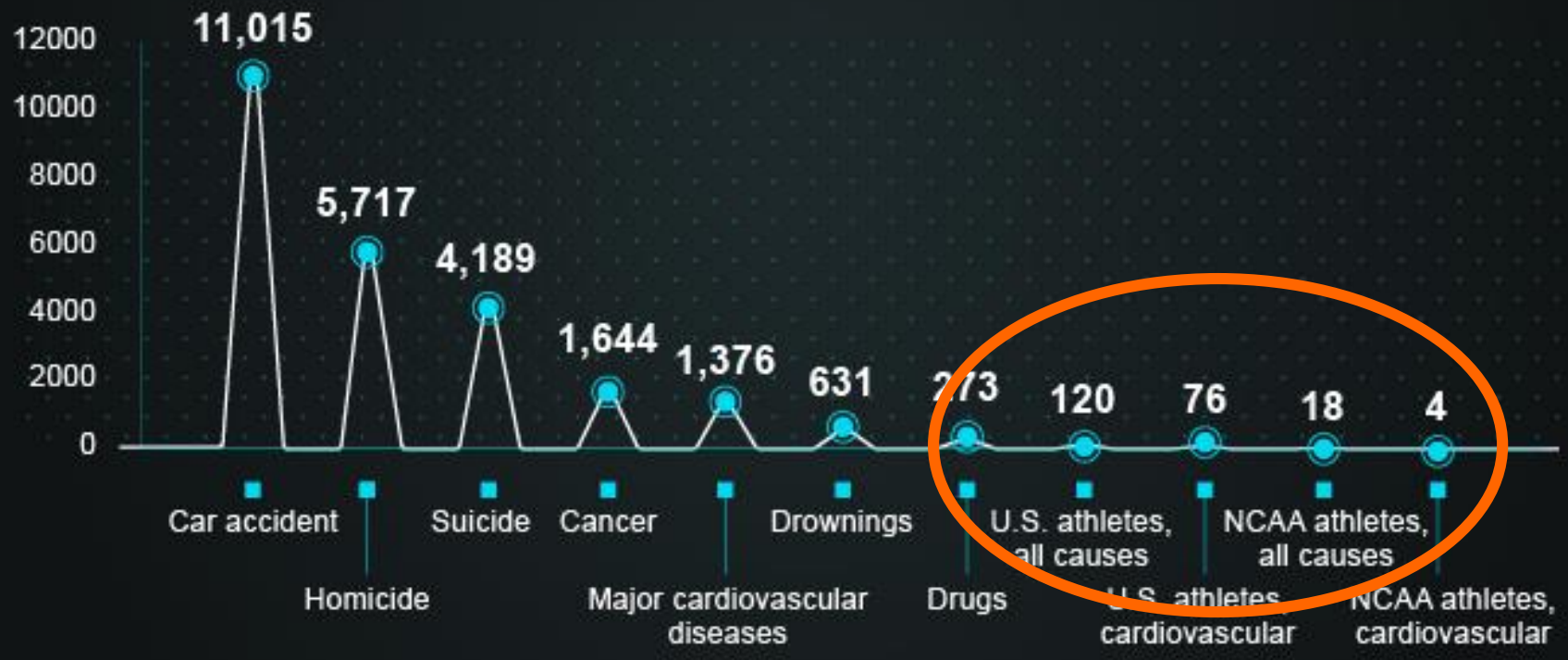
ARISTOTLE UNIVERSITY OF THESSALONIKI, GREECE
SPORTS MEDICINE LABORATORY
DIRECTOR: PROF. A. DELIGIANNIS

Sudden unexpected death syndrome in athletes

ASTERIOS DELIGIANNIS
CARDIOLOGIST
PROFESSOR OF SPORTS MEDICINE

CAUSES OF DEATH

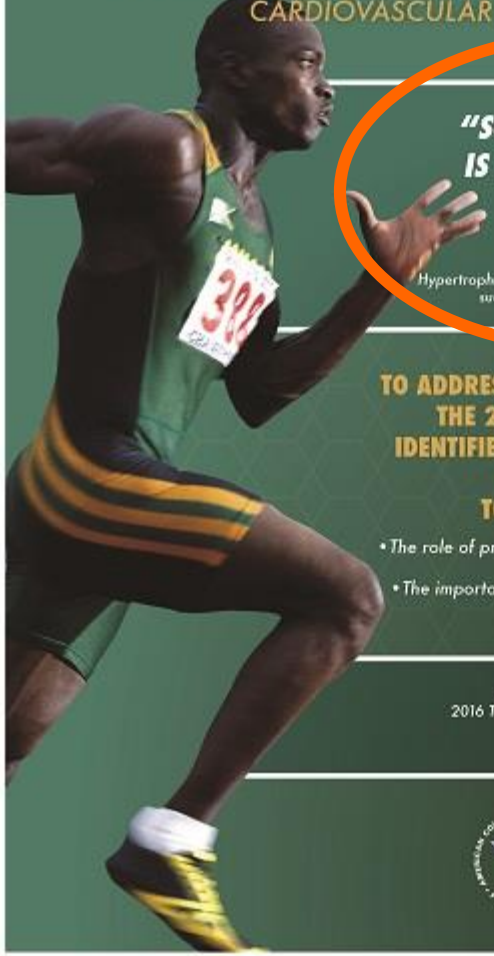
A breakdown of how many high school-age and college-age Americans die each year from select causes. The highest number of young U.S. athletes to die from heart-related causes in a single year is 76.



Source: 2014 American Heart Association/American College of Cardiology Scientific Statement

CRITICAL AREAS

CARDIOVASCULAR ISSUES



"SUDDEN CARDIAC DEATH IS RESPONSIBLE FOR 16% OF DEATHS AMONG COLLEGE ATHLETES"

Hypertrophic cardiomyopathy is the most common cause of sudden death in high school and college athl

TO ADDRESS CARDIOVASCULAR ISSUES, THE 2016 CONSENSUS STATEMENT IDENTIFIED A NUMBER OF ESSENTIALS FOR TEAM PHYSICIANS TO UNDERSTAND, INCLUDING:

- *The role of preparticipation examination in screening for cardiac conditions*
- *The importance of an emergency action plan for all practices and competition*

FOR MORE ON THESE OUTCOMES, VIEW THE 2016 TEAM PHYSICIAN CONSENSUS STATEMENT AT:

WWW.ACSM.ORG

AMERICAN COLLEGE of SPORTS MEDICINE
LEADING THE WAY

Definition of Sudden Cardiac Death

Death from cardiac causes, heralded by abrupt loss of consciousness, within 1 hour of the onset of acute symptoms

Painting of Pheidippides as he gave word of the Greek victory over Persia at the Battle of Marathon to the people of Athens.
Luc-Olivier Merson, 1869

ΑΠΟΚΛΕΙΣΤΙΚΟ ΤΕΡΑΣΤΙΕΣ ΟΙ ΕΥΘΥΝΕΣ

ΜΑΘΗΤΗΣ νεκρός στο σχολείο

Ξεψύχησε αβοήθητος την ώρα της Γυμναστικής

ΟΙ ΣΥΜΜΑΘΗΤΕΣ ΤΟΥ ΕΠΑΘΑΝ ΣΟΚ

14 April 2012 Last updated at 16:09 GMT

7K Share

Italy footballer Morosini dies after collapse on pitch

la Repubblica LUNEDÌ 26 MARZO 2012 II 10

IL DRAMMA DI MACERATA

L'ultima schiacciata di Bovolenta malore in campo, poi la morte sotto shock il mondo del volley

QUESTION 1:

Journal of the American College of Cardiology
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Published by Elsevier Inc.

Vol. 42, No. 11, 2003
ISSN 0735-1097/03/$30.00
doi:10.1016/j.jacc.2003.03.002

Does Sports Activity Enhance the Risk of Sudden Death in Adolescents and Young Adults?

Domenico Corrado, MD, PHD,* Cristina Basso, MD, PHD,† Giulio Rizzoli, MD,‡
Maurizio Schiavon, MD,§ Gaetano Thiene, MD†

Padua, Italy

CONCLUSIONS

Sports activity in adolescents and young adults was associated with an increased risk of SD, both in males and females. Sports, per se, was not a cause of the enhanced mortality, but it triggered SD in those athletes who were affected by cardiovascular conditions predisposing to life-threatening ventricular arrhythmias during physical exercise.

Epidemiology of Sudden Cardiac Death

Although likely underestimated, the incidence of SCD among competitive athletes appears to be low, ranging from 1 per 50,000 to 1 per 300,000.

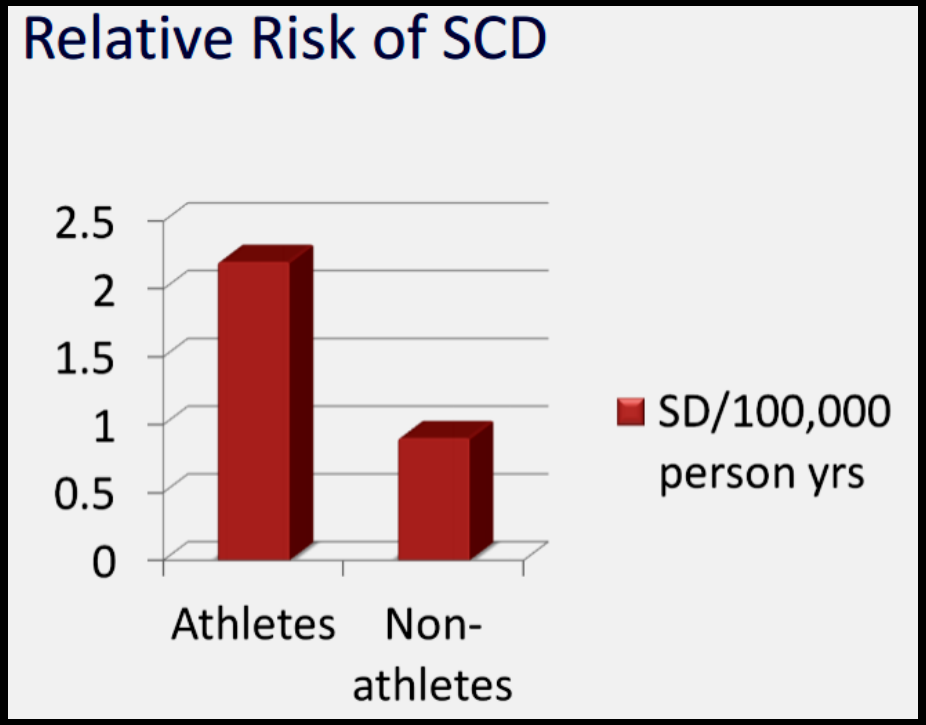
In a study of Minnesota high school athletes, the incidence of SCD was 1 in 200,000.

In a study of nearly 220,000 marathon runners, SCD occurred in 4 individuals.

- **None had any prior cardiac symptoms**
- **2 had competed in several previous marathons**
- **3 had coronary disease on autopsy**

JAMA 1996;276:1999
J Am Coll Cardiol 1998;32:1881

The rates of sudden cardiac death by cardiovascular diseases were 2.1 in 100,000 athletes per year, compared with 0,7 in 100,000 non athletes per year.



Who are they?

- Average age 17 (range 12-40)
- Predominantly male – 90%!
- Mainly team field/court sports

- **When?**
  - **During or immediately after intense physical exertion**
  - **Commonly in the afternoon and early evening hours**
  - **Often much later, at night or even when sleeping**

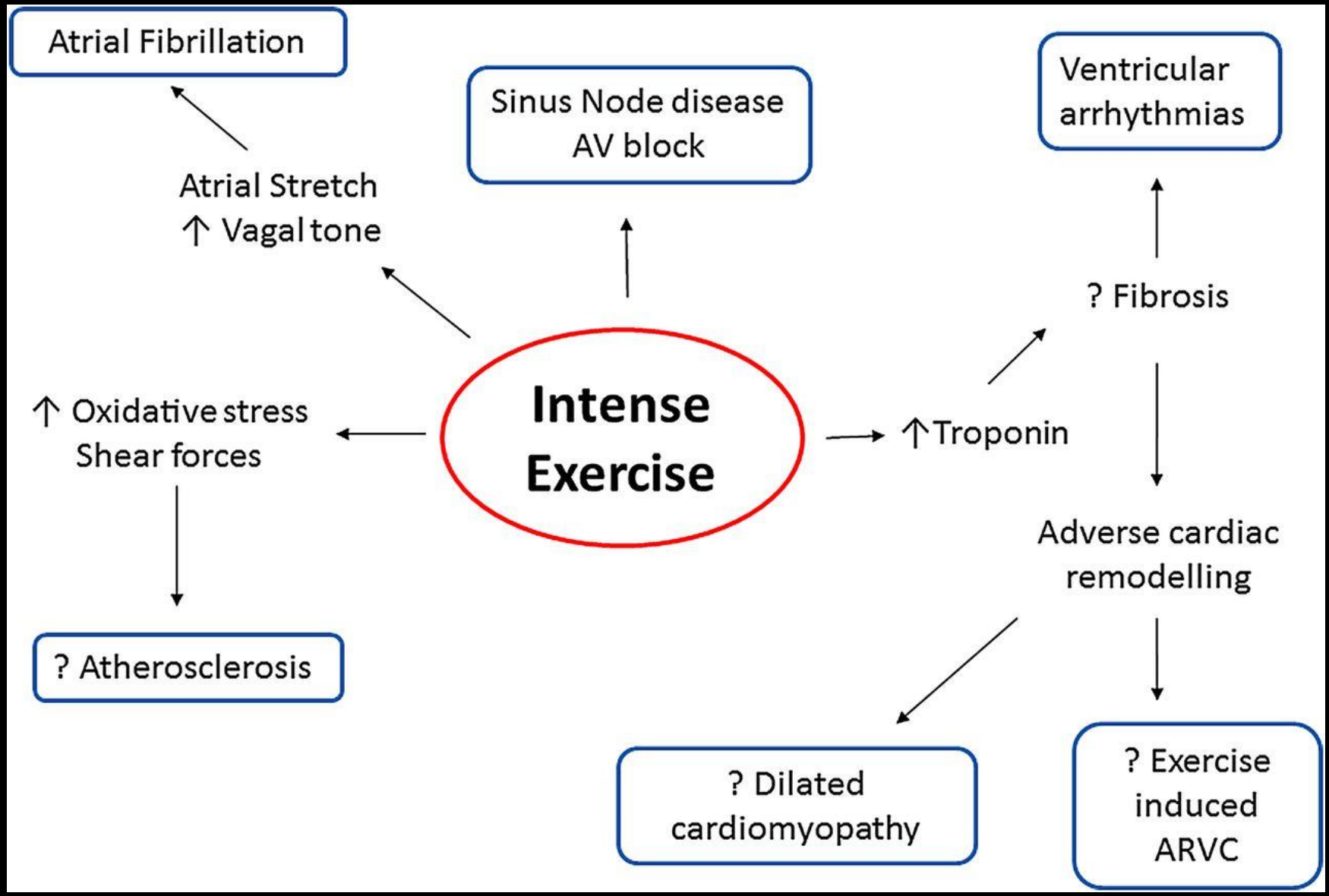
Extrinsic Risk Factors for SCD

- **The risk of SCD in competitive sports increases with “burst” exertion (rapid acceleration and deceleration; common in basketball, tennis, and soccer).**
- **Extreme environmental conditions (temperature, humidity, and altitude) that affect blood volume and electrolyte balance also contribute to the risk.**
- **Progressive and systematic training to achieve higher levels of conditioning and performance may further increase the risk by resulting in a total cardiovascular demand that often exceeds that of competition.**

