Active devices and sports

Dr Svetoslav Yovev MD

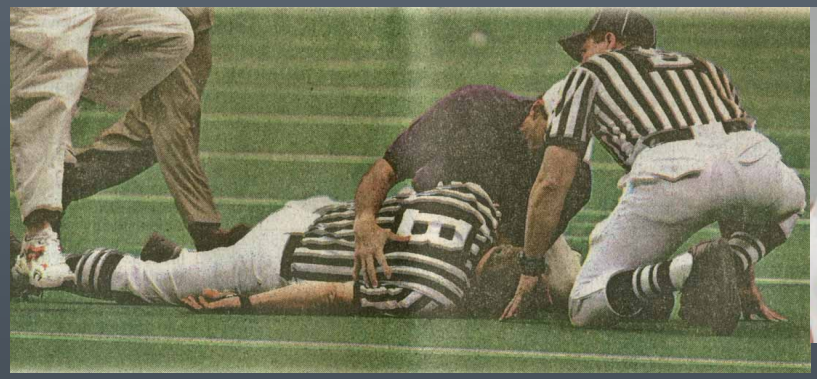
Sports Symposium heart and sudden death - Hilton Sofia, 27 - 28/04/2013

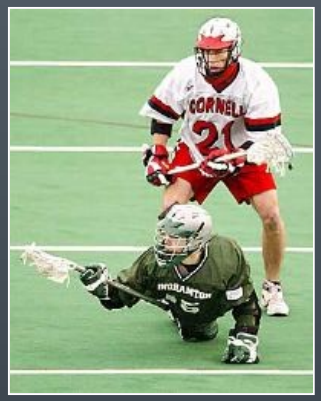
First Reported Case of Athletic SCA

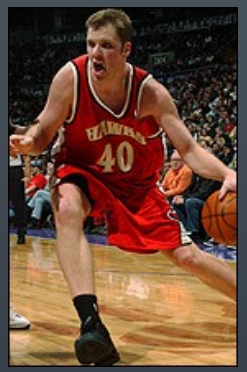
Phidippides 490 BC

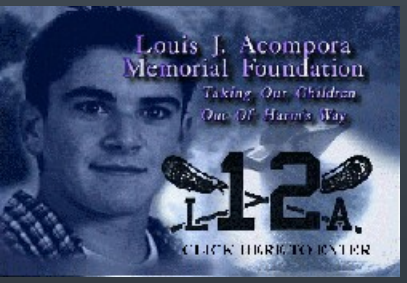
- Greek soldier and Olympic champion
- ran 26.2 miles from Marathon to Athens to deliver news of Greek victory over Persians
- collapsed and died

