
  - History may help narrow etiology- complete vs partial consciousness
  - Neurally mediated syncope rare during exertion
  - Stress testing and prolonged ambulatory monitoring may be appropriate

Symptoms (2)

- Palpitations
  - Sudden palpitations if occur in absence of trigger, more likely to be arrhythmia
  - Need to capture with prolonged monitoring
- Impaired exercise tolerance
  - May be subjective or objective
  - Careful evaluation for alternative causes (over training, viral, iron deficiency) but also exclude cardiac etiology
  - Objective determination of exercise capacity,

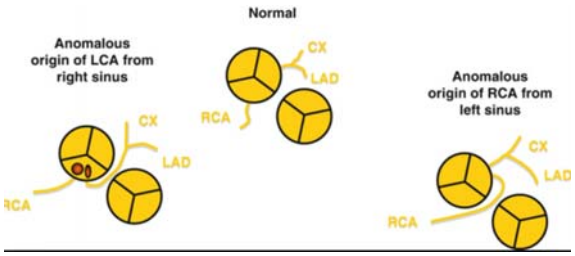
Hypertrophic cardiomyopathy

- Incidence 1 in 500, Autosomal Dominant
- Most common cause of death in athletes
- 2/3 will have resting/exercise obstruction
- Exertional dyspnea/chest pain



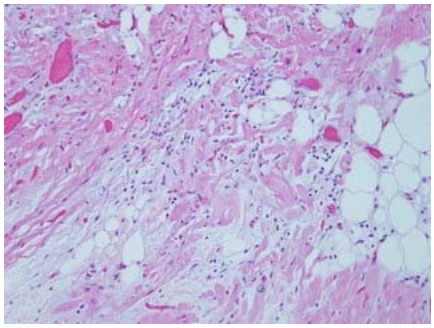
Anomalous coronary

- 2nd most common cause of death
- Syncope/pre syncope most common symptom
- Chest pain less common
- No physical exam/Ekg findings
- Coronary CTA test of choice



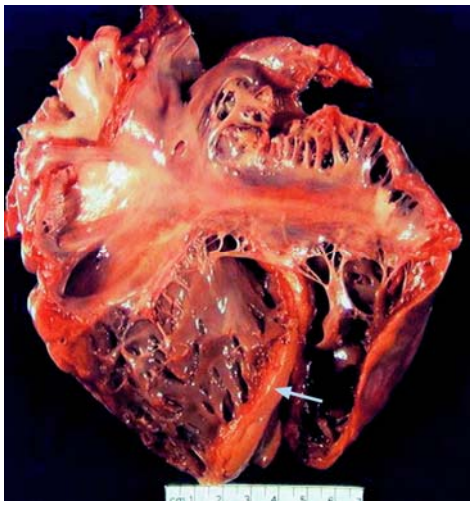
Myocarditis

- 3rd most common (6%) cause of death in young athlete
- Acquired inflammatory heart muscle disease
- Symptoms are non specific/viral and frequently not recognized
- Exercise in acute phase may exacerbate



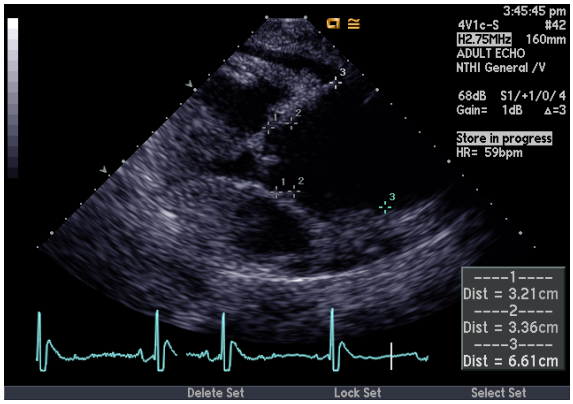
Arrhythmogenic Right ventricular cardiomopathy (ARVC)

- 4th most common cause of death
- Fibro-fatty infiltration of RV (LV) free wall
- Exercise induced palpitations, presyncope/syncope
- EKG may show epsilon waves, T wave inversion right precordium
- Should not engage in moderate or high intensity sports



Marfan syndrome (Aorta, Mitral valve prolapse)

- Classic Marfan rare connective tissue disease
- Tall stature, skeletal, eye manifestations
- Risk for aorta rupture
- Risk of SD in MVP very rare