Other Extrinsic Risk Factors for SCD

- **Cocaine abuse**
- **Amphetamine abuse**
- **Performance enhancing drugs (anabolic steroids)**
- **Dietary and nutritional supplements (including ephedra-containing products)**

- N Engl J Med 2001;345:351
- J Am Coll Cardiol 2002;39:1083


Atrial Fibrillation
Sinus Node disease
AV block
Ventricular arrhythmias
Atrial Stretch
↑ Vagal tone
? Fibrosis
↑ Oxidative stress
Shear forces
Intense Exercise
↑Troponin
Adverse cardiac remodelling
? Atherosclerosis
? Dilated cardiomyopathy
? Exercise induced ARVC

Mechanism of Acute Coronary Events with Exercise

- ← Placque rupture
- ← Conctraction of noncompliant atherosclerotic placque producing rupture
- ← Alteration of epicardial contour of coronary placque
- ← Enhanced cathecolamine-induced platelet aggregation
- ← Exercise induced coronary artery spasm
- ← Increased shear force

QUESTION 2:

WHAT ARE THE COMMON CAUSES OF SCD IN ATHLETES?

Causes of SCD in Sports

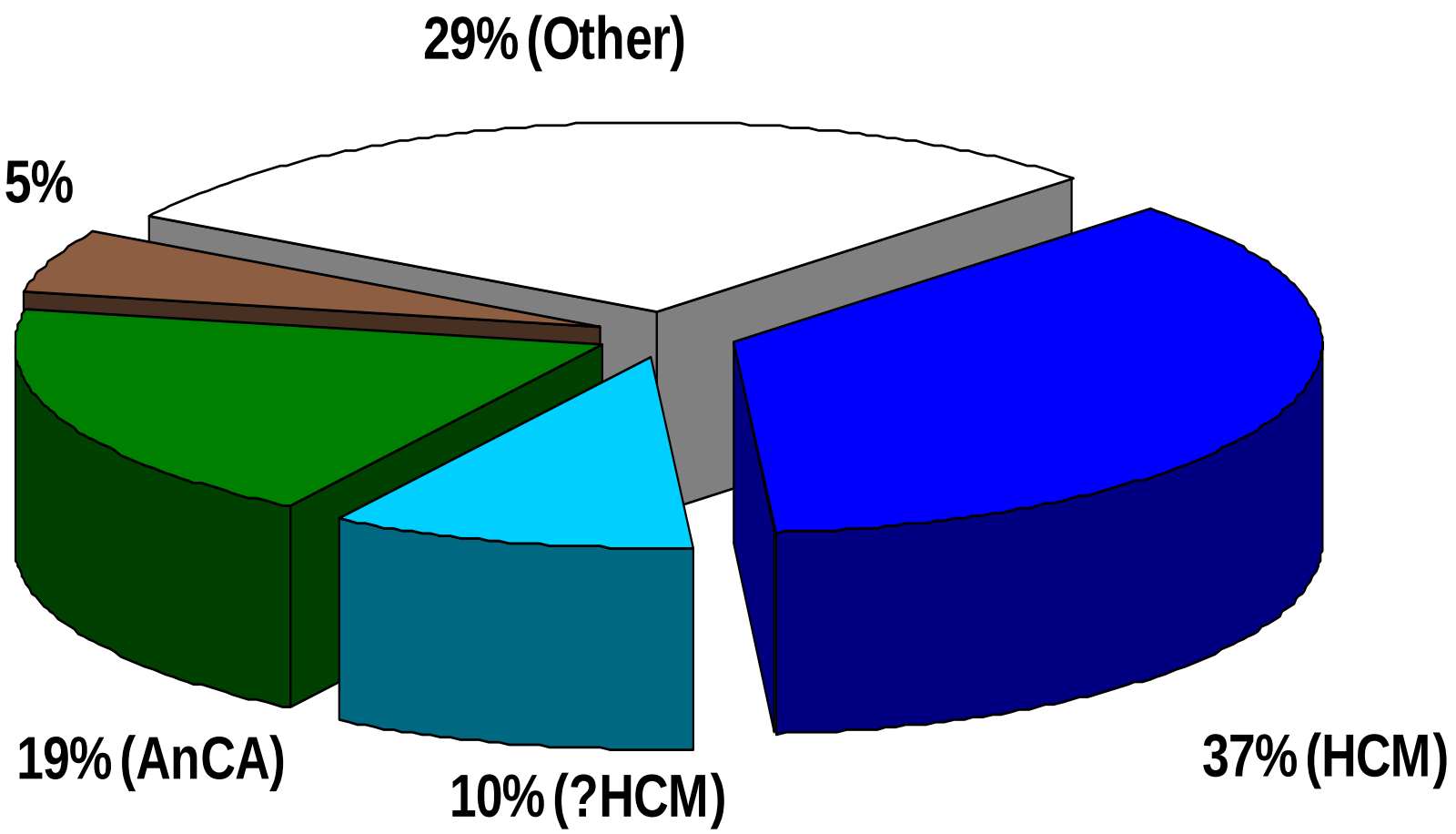
Causes of SCD in athletes vary by age and geographic location.
Among young competitive athletes (< 35 years old) in the U.S., inherited or congenital heart conditions (such as hypertrophic cardiomyopathy) are the most common etiologies.
Among "masters" athletes (> 35 years old), coronary artery disease (CAD) appears to be the predominant cause of SCD.

J Am Coll Cardiol 2003;41:974

Prevalence of Young Athletes with Conditions Predisposing to SCD

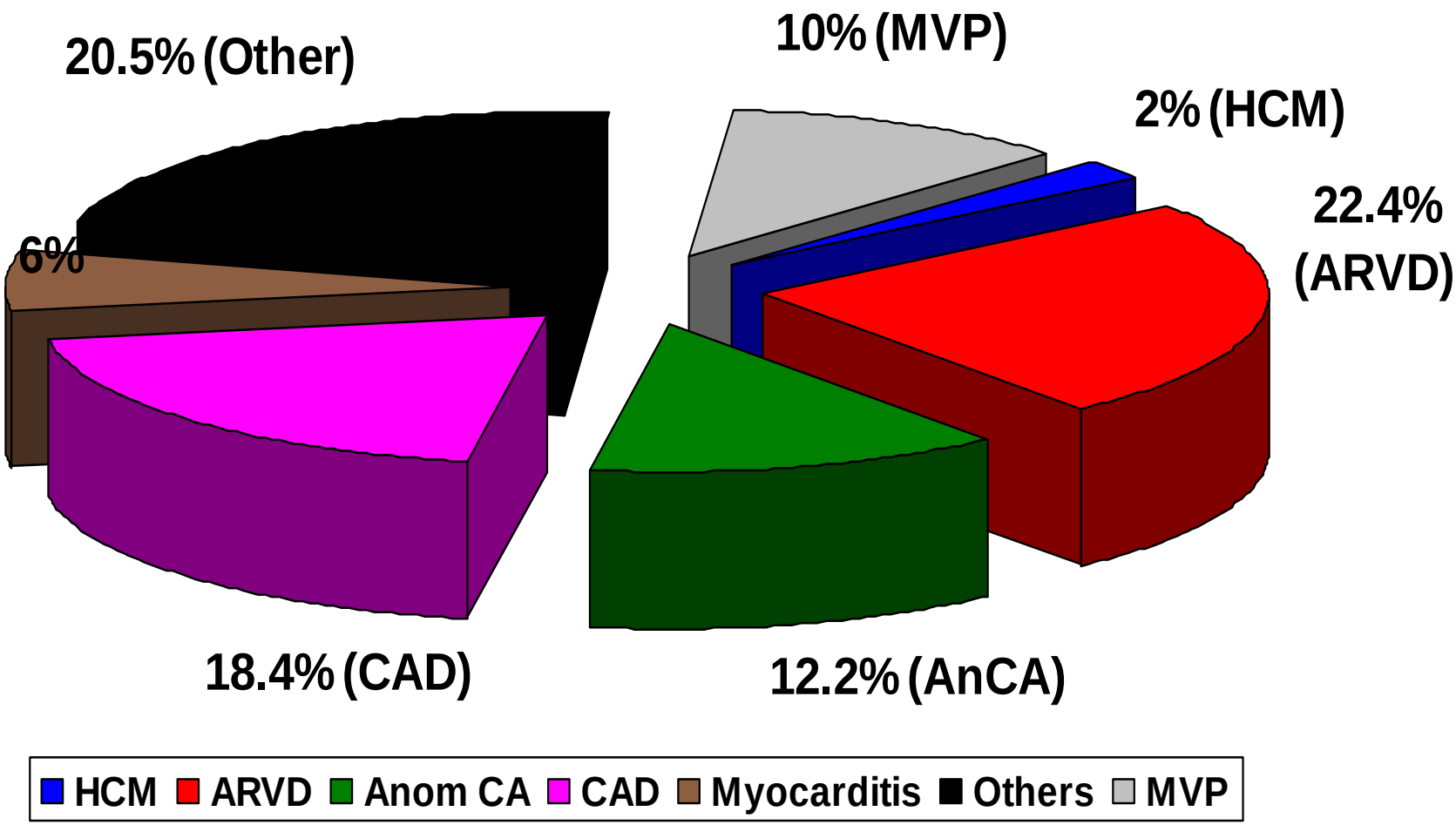
Ref:	Population	Prevalence
AHA (2007)	Competitive athletes (U.S.)	0.3%
Fuller (1997)	5,617 high school athletes (U.S)	0.4%
Corrado (2006)	42,386 athletes age 12-35 (Italy)	0.2%
Wilson (2008)	2,720 athletes /children age 10-17	0.3%
Bessem (2009)	428 athletes age 12-35 (Netherlands)	0.7%
Baggish (2010)	510 collegiate athletes (U.S.)	0.6%