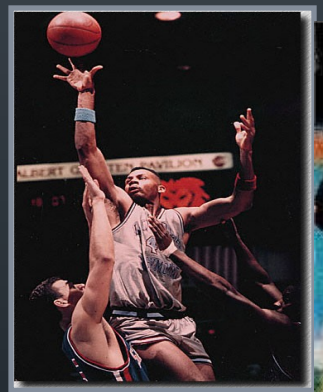
The Faces of SCA

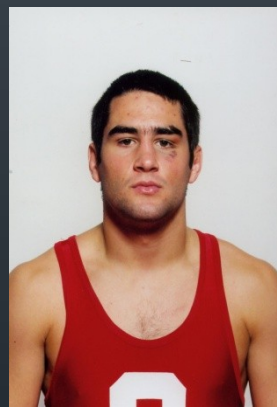








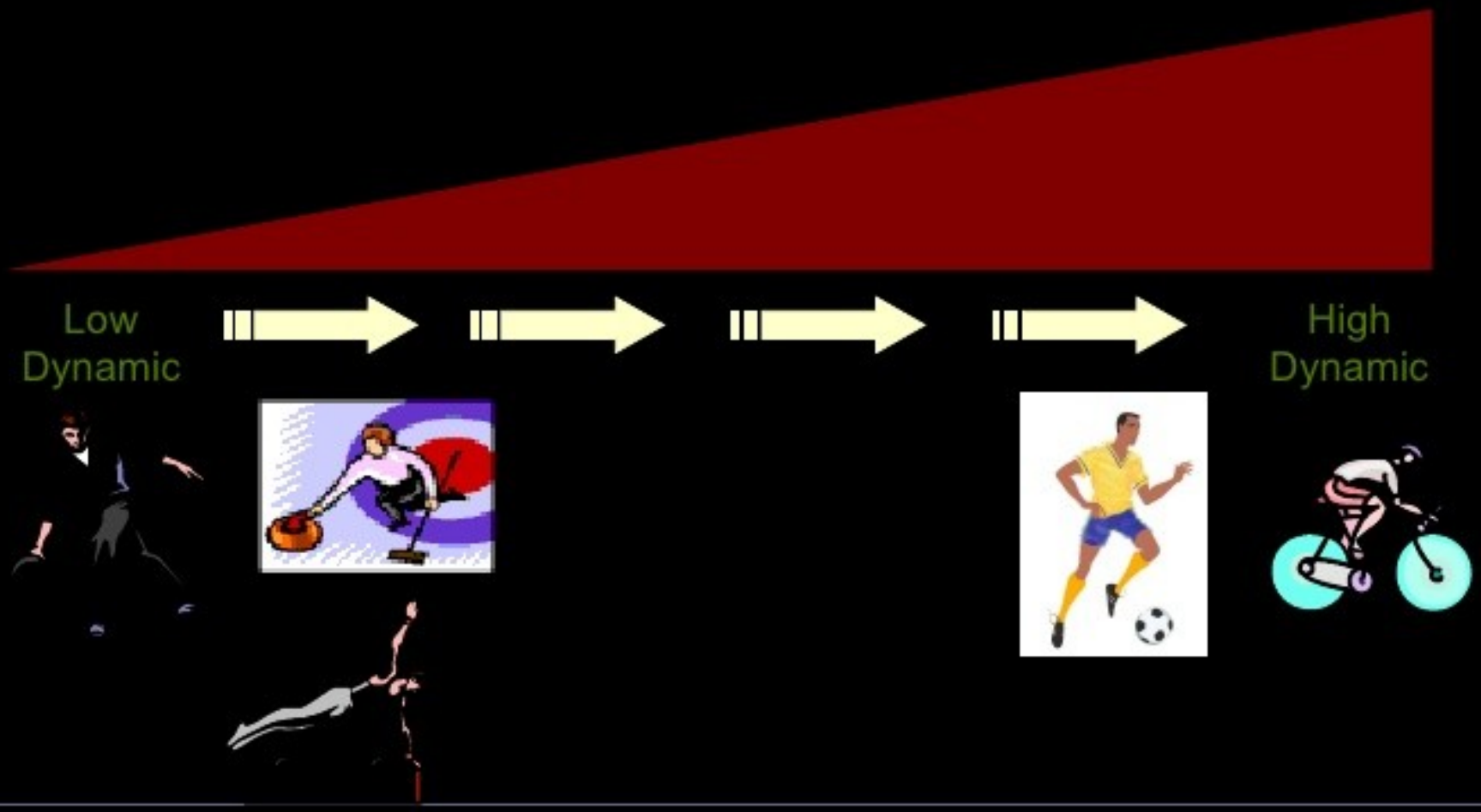




Sports Intensity: Static Classification

High Static → → → → Low Static

Sports Intensity: Dynamic Classification



Sports Classification

Increasing Static Component	A. Low (<40% Max O_2)	B. Moderate (40-70% Max O_2)	C. High (>70% Max O_2)
III. High (>50% MVC)	Bobsledding/Luge*†, Field events (throwing), Gymnastics*†, Martial arts*, Sailing, Sport climbing, Water skiing*†, Weight lifting*†, Windsurfing*†	Body building*†, Downhill skiing*†, Skateboarding*†, Snowboarding*†, Wrestling*	Boxing*, Canoeing/Kayaking, Cycling*†, Decathlon, Rowing, Speed-skating*†, Triathlon*†