AHA Recommendations (14 item)

FAMILY HISTORY OF:

1) Premature sudden death < 50 yo
2) Heart disease disability < 50 yo
3) HCM, DCM, long QT or other ion channelopathies, Marfan syndrome or arrhythmias

PERSONAL HISTORY OF:

4) Knowledge of heart murmur
5) Systemic hypertension
6) Excessive fatigue or exertional shortness of breath
7) Exertional syncope
8) Exertional chest pain
9) Prior sports restriction
10) Prior heart testing ordered by MD

PHYSICAL EXAMINATION FOR:

11) Heart murmur
12) Femoral pulses for coarct
13) Stigmata of Marfan Syndrome
14) Blood pressure measurement

2014

EKG: Pro and Con

- Pro
- Identification of cardiac disorders at young age
- Shortcomings of H and P
- HCM, Long QT, Brugada, ARVC

- Con
- Large # of athletes
- Expertise in athlete EKG interpretation
- False positive leading to anxiety, disqualification etc
- Costs of downstream testing
- Ethical?

Physiologic ECG changes

- Found in 80% of athletes
  - More prevalent in Males and African/Caribbean
- Training-related ECG changes include:
  - Sinus Bradycardia
  - First degree and Mobitz type 1 AV block
  - Incomplete RBBB
  - Early Repolarization
  - QRS voltage criteria for LVH

Drezner, Br J Sports Med, 2013

Uncommon ECG changes

(ie deserve further evaluation)

- Non-voltage criteria for LVH
  - LAE or LAD
  - ST depression and T wave inversion
- RAE and RVH
- Q waves
- Complete LBBB
- Ventricular pre-excitation (ie WPW)
- Long QT
- Brugada like ECG
- PVC/NSVT, Heart block, Profound bradycardia, SVT

Masters Screening: Exercise test

- AHA Masters athletes statement recommends ETT if:
  - Symptoms suggestive of CAD
  - Men > 40 or Women > 55 with 1 risk factor
  - ≥ 65 years (even if no risks)

What about community screening efforts?

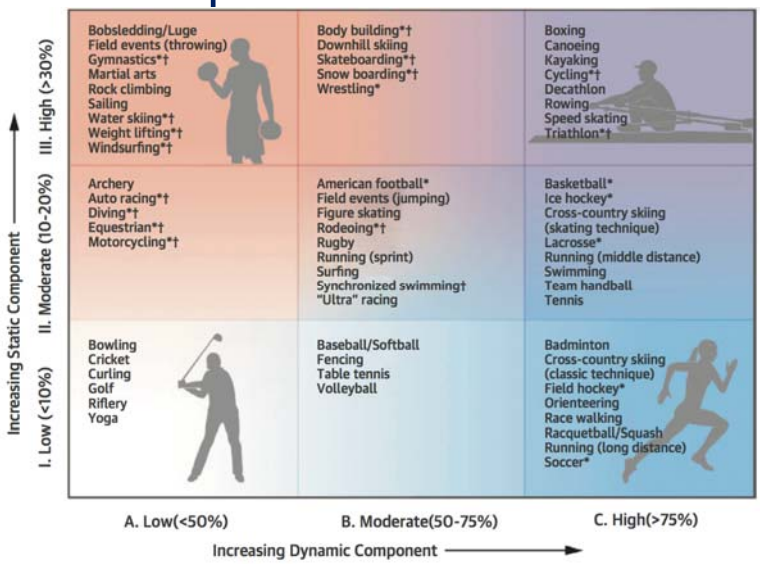
- More comprehensive than usual H/P
- Low cost
- Volunteer by interested professionals
- Identification of high risk conditions
- Failure to replicate complete evaluation
- Quality control
- Follow up
- False reassurance
- Liability

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Preamble, Principles, and General Considerations

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

- Task Forces:
- HCM, ARVC, Cardiomyopathies, Myocarditis
- Congenital heart disease
- Valvular heart disease
- Hypertension
- Aortic disease, including Marfan syndrome
- Coronary artery disease
- Arrythmias and conduction defects
- Cardiac Channelopathies
- Drugs and Performance enhancing substrates
- Sickle cell trait
- Emergency action plans, Resuscitation, CPR and AED

Classification of Sports



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