The USA experience



Maron et al, Cardiology Clinics 1996 ; 14 : 196

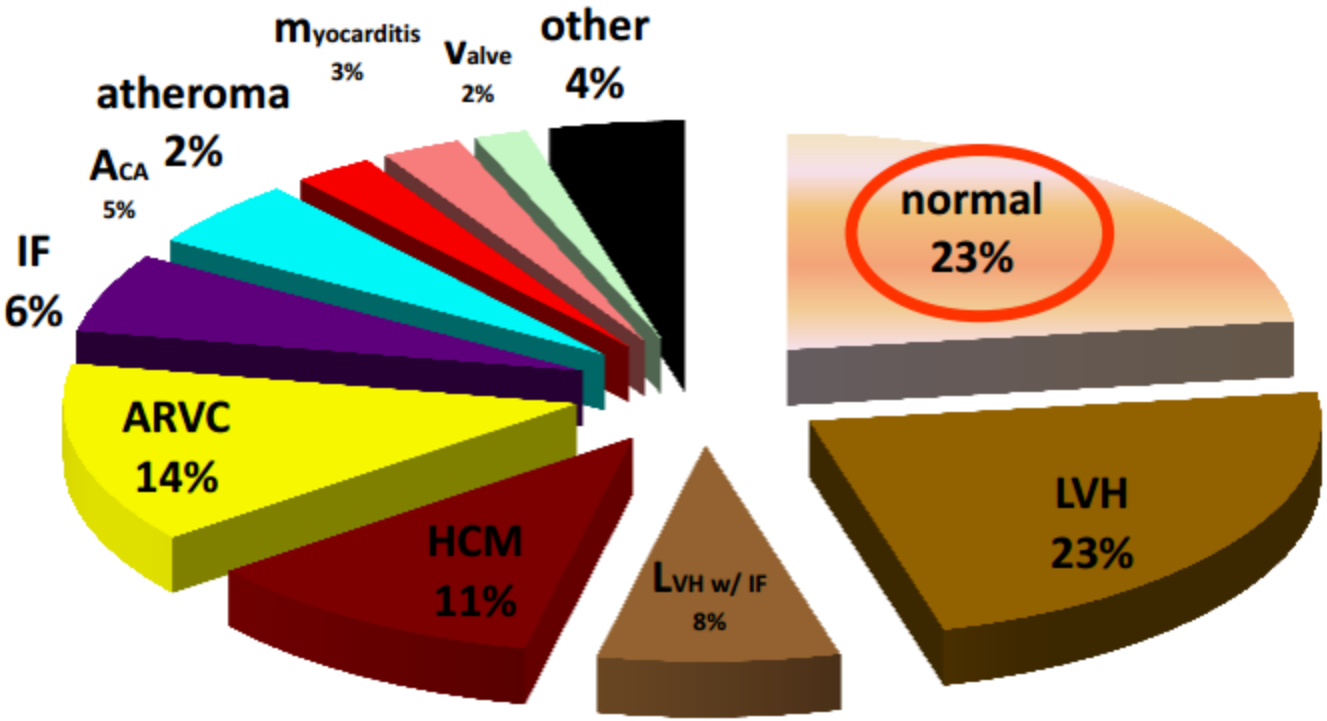
The Italy experience



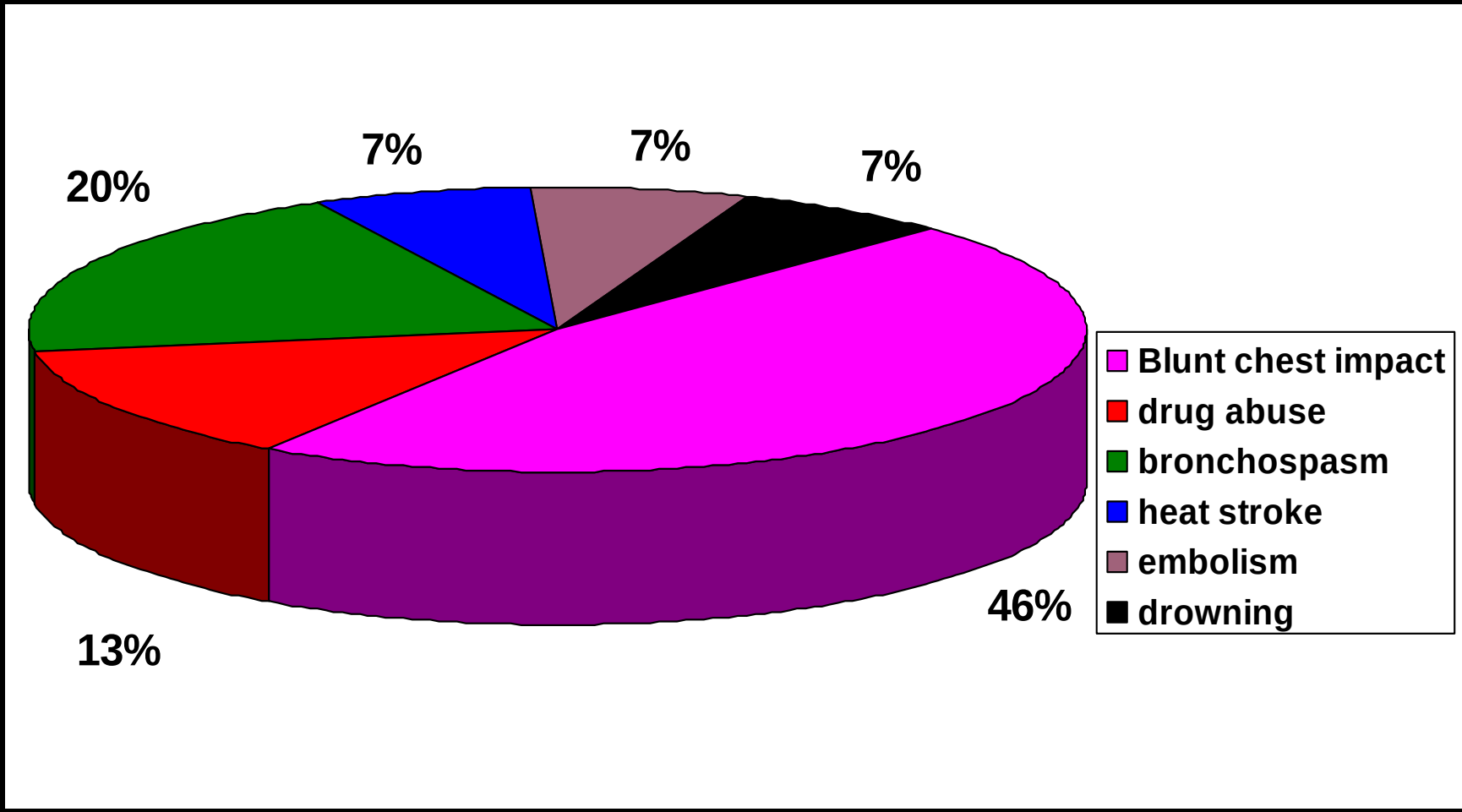
Corrado et al, NEJM 1998 ; 339 : 364-369

Sudden Death in Athletes: The British Experience

UK SCD, n=118, age range 7-59 yr



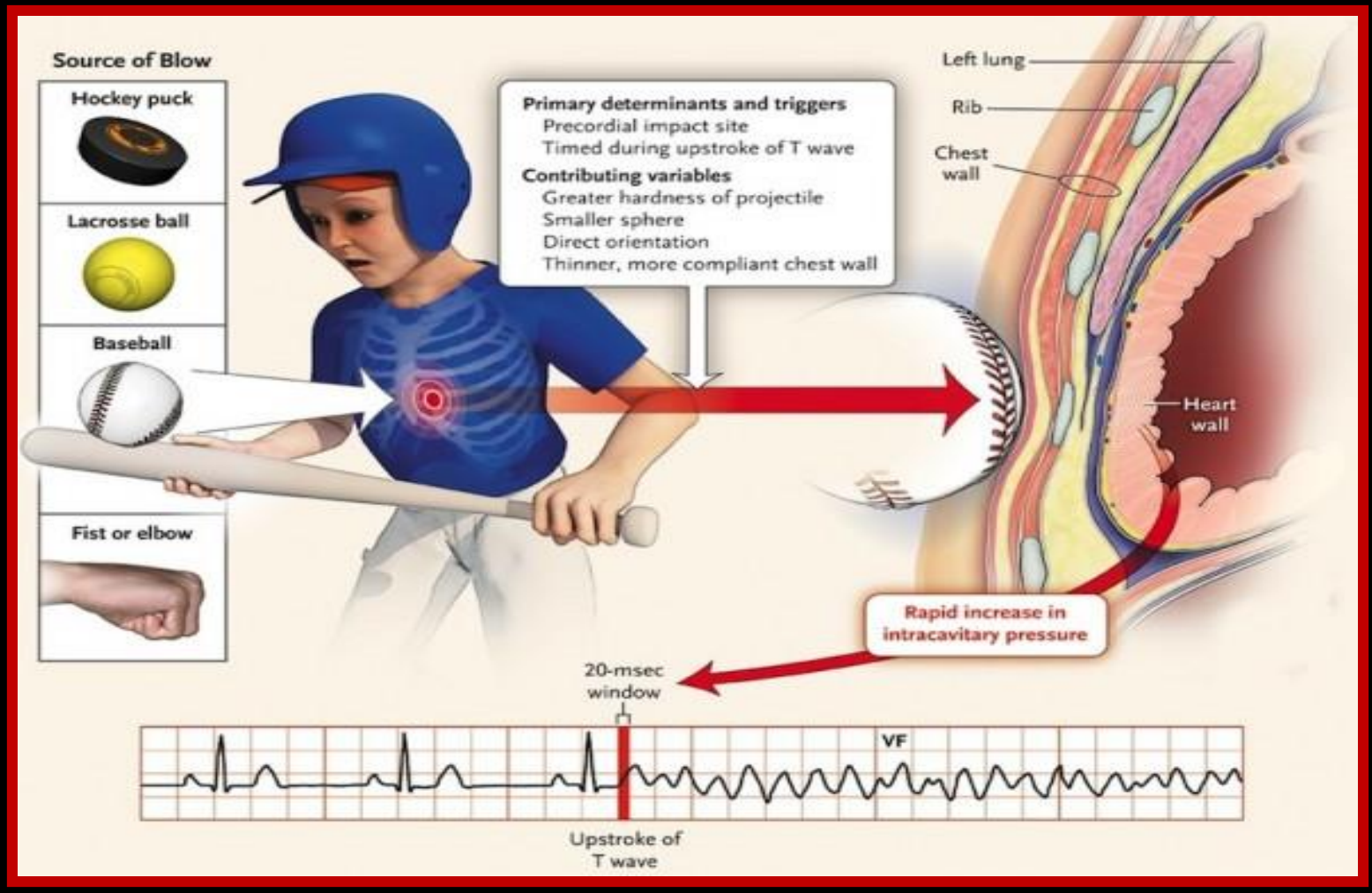
Non-cardiovascular Causes of Death

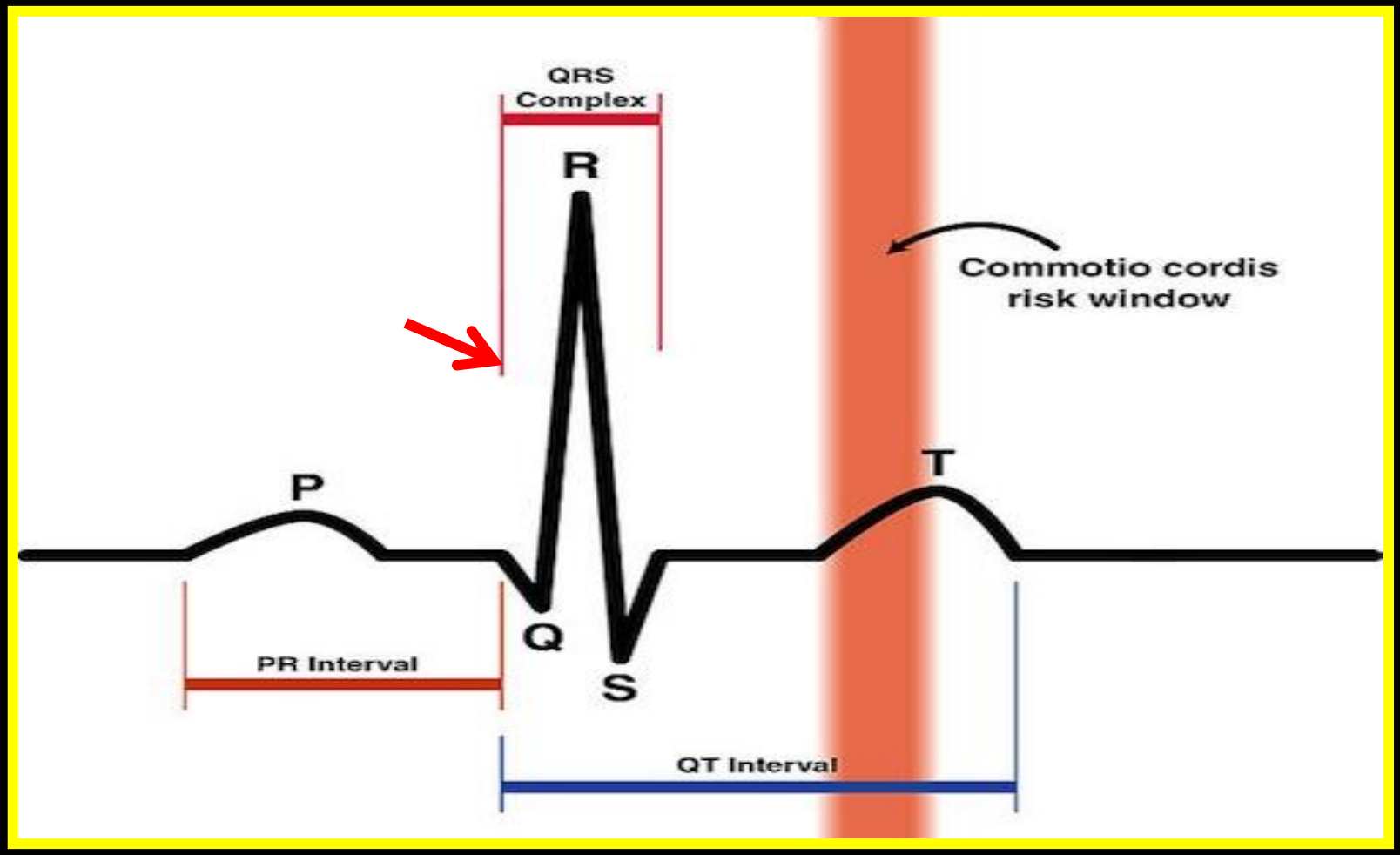


Maron BJ et al, JAMA 1996 ; 276 : 199 - 203

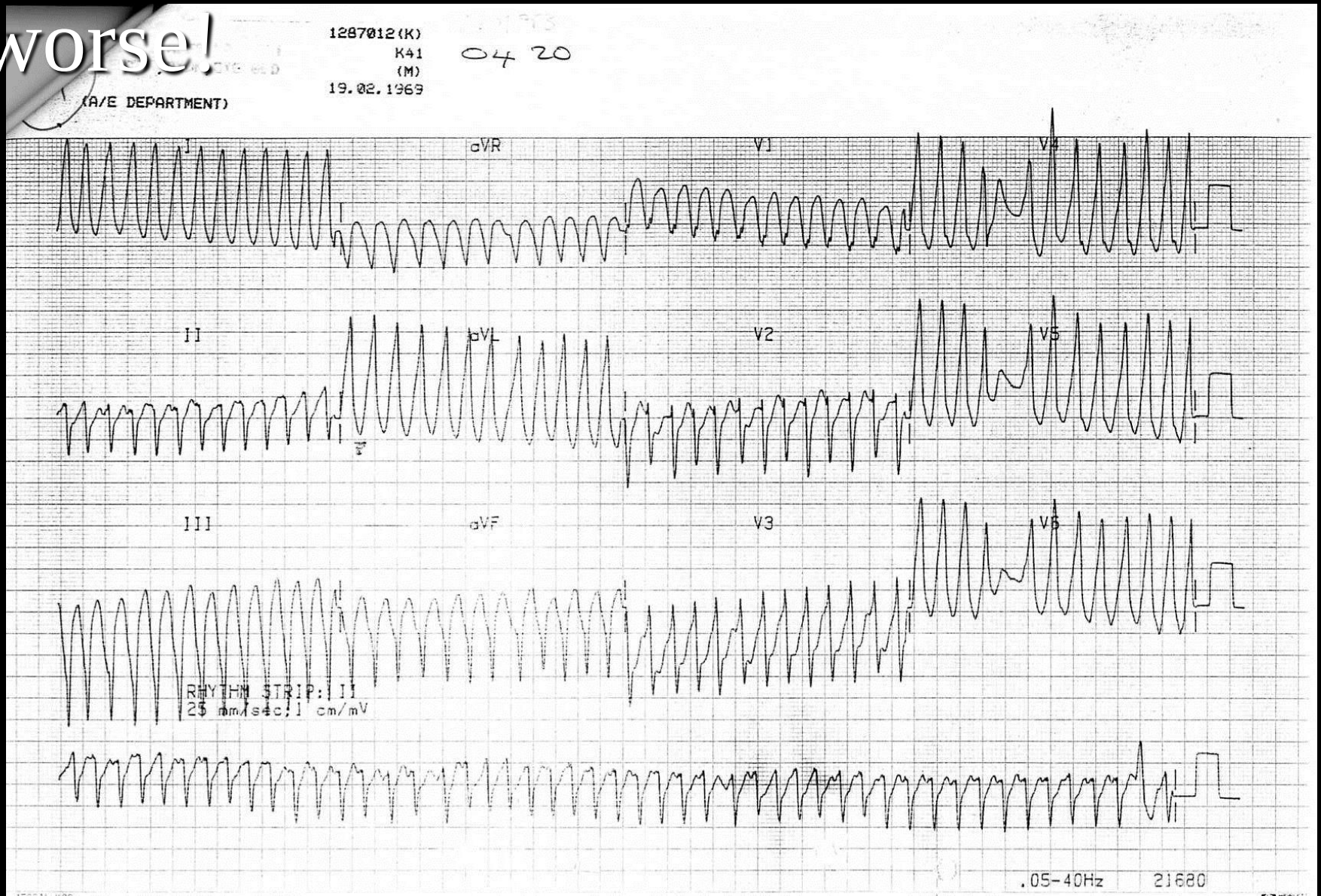

A
B
C
D
E
F

Cardiac Concussion




QRS
Complex
R
Commotio cordis
risk window
P
T
Q
S
PR Interval
QT Interval

25-year old rugby player- never worse!