II. Moderate (20-50% MVC)	Archery, Auto racing*†, Diving*†, Equestrian*†, Motorcycling*†	American football*, Field events (jumping), Figure skating*, Rodeoing*†, Rugby*, Running (sprint), Surfing*†, Synchronized swimming†	Basketball*, Ice hockey*, Cross-country skiing (skating technique), Lacrosse*, Running (middle distance), Swimming, Team handball
I. Low (<20% MVC)	Billiards, Bowling, Cricket, Curling, Golf, Riflery	Baseball/Softball*, Fencing, Table tennis, Volleyball	Badminton, Cross-country skiing (classic technique), Field hockey*, Orienteering, Race walking, Racquetball/Squash, Running (long distance), Soccer*, Tennis

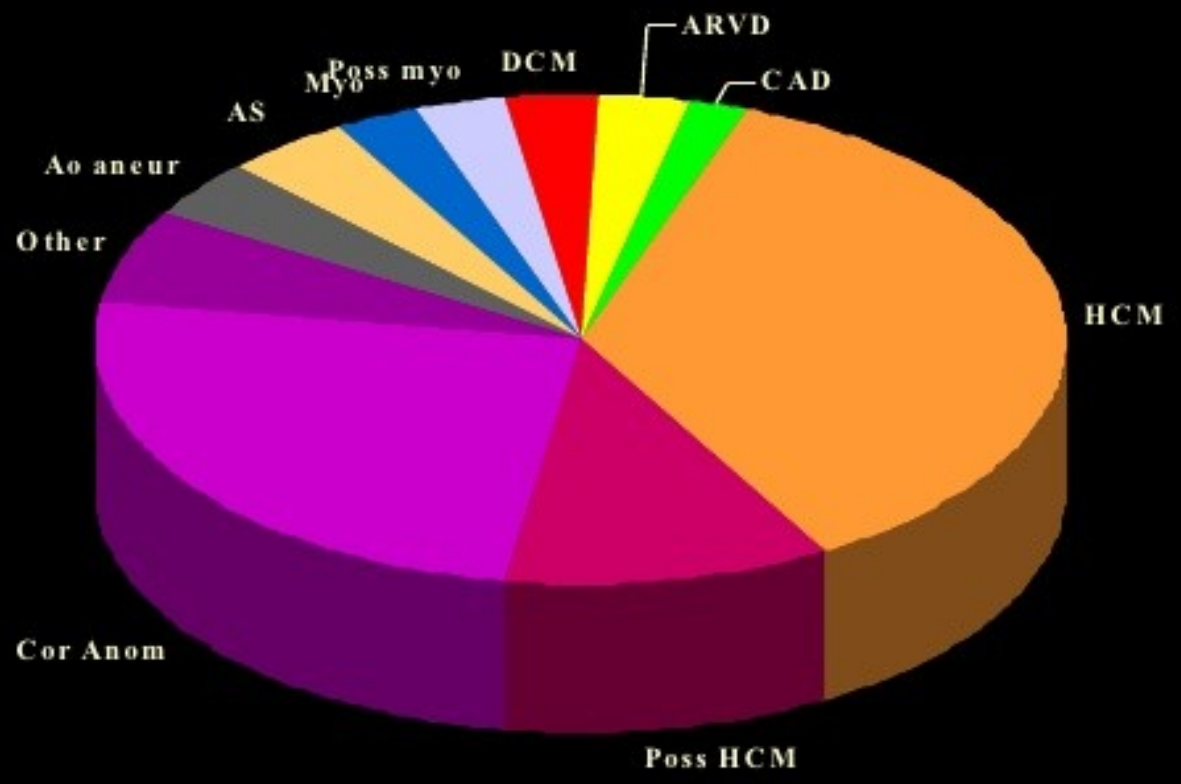
Increasing Dynamic Component →

MVC = maximum voluntary contraction

Max O_2 = maximum oxygen consumption

Mitchell JH, et al. JACC 45:1364-67. 2005

Cardiac Etiologies of Sudden Death in ≤ 35 y.o.



Fred Hoiberg: Risks Are Too Much

- Diagnosed with bicuspid aortic valve at Iowa State in 1995
- Drafted by Pacers, traded to Bulls, then Timberwolves
- Shooting guard, led league in 3-point percentage in 2004-2005
- Echo as part of insurance policy in 2005 – Sinus of Valsalva aneurysm
- Surgery and pacemaker in 6/2005
- 1st NBA player to play with a pacemaker???
- Announces retirement on 4/17/06
- Now coach for Timberwolves

Active devices and sports

Sports and Cardiovascular Events
Sports and Heart Pacemaker
Sports and ICD

Heart disease and sports

Sports and heart pacemaker

Sports and ICD

Does Exercise Increase the Risk of Sudden Death?

Sports, per se, is not a cause of the enhanced mortality, but it triggers sudden death in those athletes who are affected by cardiovascular conditions predisposing to life-threatening ventricular arrhythmias during physical exercise [1]

Table 1. Characteristics of Sudden Death Victims

	Athletes (n = 55)	Non-Athletes (n = 245)	p Value
Mean age (yrs)	23.1 ± 7	23.9 ± 9	1.0
Gender			
Males	50	170	0.002
Females	5	75	
Circumstances of death			
Exercise-related	49 (89%)	22 (9%)	< 0.0001
During effort	40	15	
After effort	9	7	
Unrelated to exercise	6 (11%)	225 (91%)	
Medical history			
Familial history of SD	5 (9%)	27 (11%)	0.8
Previous symptoms	18 (32%)	56 (23%)	0.2
ECG abnormalities/ arrhythmias	22 (40%)	36/63 (57%)	0.1

Data are presented as the mean value ± standard deviation or number (%) of subjects. ECG = electrocardiographic; SD = sudden death.

Source: Corrado et al.; JACC 2003; 42(11): 1959-63

Does Exercise Increase the Risk of Acute Cardiovascular Events?

- Vigorous exertion transiently increases the risk of acute myocardial infarction (MI) and sudden cardiac death (SCD)
  - particularly among habitually sedentary persons
  - with occult or known coronary arterial disease (CAD)
  - performing unaccustomed, vigorous physical activity

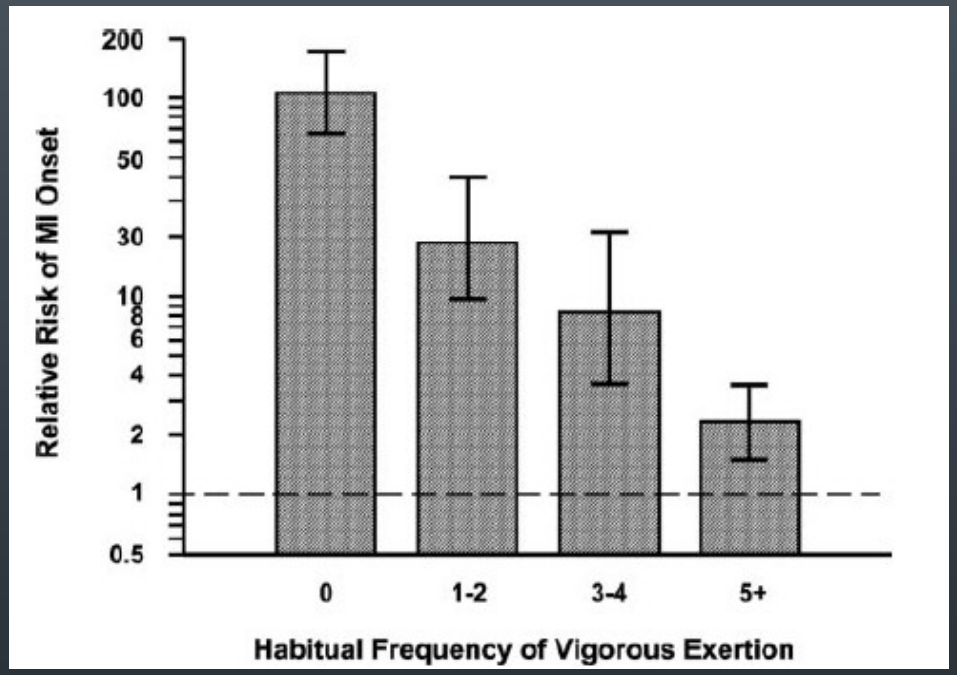
Source: Thompson et al.; Circulation 2007; 115: 2358-68