Thunderbolt !

Αυστρία: Κεραυνός «χτύπησε» σε ποδοσφαιρικό αγώνα – Οκτώ τραυματίες! (ΦΩΤΟ)

8. Απριλίου, 2014 Αθλητικά Εκτύπωση Μέγεθος Κειμένου: A A A

Πηγή:
onsports.gr

Pflugers Arch - Eur J Physiol (2010) 460:31–40
DOI 10.1007/s00424-010-0798-0

CARDIOVASCULAR PHYSIOLOGY

Possible mechanisms of sudden cardiac death in top athletes: a basic cardiac electrophysiological point of view

András Varró · István Baczkó

Bad luck

ventricular tachycardia or ventricular fibrillation. On the level of the individual, however, as a contributor factor, misfortune should be emphasized as the most important factor, since in case the trigger extrasystole occurs even a fraction of a millisecond prior to or later than the vulnerability period, serious cardiac arrhythmia will not develop. In other words, even if all the objective prerequisites for arrhythmia development exist (substrate + trigger), the exact but random timing of the trigger extrasystoles will determine the induction of a lethal arrhythmic attack in a given individual. In the statistical sense, however, in competitive

Bad Luck !

QUESTION 3:

ELSEVIER

Cardiovascular Pathology xx (2010) xxx–xxx

CARDIOVASCULAR PATHOLOGY

Review Article

Can sudden cardiac death be prevented?

Barry J. Maron*

Strategies for the prevention of sudden cardiac death during sports

Domenico Corrado[1]
Jonathan Drezner[2]
Cristina Basso[3]
Antonio Pelliccia[4]
Gaetano Thiene[3]

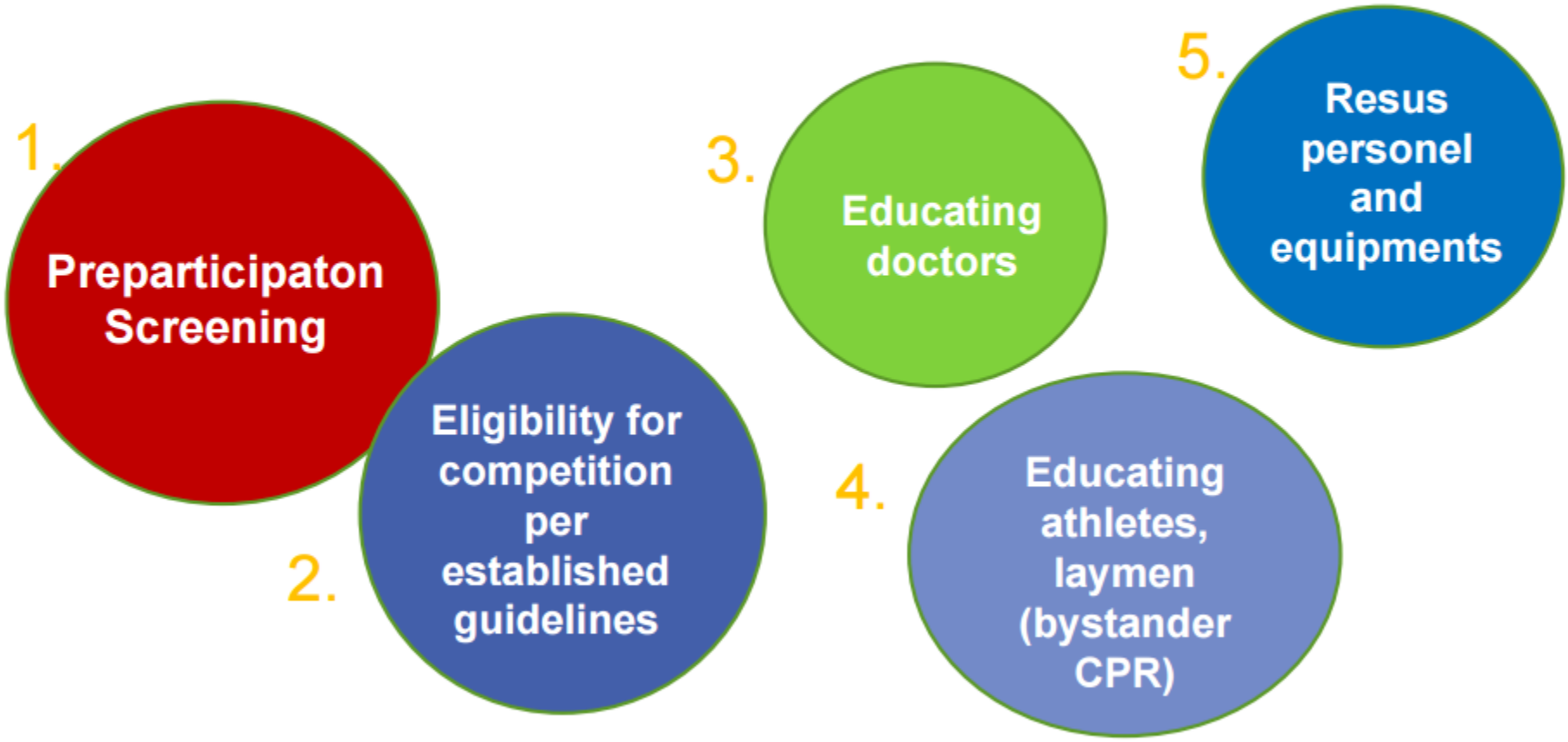
European Journal of Cardiovascular Prevention & Rehabilitation **April 2011** vol. 18 no. 2 **197-208**

Pre-participation Health Screening

Identification of Target Groups (High Risk Family)

Organization of First Aids in Arena

How can we prevent SCD during exercise?



ACSM /AHA : Exercuse and Acute Cardiovascular events: placing the risks into perspective. Med Sci Sports Exerc. 2007;39(5):886-97

QUESTION 4:

IS PRE-PARTICIPATION SCREENING OF ATHLETES NECESSARY?

www.escardio.org/esc-congress

Prevention: the highlight of ESC Congress 2009

Screening for all pre-sports children?

NO

'The time is definitely too early to recommend pre-participation screening,' says Asle Hirth from Haukeland University Hospital in Bergen, Norway.

'The acceptance of this type of screening is gradually growing throughout the world,' says Erik Jan Meijboom from the University Hospital Vaudois in Lausanne, Switzerland.

YES

Prevention of SCD in athletes: The Needle in a Haystack?

Eur J Cardiovasc Prev Rehabil. 2011 Apr;18(2):194-6.

Preventing sudden cardiac death in athletes: finding the needle in the haystack or closing the barn door?

Mosterd A, Senden JP, Engelfriet P.

Department of Cardiology, Meander Medical Center, Amersfoort, The Netherlands.

PMID: 21450665 [PubMed - in process]

American Family Physician

PUBLISHED BY THE AMERICAN ACADEMY OF FAMILY PHYSICIANS JUNE 1998

Articles | Departments| Patient Information

Sudden Death in Young Athletes: Screening for the Needle in a Haystack

FRANCIS G. O'CONNOR, LTC, MC, USA,

And frustratingly -

- **Cardiovascular disease is usually unsuspected during life in these individuals and is rarely identified by pre-participation screening.**

  (And this screening is rarely done!)

High False Positive Rate

False positive rate 10%

False positive rate 16.9%

False positive rate 17.3%

Arguments For and Against Screening

For

Highly visible events

Loss of numerous years of life

Association between exercise and sudden death

Acceptable interventions to prevent fatalities

Against

Sudden deaths in athletes uncommon; 1 in 50,000

Rare disorders. Diverse pathology

Elaborate screening programmes not cost effective

Risk of false positives

Screening

- **Due to the devastating nature of SCD and the potential to prevent such deaths by diagnosing associated disorders noninvasively, clinicians have a strong incentive to screen athletes.**
- **However, the following obstacles prevent widespread screening with noninvasive testing:**
  - **Large number of competitive athletes (8 million in the U.S., including high school, collegiate, professional)**
  - **Low prevalence of underlying congenital heart disease**
  - **Number of disorders to consider, each with different optimal testing modalities**
  - **Impact of false-positive studies (substantial when screening for rare diseases; possible medicolegal implications)**
  - **No randomized trials evaluating the impact of pre-participation screening on the incidence of SCD**

N Engl J Med 2003;349:11

TIME-TREND OF SUDDEN CARDIAC DEATH INCIDENCE IN ATHLETES VS NON-ATHLETES

Veneto Region of Italy 1979-2002

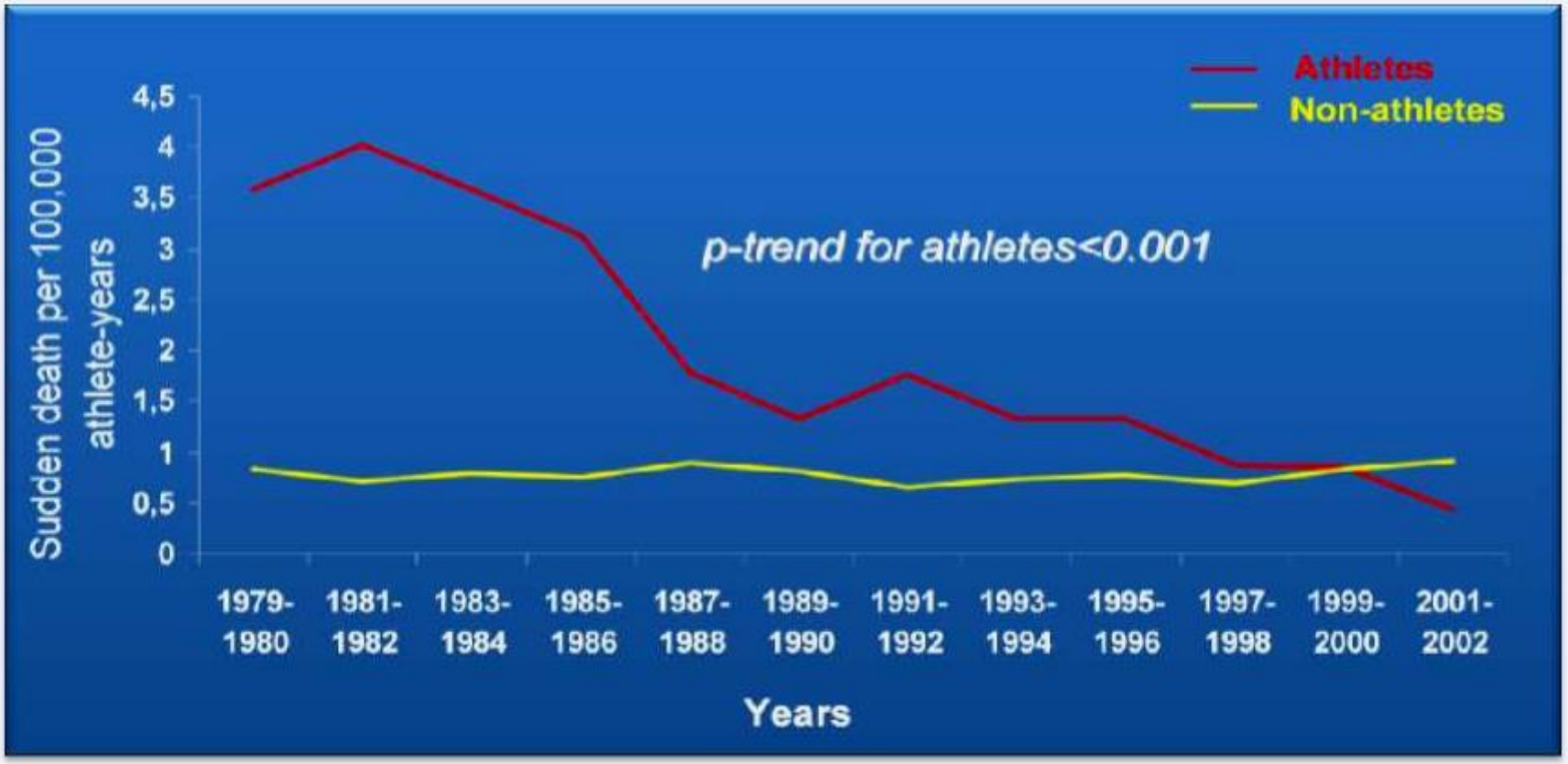


Table 2. Preparticipation Athletic Screening and Athletic Restriction in Italy, the United States, and Israel

Country	Years	Screening	Initial	Examiners	Sudden Death
Italy[6]	1981–2008	Mandatory	History, PE, ECG, ETT	Sports medicine MD	Decrease
United States[30]	1985–2006	Recommended	History, PE	MD and non-MD	No decrease
Israel[26]	1985 to 2009	Mandatory	History, PE, ECG, ETT	Certified MD	No decrease

PE indicates physical examination; ETT, exercise tolerance test.

No Consensus on the screening ECG
- To mandate or not to mandate?