Does Exercise Increase the Risk of Acute Cardiovascular Events?

Physical stress as a trigger of acute cardiovascular events during vigorous exertion

RR indicates relative risk and compares the risk of the cardiac event during exertion with that during sedentary activities

TRIMM: Triggers and Mechanisms of Myocardial Infarction Study; SHEEP: Stockholm Heart Epidemiology Program



Relative risk of MI associated with vigorous exertion (≥6 metabolic equivalents) according to habitual frequency of vigorous exertion. The T bars indicate 95% confidence limits. The dotted line indicates risk of MI with no prior vigorous exertion.

Source: Thompson et al.; Circulation 2007; 115: 2358-68

The Risk of Special Situations and Activities

- In general, the risk of any vigorous physical activity is an interaction of the exercise per se and the individual's physical fitness
- E.g. snow shoveling has repeatedly been associated with increased cardiovascular events, probably
  - because it can elicit higher rate-pressure products than does treadmill exercise testing
  - because it is often performed out of necessity by unfit individuals
  - because some cardiac patients develop angina at lower rate pressure products, suggesting a coronary vasoconstrictor response, during exercise in cold temperatures

Source: Thompson et al.; Circulation 2007; 115: 2358-68

Strategies to Reduce Exercise-Related Cardiovascular Events

ACC/AHA, ACSM, and USPSTF Recommendations for Exercise Testing Before Exercise Training

ACC/AHA	ACSM	USPSTF
Asymptomatic persons with diabetes mellitus who plan to start vigorous exercise *(Class IIa)*	Asymptomatic persons with diabetes mellitus (or other metabolic disease) who plan to start moderate (40% to 59% $\dot{V}O_2$ reserve) to vigorous (≥60% $\dot{V}O_2$ reserve) exercise	Recommends against routine exercise testing of low-risk adults in general and finds insufficient evidence for exercise testing before exercise training
Asymptomatic men >45 y of age and women >55 y of age who plan to start vigorous exercise *(Class IIb)*	Asymptomatic men >45 y of age and women >55 y of age or those who meet the threshold for >2 risk factors who plan to start vigorous exercise	

ACC/AHA: American College of Cardiology / American Heart Association
ACSM: American College of Sports Medicine
USPSTF: US Preventive Services Task Force

Conclusion: No strategies have been adequately studied to evaluate their ability to reduce exercise-related acute cardiovascular events.

Source: Thompson et al.; Circulation 2007; 115: 2358-68

Heart disease and sports

Sports and heart pacemaker

Sports and ICD

Sports and pacemaker

General

- Patients with heart disease and a pacemaker can participate only in sports consistent with the limitations of the underlying heart disease.
- About 1/3 of pacemaker patients suffer from coronary disease, another 1/3 from left ventricular systolic dysfunction.
- In the absence of heart disease, competitive or recreational sports participation is allowed in sports with minor to moderate cardiovascular demand.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 475-84
Kindermann; Dt Z für Sportmedizin 2010; 61(10) 241-242

Sports and pacemaker

Programming

- Exercise testing and Holter ECG monitoring will help to program an appropriate pacing rate responsiveness during exercise.
- In patients with coronary disease or left ventricular systolic dysfunction rate adaptation must be tested individually. The maximum rate must not cause ischemia.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 475-84