QUESTION 5:

ARE THERE COMMON RECOMMENDATIONS FOR THE PRE-PARTICIPATION SCREENING OF ATHLETES?

Europe vs. USA.
Who Wins?

Journal of the American College of Cardiology
© 2005 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 45, No. 8, 2005
ISSN 0735-1097/05/$30.00
doi:10.1016/j.jacc.2005.02.006

36TH BETHESDA CONFERENCE

Introduction: Eligibility Recommendations for Competitive Athletes With Cardiovascular Abnormalities—General Considerations

Barry J. Maron, MD, FACC, *Co-Chair*
Douglas P. Zipes, MD, MACC, *Co-Chair*

AHA guidelines differ from those of the European Society of Cardiology (ESC) and the International Olympic Committee (IOC) such that routine noninvasive testing (including ECG) is not recommended.

The 12-Element AHA Recommendations for Preparticipation Cardiovascular Screening of Competitive Athletes

Medical history*

Personal history

1. Exertional chest pain/discomfort
2. Unexplained syncope/near syncope†
3. Excessive exertional and unexplained dyspnea/fatigue associated with exercise
4. Prior recognition of a heart murmur
5. Elevated systemic blood pressure

Family history

6. Premature death (sudden and unexpected or otherwise) before 50 y of age resulting from heart disease in ≥1 relative
7. Disability from heart disease in a close relative <50 y of age
8. Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long-QT syndrome or other ion channelopathies, Marfan syndrome, or clinically important arrhythmias

Physical examination

9. Heart murmur‡
10. Femoral pulses to exclude aortic coarctation
11. Physical stigmata of Marfan syndrome
12. Brachial artery blood pressure (sitting position)§

Circulation 2007; 116: 2610-15

European Heart Journal (2005) 26, 516–524
doi:10.1093/eurheartj/ehi108

EUROPEAN SOCIETY OF CARDIOLOGY®

ESC Report

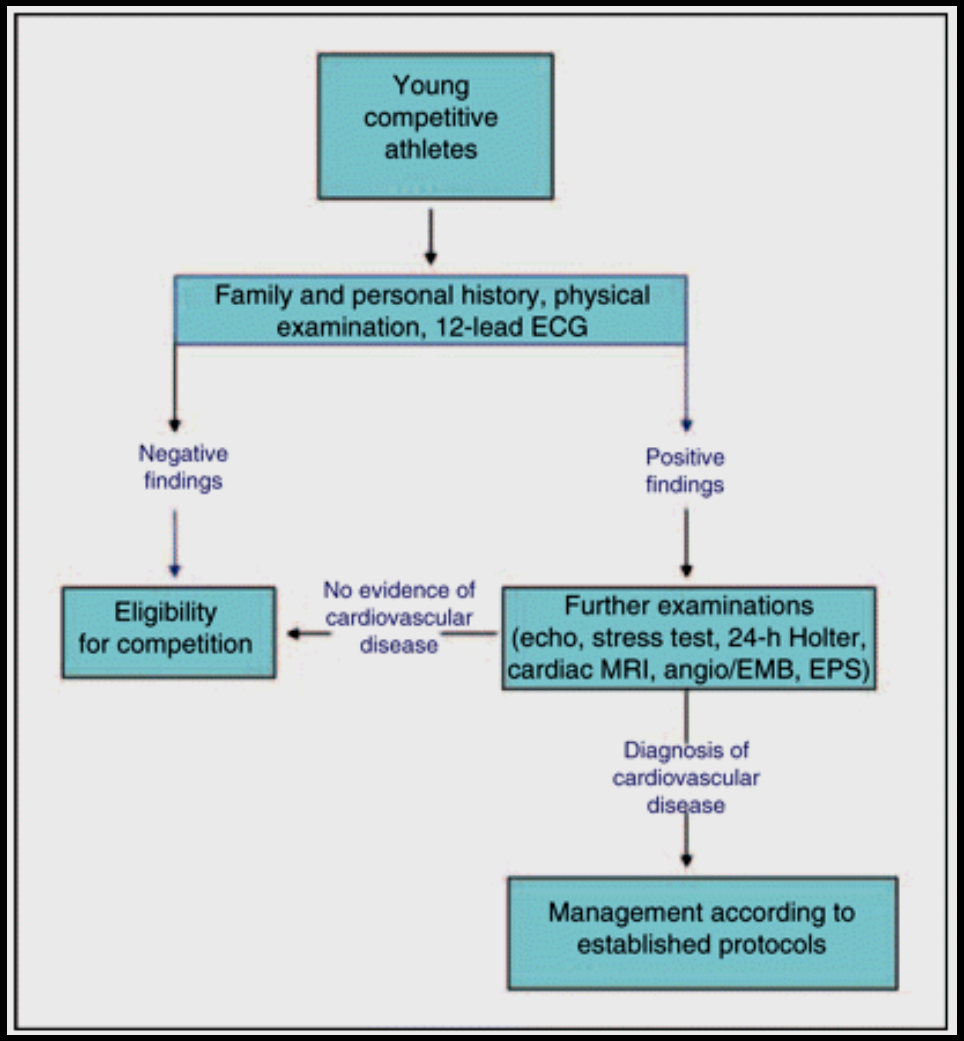
Cardiovascular pre-participation screening of young competitive athletes for prevention of sudden death: proposal for a common European protocol

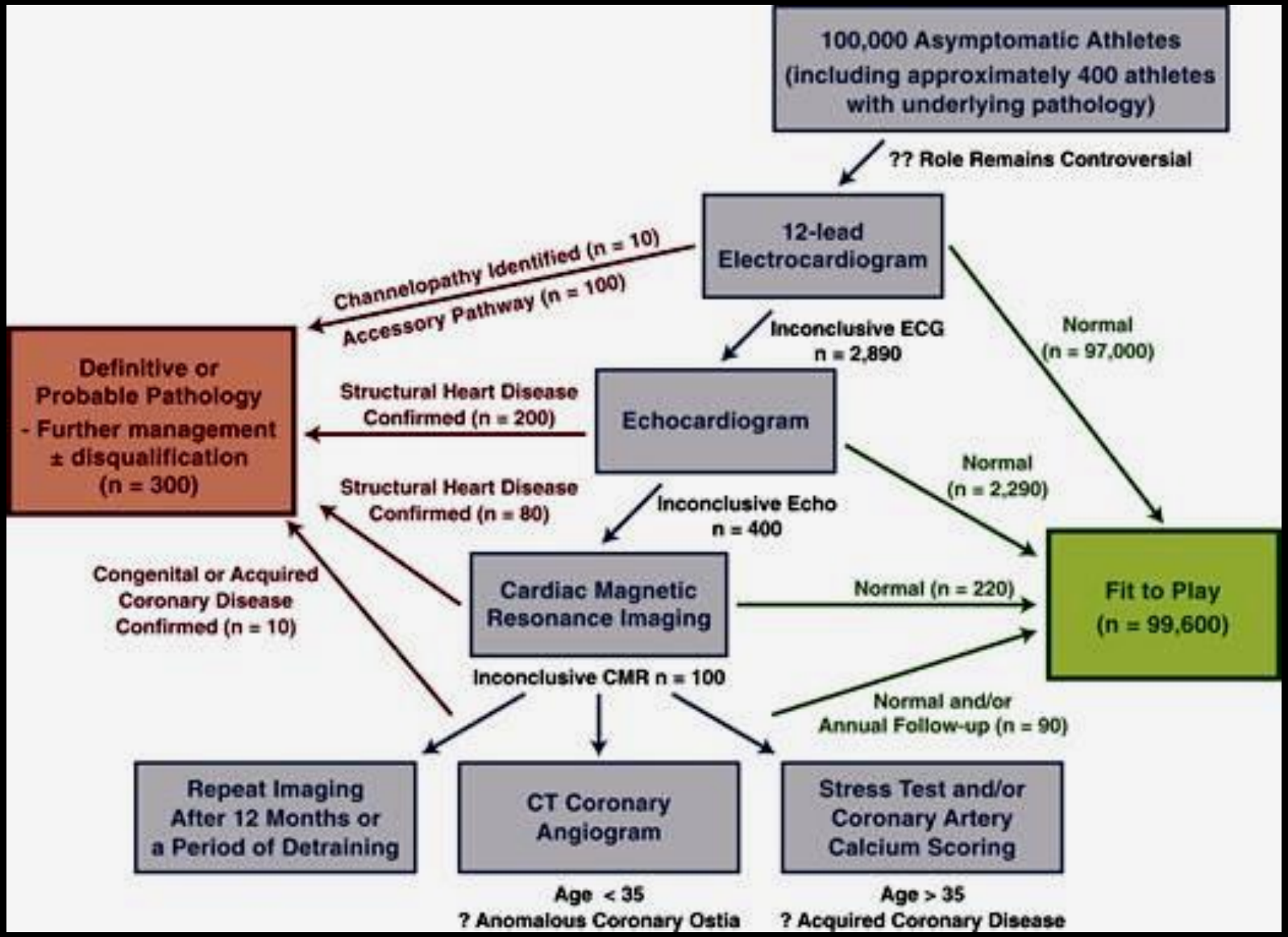
Consensus Statement of the Study Group of Sport Cardiology of the Working Group of Cardiac Rehabilitation and Exercise Physiology and the Working Group of Myocardial and Pericardial Diseases of the European Society of Cardiology

Domenico Corrado[1*], Antonio Pelliccia[2], Hans Halvor Bjørnstad[3], Luc Vanhees[4], Alessandro Biffi[2], Mats Borjesson[5], Nicole Panhuyzen-Goedkoop[6], Asterios Deligiannis[7], Erik Solberg[8], Dorian Dugmore[9], Klaus P. Mellwig[10], Deodato Assanelli[11], Pietro Delise[12], Frank van-Buuren[10], Aris Anastasakis[13], Hein Heidbuchel[4], Ellen Hoffmann[14], Robert Fagard[4], Silvia G. Priori[15], Cristina Basso[19], Eloisa Arbustini[16], Carina Blomstrom-Lundqvist[17], William J. McKenna[18], and Gaetano Thiene[19]

European Society of Cardiology Study Group:

All young athletes should have rigorous physical examination, detailed investigation of personal and family history and 12-lead ECG repeated every 2 years.




100,000 Asymptomatic Athletes
(including approximately 400 athletes with underlying pathology)
?? Role Remains Controversial
12-lead Electrocardiogram
Channelopathy Identified (n = 10)
Accessory Pathway (n = 100)
Definitive or Probable Pathology
- Further management
± disqualification
(n = 300)
Inconclusive ECG
n = 2,890
Normal
(n = 97,000)
Structural Heart Disease
Confirmed (n = 200)
Echocardiogram
Normal
(n = 2,290)
Structural Heart Disease
Confirmed (n = 80)
Inconclusive Echo
n = 400
Congenital or Acquired
Coronary Disease
Confirmed (n = 10)
Cardiac Magnetic Resonance Imaging
Normal (n = 220)
Fit to Play
(n = 99,600)
Inconclusive CMR n = 100
Normal and/or
Annual Follow-up (n = 90)
Repeat Imaging
After 12 Months or
a Period of Detraining
CT Coronary Angiogram
Stress Test and/or
Coronary Artery
Calcium Scoring
Age < 35
? Anomalous Coronary Ostia
Age > 35
? Acquired Coronary Disease

Hellenic J Cardiol 2010; 51: 530-537

Review Article

Recommendations for the Cardiovascular Screening of Athletes

Asterios Deligiannis[1], Aris Anastasakis[2], Loizos Antoniades[3], Georgios Bobotis[4], Paraschos Geleris[5], John Goudevenos[6], Georgios Hahalis[7], Evangelia Kouidi[1], Athanasios Kranidis[8], Dimitrios Kremastinos[9], John Lekakis[10], Georgios Parcharidis[10], Vlassis Pyrgakis[11], Georgios Rontogiannis[12], Christodoulos Stefanadis[2], Ioannis Styliadis[10], Panos Vardas[13]

[1]Sports Medicine Laboratory, Aristotle University of Thessaloniki, [2]First Department of Cardiology, Hippokration Hospital, University of Athens, Greece; [3]Cardiology Department, Nicosia General Hospital, Cyprus; [4]Second Cardiology Department, Papageorgiou Hospital, Thessaloniki, [5]Second Propedeutic Department of Internal Medicine, Hippokration Hospital, Aristotle University of Thessaloniki, [6]Department of Cardiology, University Hospital, Ioannina, [7]Internal Medicine Department, Patras University Hospital, [8]First Cardiac Department, Evangelismos Hospital, Athens, [9]Second University Department of Cardiology, Attikon Hospital, Athens, [10]First Cardiology Department, AHEPA Hospital, Aristotle University of Thessaloniki, [11]Cardiology Department, "G. Gennimatas" Hospital, Athens, [12]Sports Medicine Laboratory, University of Thessaly, [13]Cardiology Department, Heraklion University Hospital, Crete, Greece

ARISTOTLE UNIVERSITY OF THESSALONIKI
DEPARTMENT OF PHYSICAL EDUCATION & SPORTS SCIENCE
LABORATORY OF SPORTS MEDICINE
DIRECTOR: PROFESSOR A. DELIGIANNIS

CARDIOVASCULAR PRE-PARTICIPATION SCREENING OF 32.205 ATHLETES: A NORTHERN GREECE 20 YEARS EXPERIENCE

Deligiannis A. et al., HJC,2013

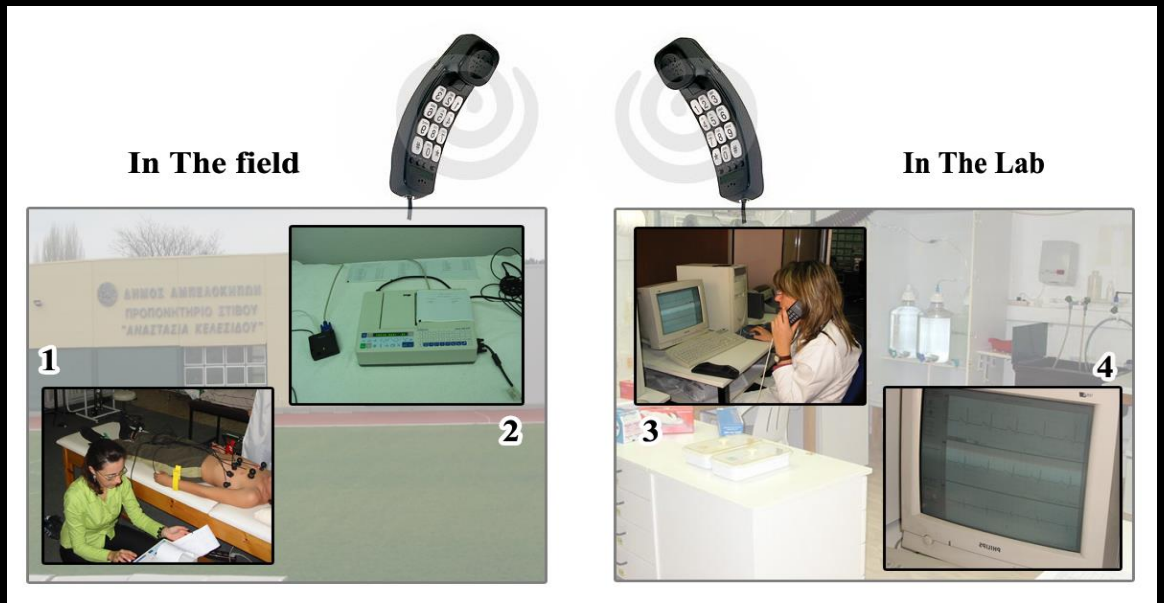
Hindawi Publishing Corporation
International Journal of Telemedicine and Applications
Volume 2008, Article ID 217909, 4 pages
doi:10.1155/2008/217909

Research Article

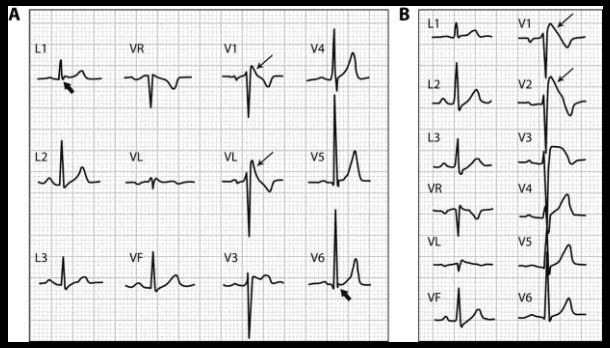
Transtelephonic Electrocardiographic Transmission in the Preparticipation Screening of Athletes

Theodoros Samaras,[1] Savvato Karavasiliadou,[2] Evangelia Kouidi,[2] John N. Sahalos,[1] and Asterios Deligiannis[2]

[1] *Radiocommunications Laboratory, Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece*
[2] *Laboratory of Sports Medicine, Department of Physical Education and Sport Science, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece*



IS ECG USEFUL?



British Journal of Sports Medicine

Debate: Challenges in sports cardiology; US versus European approaches

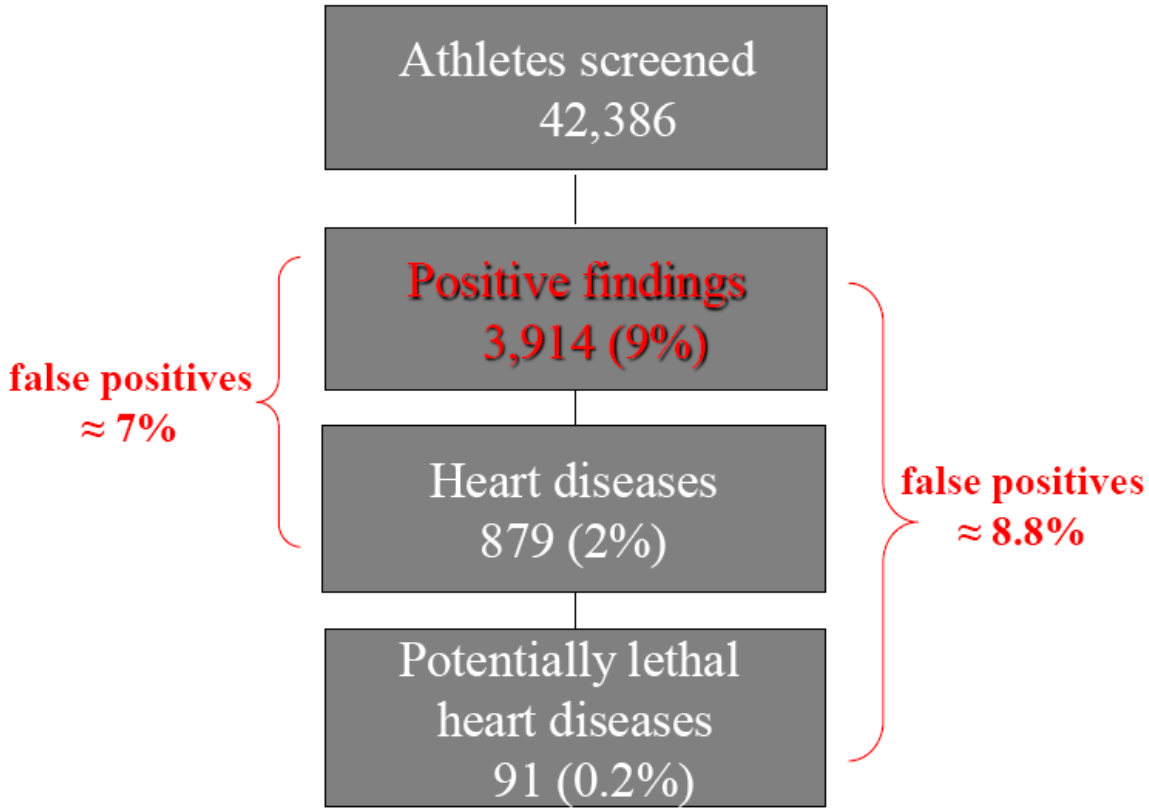
Bruce Hamilton, Benjamin D Levine, Paul D Thompson, Gregory P Whyte, Mathew G Wilson

JACC
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

ECG Screening Is Not Warranted for the Recreational Athlete

Anne B. Curtis, MD; Mohamad Bourji, MD

Mass ECG screening programs before sports participation, especially in recreational athletes, are neither cost-effective nor sustainable. The most common finding by far is a false positive test result leading to additional testing before most individuals are found to be normal and cleared to exercise. The best way to avoid that scenario is not to screen with the use of ECGs in the first place.



Corrado D, et al. EJCPR 2010

American Family Physician

Editorials

SHOULD PREPARTICIPATION CARDIOVASCULAR SCREENING OF ATHLETES INCLUDE ECG?

No: There Is Not Enough Evidence to Support Including ECG in the Preparticipation Sports Evaluation

RON WEXLER, MD, and N.A. MARK ESTES III, MD ,Tufts Medical Center, Boston, Massachusetts

American Family Physician

Editorials

SHOULD PREPARTICIPATION CARDIOVASCULAR SCREENING OF ATHLETES INCLUDE ECG?

Yes: Screening ECG Is Cost-Effective

SANJAY SHARMA, MD, MBChB, BSc, FRCP, and LYNNE MILLAR, MB, BCh, BAO, St. George's University of London, London, United Kingdom

Transl Med UniSa. 2015 Jan-Apr; 11: 2–13.

The Validity of Adding ECG to the Preparticipation Screening of Athletes An Evidence Based Literature Review

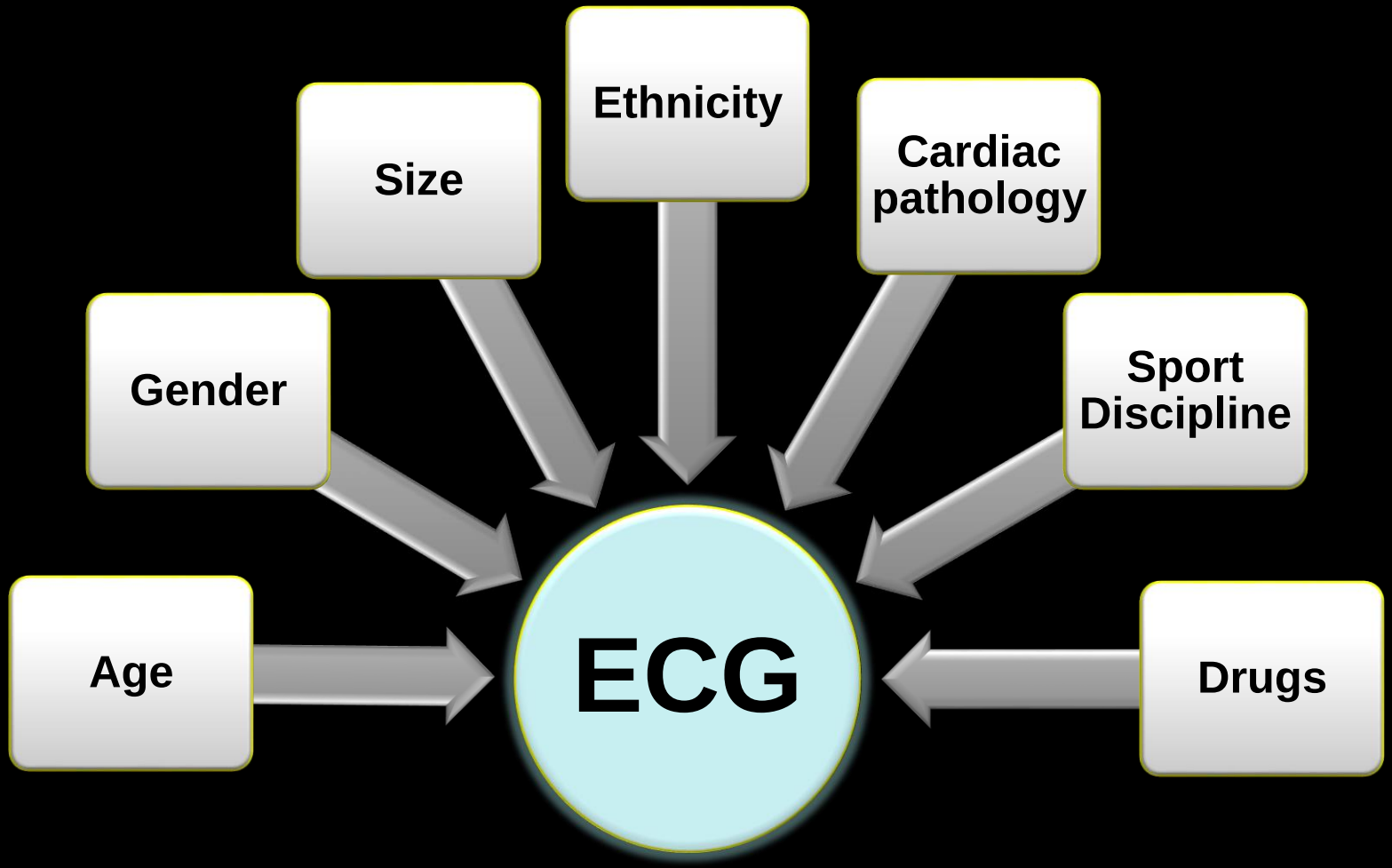
A Alattar and N Maffulli

Search Result and Quality Assessment:

The initial literature search identified 226 papers. Of these, 16 original articles (all type II evidence—population-based clinical studies) met the selection criteria and directly related to the use of electrocardiography in athletes cardiac screening.

Conclusion:

Screening with electrocardiography represents best clinical practice to prevent or reduce the risk of sudden cardiac death in athletes.

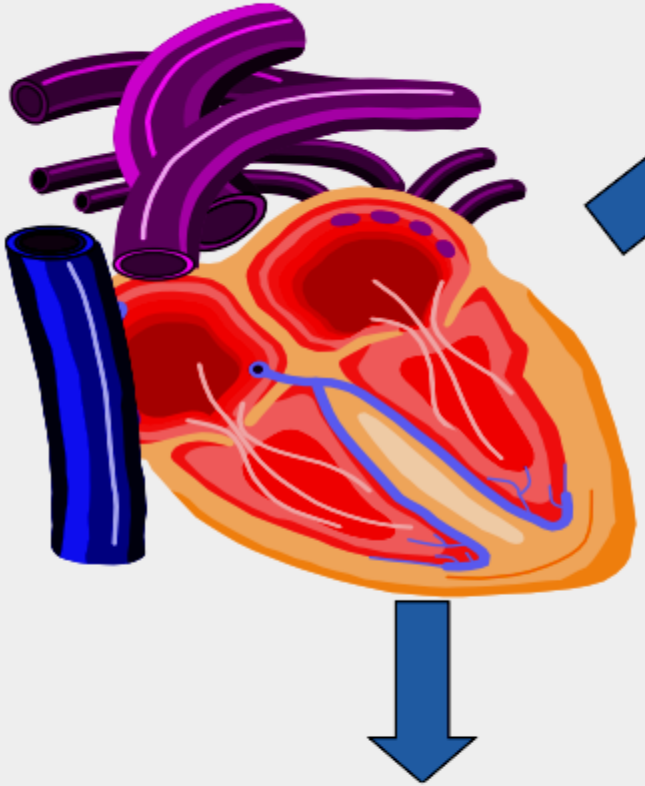

Ethnicity
Size
Cardiac pathology
Gender
Sport Discipline
Age
ECG
Drugs

REASONS FOR COMMON ECG ALTERATIONS IN ATHLETES (TRAINING RELATED)

- Structural cardiac adaptations
- Lower intrinsic heart rate
- Increased parasympathetic tone
- Decreased sympathetic tone
- Non-homogenous repolarisation of ventricles
- Electrolytic disturbances
- Doping