Sports and pacemaker

Tachycardia

- Pre-implant screening should evaluate the possible association of bradycardia with atrial or (rarely) ventricular tachycardia by Holter or event recording.
- Supraventricular tachycardia is generally considered to be a benign arrhythmia.
- If it is only sporadic and is not associated with haemodynamic consequences even when it develops during exercise, sports activity is allowed when there is no increased risk from the loss of consciousness (such as in pilots, motorsports drivers, parachute jumpers, ...).
- Exercise should be stopped as soon as palpitations arise but can be resumed after the cessation of palpitations.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 475-84

Sports and pacemaker

Avoid physical damage

- Individuals with a pacemaker should be restricted from sports with a risk of bodily impact (e.g. rugby, martial arts, ...), because of the possible damage to the electrodes or pacing unit or the risk of skin perforation.
- Other sports (such as soccer, basketball, baseball, ...) can be allowed while wearing appropriate padding.
- Extreme ipsilateral arm movements should be avoided at least until complete fixation of the leads (6 weeks).

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 475-84

Sports and pacemaker

Avoid physical damage

- Sports with pronounced arm movements (such as volleyball, basketball, tennis, climbing, ...) may also increase the risk of late lead damage as a result of subclavian crush
- (with insulation or conductor failure).

- Diving depth is limited by the maximum pressure allowed for the pacemaker housing.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 475-84

Sports and pacemaker

Prevention of malfunction

- The pacemaker should be implanted at the right or left side depending on arm dominance and the type of sports (e.g. on the left side in a right-handed tennis player).
- Electromagnetic interference is uncommon with modern devices, but it should be closely evaluated in specific athletic environments (such as starting gate electronic equipment or scoring equipment during fencing).
- Myopotential inhibition may result in an inhibition of pacing, a problem that is more common with unipolar electrodes. It can usually be corrected with appropriate reprogramming of the device. Bipolar leads are less sensitive to this problem.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 475-84

Heart disease and sports

Sports and heart pacemaker

Sports and ICD

Sports and ICD

General

- Physical activity may trigger ventricular arrhythmia and ICD therapy.
- The underlying pathology and the individual case history of arrhythmias determine the recommendation of the level of sporty activities.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 676-86
Kindermann; Dt Z für Sportmedizin 2010; 61(10) 241-242

Sports and ICD

General

- Although very effective to prevent sudden death, ICD implantation should not be regarded as a substitute for such a recommendation.

General

- The efficacy of the ICD to interrupt malignant ventricular arrhythmias during intense exercise is unknown and from theoretical considerations probably suboptimal (given the associated metabolic, autonomic and potentially ischemic conditions).

- Specific data on the benefits and risks of ICD in physically active patients are lacking, explaining a large variability in current recommendations made by physicians to their patients.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 676-86
Kindermann; Dt Z für Sportmedizin 2010; 61(10) 241-242

Sports and ICD

Recommendations

- An ICD disqualifies an athlete for competitive sports, except those with a low cardiovascular demand (like golf, billiards or bowling)
- On the other hand, physicians and patients alike may feel more assured to continue leisure-time physical activities with low to moderate dynamic or static demand if an ICD is on board, which may contribute to physical and psychological well-being.
- In patients with arrhythmias that are particularly sensitive to triggering by exercise, these recommendations should be made with caution.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 676-86

Sports and ICD

Recommendations

- Leisure-time sports resumption is allowed from 6 weeks after implant, preferably after a control stress test.
- When appropriate or inappropriate ICD interventions occur (antitachypacing or shocks), a 6-week period refraining from sports should be reconsidered to evaluate the effect of changes in medical therapy or ICD programming.
- All the recommendation already mentioned for pacemaker patients apply for ICD patients as well.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 676-86

Sports and ICD

Sinus tachycardia

- Exercise in young people may result in sinus tachycardia which exceeds the detection threshold for ICD intervention, leading to inappropriate therapy delivery.
- Inappropriate shocks are painful and may result in psychological problems like anxiety and unrest, which even may amount to aversion for the ICD protection.
- They also can trigger real life-threatening ventricular arrhythmias.
- It is therefore extremely important to tailor ICD settings and recommended exercise levels to the anticipated heart rate during sports activity for any individual patient.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 676-86

Sports and ICD

Atrial arrhythmia

- Many structural or arrhythmogenic conditions may also increase the risk for atrial arrhythmias (most commonly atrial fibrillation) with possible rapid atrioventricular conduction during exercise, with the risk for inappropriate therapy delivery and thus the need for prophylactic antiarrhythmic or bradycardic drug therapy.

Source: Heidbüchel et al.; Eur J Cardiovasc Prev Rehabil 2006; 13: 676-86

Management of HCM

Symptom Control

Mild-Moderate Symptoms → β-blocker or L-type CaChBl

Volume Overload → Judicious Diuresis (caution: potential preload-dependence)

Continued Symptoms And Obstruction → Add Disopyramide

Continued Symptoms And Obstruction → ?Combined β-blocker + CaChBl (caution: potential high-grade atrioventricular block)

If Obstruction Present → Avoid vasodilators

Refractory Severe Symptoms
Consider Referral to HCM Center

Obstruction Present (≥50mmHg)
Invasive Septal Reduction Therapy

Obstruction Absent
Advanced HF Management
Consider Cardiac Transplantation

SCD Risk Stratification

2° Prevention → ICD unless contraindicated

1° Prevention
- Assess number and nature of risk factors

≥ 1 Risk Factor Present
- Detailed risk/benefit discussion with patient
- ICD as appropriate

No Risk Factors Present
- Periodic reassessment of risk (~every 12-24 months)

Counseling/ Screening

- **Exercise recommendations**
- **Family screening**
  - Identify relatives with previously undiagnosed HCM to initiate appropriate care
  - Clinical follow up of at-risk relatives to monitor for disease development, potentially guided by genetic testing
- **Practical Matters**
  - Consider obtaining Life/Disability insurance for at risk relatives prior to clinical diagnosis
- **Genetic counseling and discussion of testing options**

Consider Referral to CV Genetics Center

Ho C Y Circulation 2012;125:1432-1438

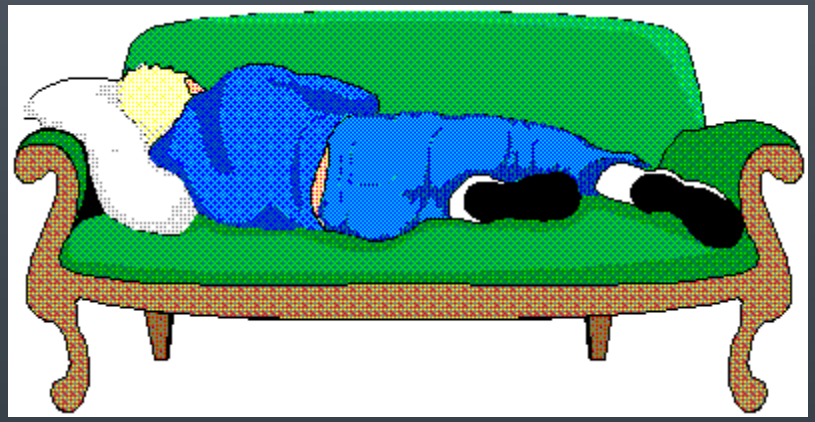
Summary

- Vigorous exertion transiently increases the risk of acute cardiovascular events overall.
- Pacemaker or ICD patients can participate in sports consistent with the limitations of the underlying heart disease.
- Physical damage must be avoided for the device and the leads, individual device programming is recommended.

Purpose of Preparticipation Evaluation

- Identify individuals
  - Known to be at risk
  - Not known to be at risk
- Make recommendations regarding participation

The choice is yours...



If the individual becomes *sedentary or significantly reduces* the amount of training, the effects of training are lost.

The body also adapts to inactivity