Deligiannis A. et al. Eur J Cardiovasc Prev Rehabil 2006;13:687

Athlete's Heart



ELECTRICAL

Bradycardia

Repolarisation anomalies

Voltage criteria for chamber enlargement

STRUCTURAL

Increased wall thickness

Increaed cavity size

FUNCTIONAL

Enhanced diastolic filling

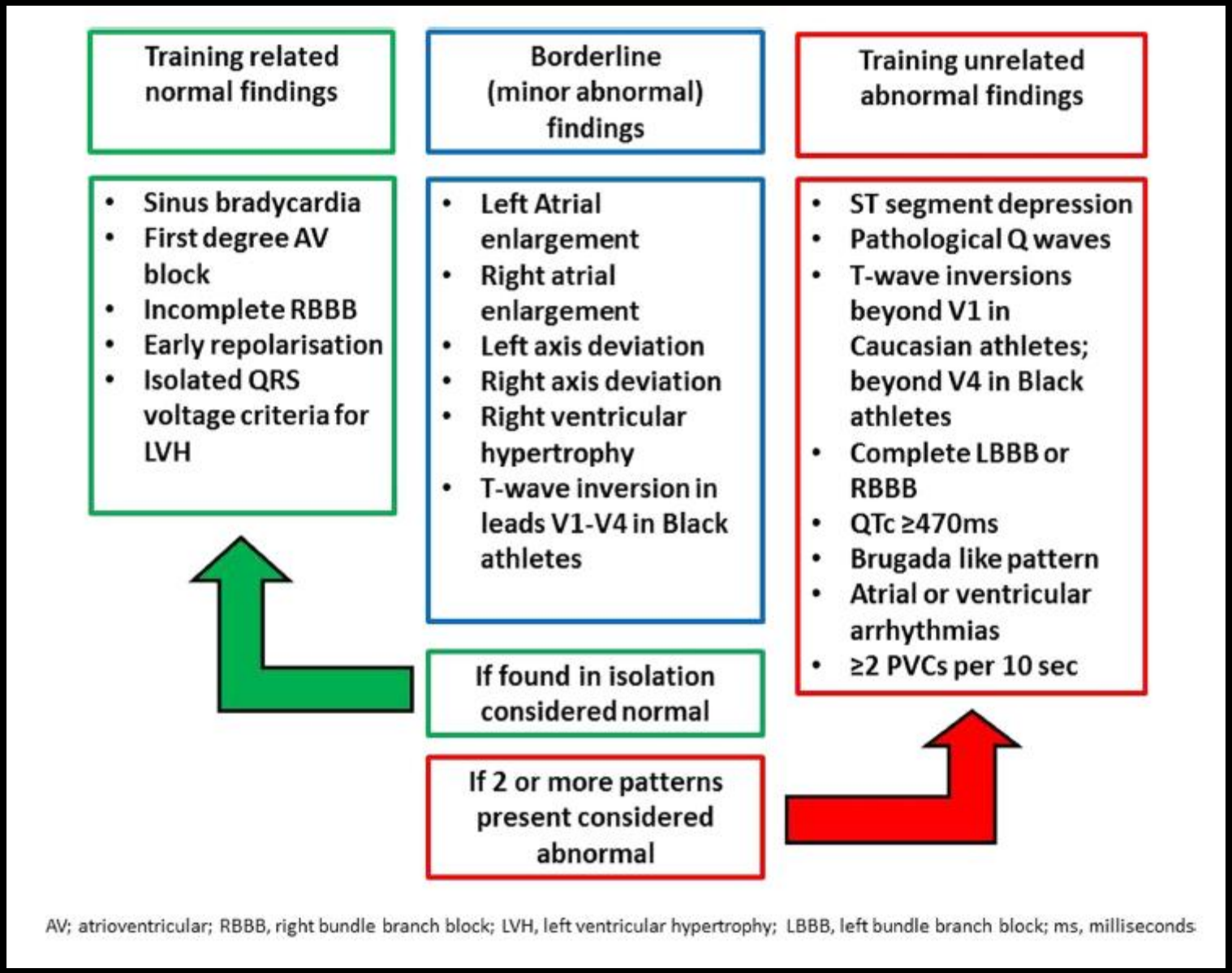
Augmentation of stroke volume

European Heart Journal (2010) **31**, 243–259
doi:10.1093/eurheartj/ehp473

ESC REPORT

Recommendations for interpretation of 12-lead electrocardiogram in the athlete

Domenico Corrado[1*], Antonio Pelliccia[2], Hein Heidbuchel[3], Sanjay Sharma[4], Mark Link[5], Cristina Basso[6], Alessandro Biffi[2], Gianfranco Buja[1], Pietro Delise[7], Ihor Gussac[8], Aris Anastasakis[9], Mats Borjesson[10], Hans Halvor Bjørnstad[11], François Carrè[12], Asterios Deligiannis[13], Dorian Dugmore[14], Robert Fagard[3], Jan Hoogsteen[15], Klaus P. Mellwig[16], Nicole Panhuyzen-Goedkoop[17], Erik Solberg[18], Luc Vanhees[3], Jonathan Drezner[19], N.A. Mark Estes, III[5], Sabino Iliceto[1], Barry J. Maron[20], Roberto Peidro[21], Peter J. Schwartz[22], Ricardo Stein[23], Gaetano Thiene[6], Paolo Zeppilli[24], and William J. McKenna[25] on behalf of the Sections of Sports Cardiology of the European Association of Cardiovascular Prevention and Rehabilitation; and the Working Group of Myocardial and Pericardial Disease of the European Society of Cardiology



AV; atrioventricular; RBBB, right bundle branch block; LVH, left ventricular hypertrophy; LBBB, left bundle branch block; ms, milliseconds

COST EFFECTIVENESS OF ECHO IN PRE-PARTICIPATION SCREENING

Additional testing, as echocardiography, requires enormous financial support and raises a number of criticisms, since it is considered to have limited diagnostic accuracy and efficiency in many cardiac disorders and, also they are time-consuming.

Maron BJ, et al. Circulation 2007; 115:1643-55.

QUESTION 6:

Are there recommendations for the preparticipation screening of aged athletes?

Wolters Kluwer Health | Lippincott Williams & Wilkins

EUROPEAN SOCIETY OF CARDIOLOGY®

Review

Cardiovascular evaluation of middle-aged/senior individuals engaged in leisure-time sport activities: position stand from the sections of exercise physiology and sports cardiology of the European Association of Cardiovascular Prevention and Rehabilitation

Mats Borjesson[a], Alex Urhausen[b], Evangelia Kouidi[c], Dorian Dugmore[d], Sanjay Sharma[e], Martin Halle[i], Hein Heidbüchel[f], Hans Halvor Björnstad[h], Stephan Gielen[j], Alessandro Mezzani[k], Domenico Corrado[l], Antonio Pelliccia[m] and Luc Vanhees[g]

European Journal of Cardiovascular Prevention and Rehabilitation 2010, 00:000–000

Exercise ECG screening test

men > 40-45 years of age

women > 50-55 years of age (or postmenopausal)

with 1 independent coronary risk factor

- **hypercholesterolemia or dyslipidemia including low HDL**
- **systemic hypertension**
- **current or recent cigarette smoking**
- **diabetes mellitus**
- **a history of myocardial infarction or SCD in a first-degree relative aged < 60 years.**

Limitations of Screening Exercise Testing

- Good prognostic value in symptomatic patients
- Low sensitivity and specificity, poor positive predictive value and high false positives in prediction of exercise-related MI and SD in asymptomatic individuals due to low event rates

Symptomatic	Sens 68%	Spec 77%
Asymptomatic	**Sens 46%**	**Spec 16%**

- False negative

Treadmill testing ≠ marathon/triathlon

- Prevalence rate of SCD in marathons/triathlons is too low to warrant routine screening

QUESTION 7:

ARE THERE RECOMMENDATIONS FOR ATHLETES WITH CARDIOVASCULAR DISEASES?

European Heart Journal (2005) 26, 1422–1445
doi:10.1093/eurheartj/ehi325

ESC Report

Recommendations for competitive sports participation in athletes with cardiovascular disease

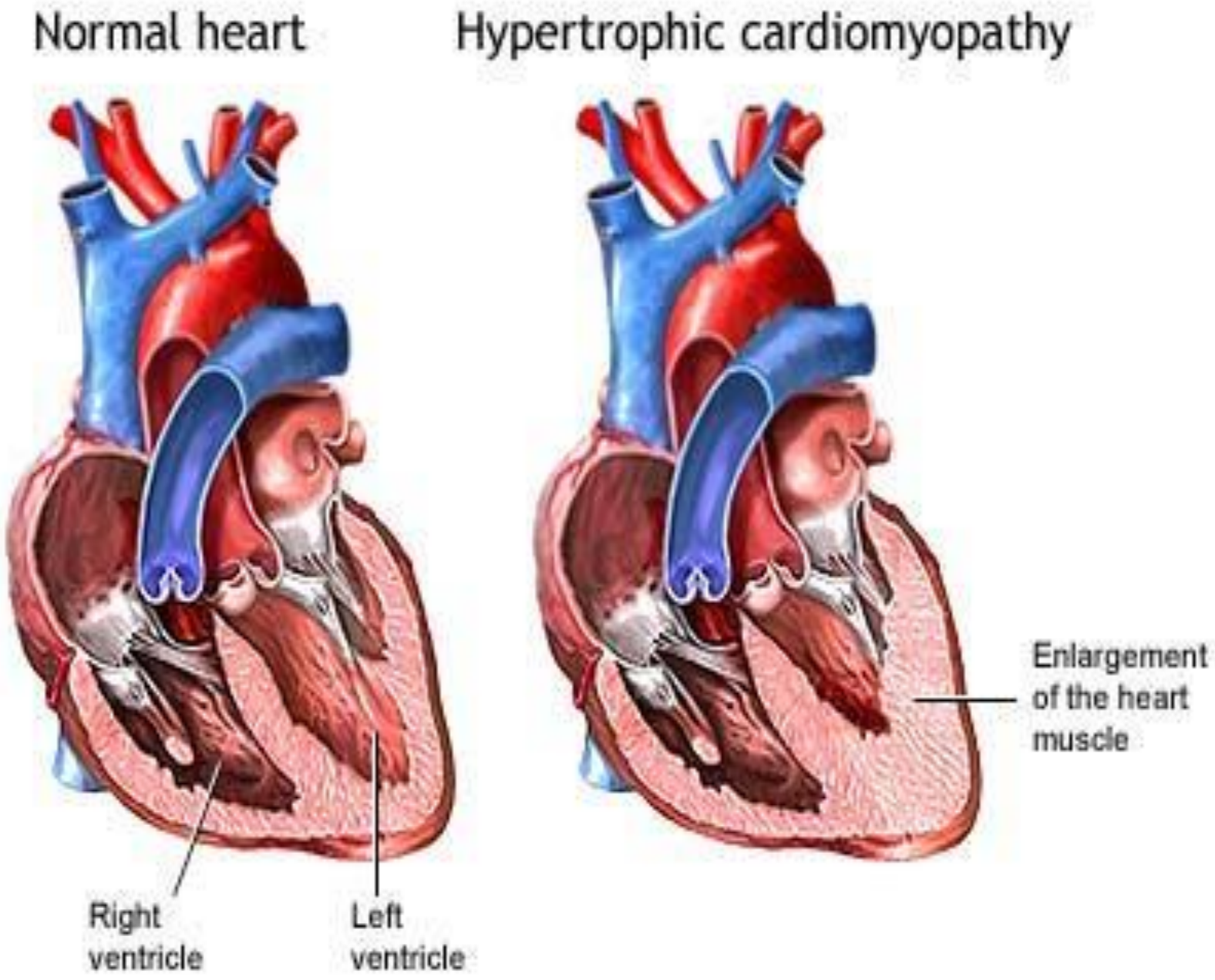
A consensus document from the Study Group of Sports Cardiology of the Working Group of Cardiac Rehabilitation and Exercise Physiology and the Working Group of Myocardial and Pericardial Diseases of the European Society of Cardiology

Antonio Pelliccia[1*], Robert Fagard[2], Hans Halvor Bjørnstad[3], Aris Anastassakis[4], Eloisa Arbustini[5], Deodato Assanelli[6], Alessandro Biffi[1], Mats Borjesson[7], François Carrè[8], Domenico Corrado[9], Pietro Delise[10], Uwe Dorwarth[11], Asle Hirth[3], Hein Heidbuchel[12], Ellen Hoffmann[11], Klaus P. Mellwig[13], Nicole Panhuyzen-Goedkoop[14], Angela Pisani[5], Erik E. Solberg[15], Frank van-Buuren[13], and Luc Vanhees[2]

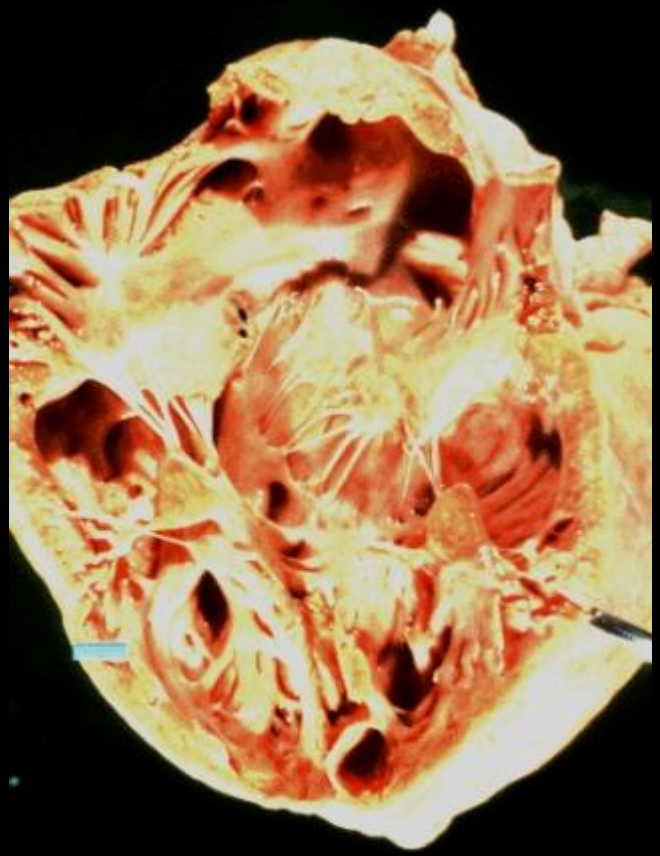
Experts who contributed to and revised parts of these recommendations:
Carina Blomstrom-Lundqvist[16], Asterios Deligiannis[17], Dorian Dugmore[18], Michael Glikson[19], Per Ivar Hoff[3], Andreas Hoffmann[20], Erik Hoffmann[21], Dieter Horstkotte[14], Jan Erik Nordrehaug[3], Jan Oudhof[22], William J. McKenna[23], Maria Penco[24], Silvia Priori[25], Tony Reybrouck[2], Jeff Senden[26], Antonio Spataro[1], and Gaetano Thiene[9]

Table 16 – Athletes with congenital heart diseases

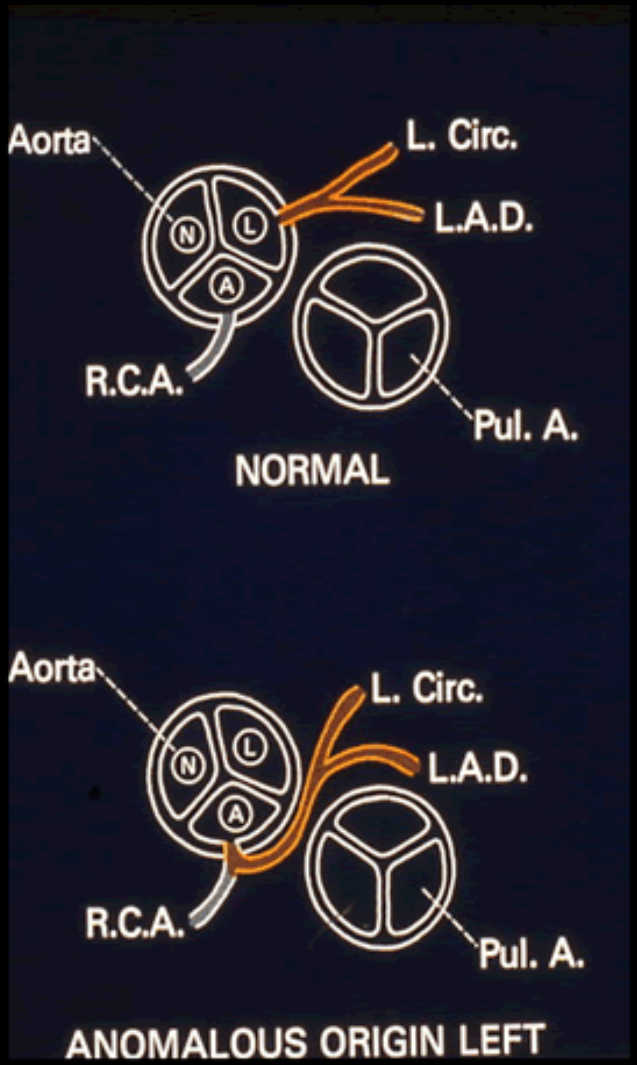
Pathology	Eligibility criterion	Recommendation
Atrial septal defect (closed or small, non-operated) and patent foramen ovale	Defect <6mm or 6 months post-closing, with normal pulmonary artery pressure without significant arrhythmia or ventricular dysfunction	Release for all sports. In patients with patent foramen ovale, percutaneous closure may be considered before the regular practice of diving.
Ventricular septal defect (closed or small, non-operated)	Restrictive defect (left to right gradient <64mmHg) or 6 months post-closing, without pulmonary hypertension.	Release for all sports
Atrioventricular septal defect	With no or only mild insufficiency of the atrioventricular valves, no subaortic stenosis, or significant arrhythmia, normal maximum gas exchange measurements.	Release for all sports
Partial or complete anomalous venous drainage	No significant systemic or pulmonary venous obstruction, without pulmonary hypertension or atrial arrhythmia induced by exercise.	Release for all sports
Persistent ductus arteriosus (operated)	6 months post-closing and no residual hypertension.	Release for all sports
Pulmonary stenosis (native mild or treated)	Native or 6 months post-intervention/post-surgery; peak transvalvular gradient between 30 and 50 mmHg, normal right ventricle, normal ECG or only mild right ventricular hypertrophy.	Release for sports low dynamic and static low to moderate.
Aortic coarctation (native or repaired)	Without systemic hypertension; peak pressure gradient between upper and lower limbs<21mmHg, peak systolic blood pressure<231mmHg during exercise without ischemia on exertion ECG without left ventricular overload.	Release for sports dynamics and sports low and moderate static (IA, B + II A, B). If the presence of graft, avoid risk of collision with sport body.
Aortic stenosis (moderate)	Transvalvular mean gradient <21mmHg, with no history of arrhythmia, without syncope, dizziness or angina pectoris.	Release for all sports except high static and dynamic sports.
Aortic stenosis (mild)	Transvalvular mean gradient between 21mmHg and 49mmHg, with no history of arrhythmia, without syncope, dizziness or angina pectoris.	Release for low dynamic and static sports (IA).
Tetralogy of Fallot	With no or only mild obstruction of the outflow tract of the RV, no more than mild pulmonary regurgitation, normal or near normal biventricular function and no evidence of arrhythmia.	Sports of low to moderate dynamic and static

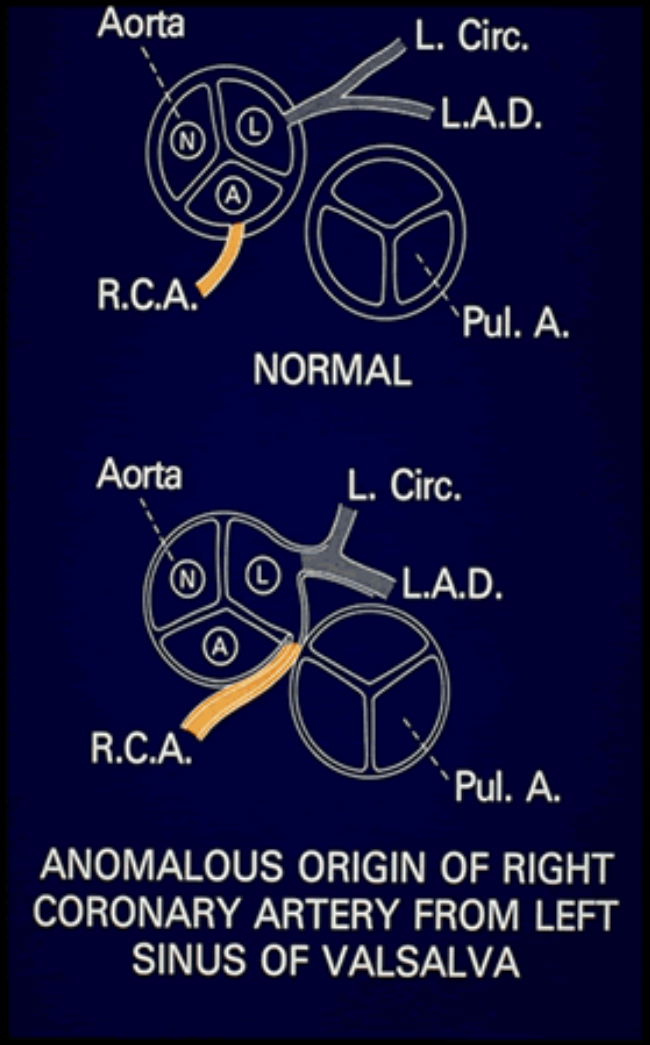

Normal heart
Hypertrophic cardiomyopathy
Enlargement of the heart muscle
Right ventricle
Left ventricle
A.D.A.M.

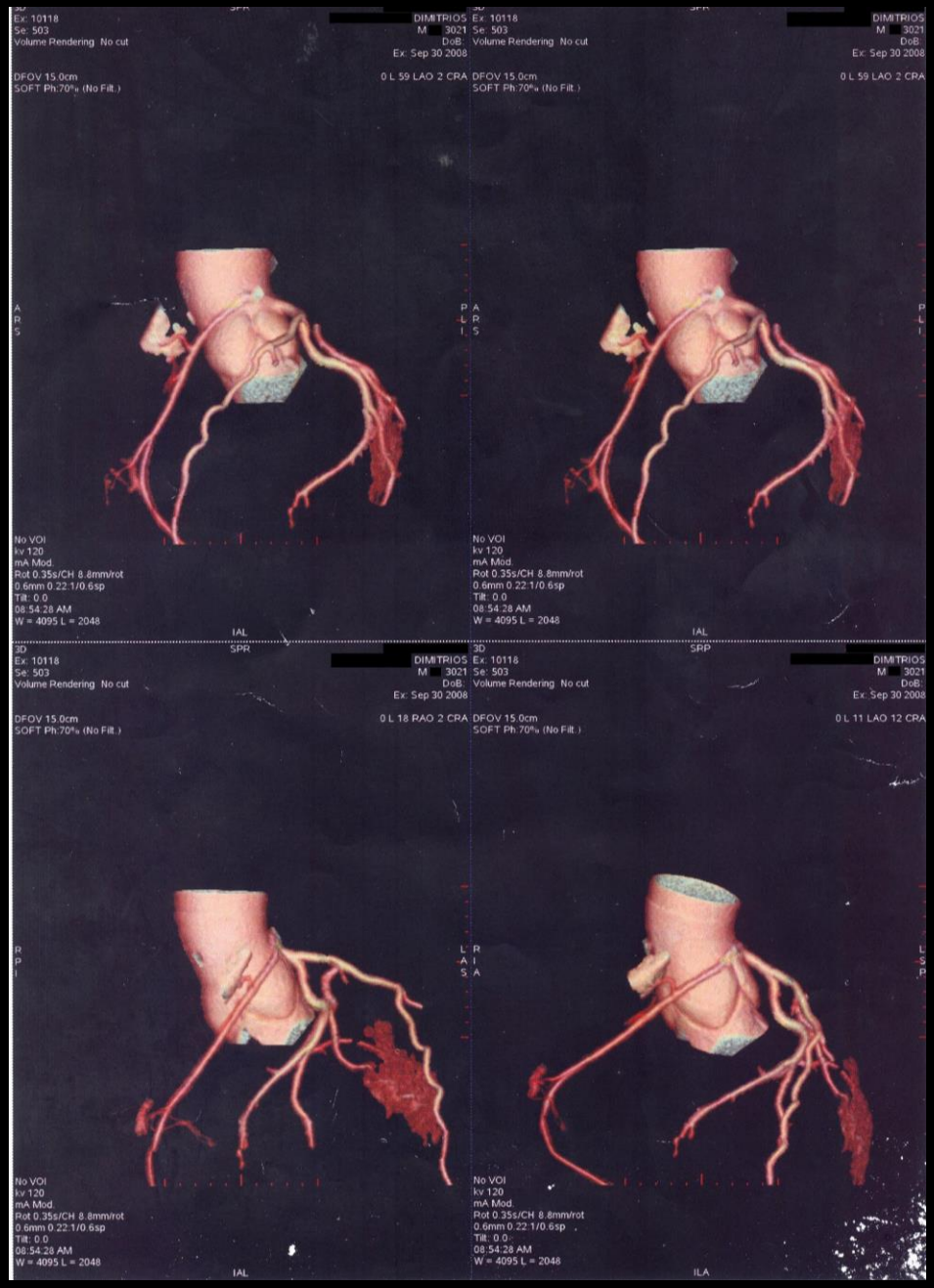
Acute myocarditis



ANOMALOUS CORONARY ARTERY



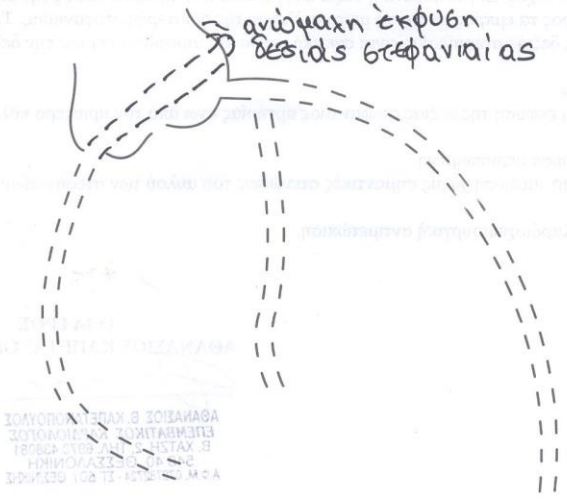




ΑΙΜΟΔΥΝΑΜΙΚΟ ΕΡΓΑΣΤΗΡΙΟ

Επώνυμο [redacted] Όνομα ΔΗΜΗΤΡΙΟΣ

Ηλικία [redacted] Ημερομηνία 17/10/2008 Κ.Α.

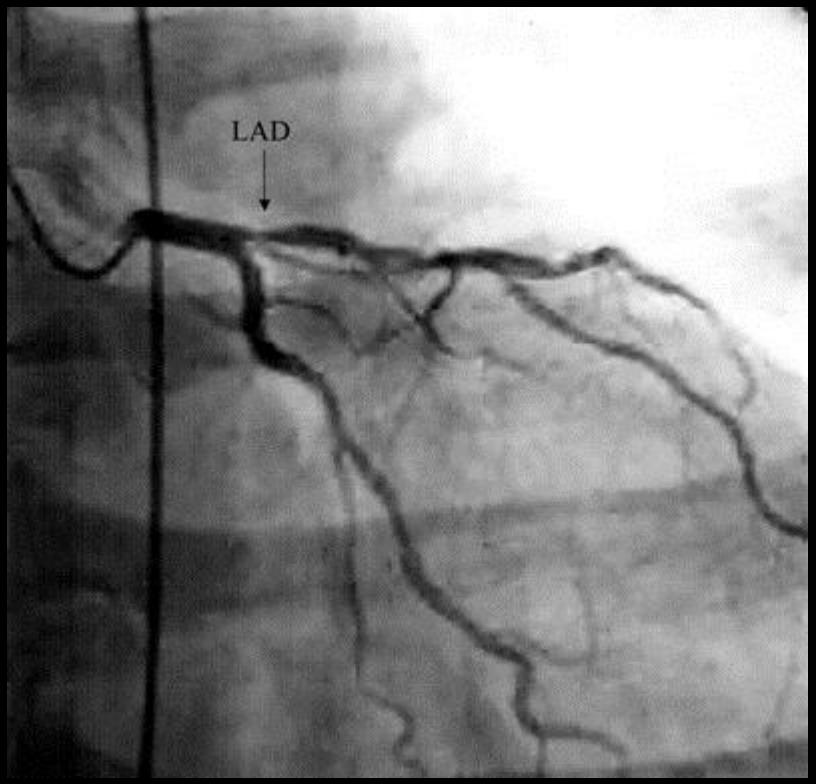


ΑΓΓΕΙΟΓΡΑΦΙΚΑ ΕΥΡΗΜΑΤΑ

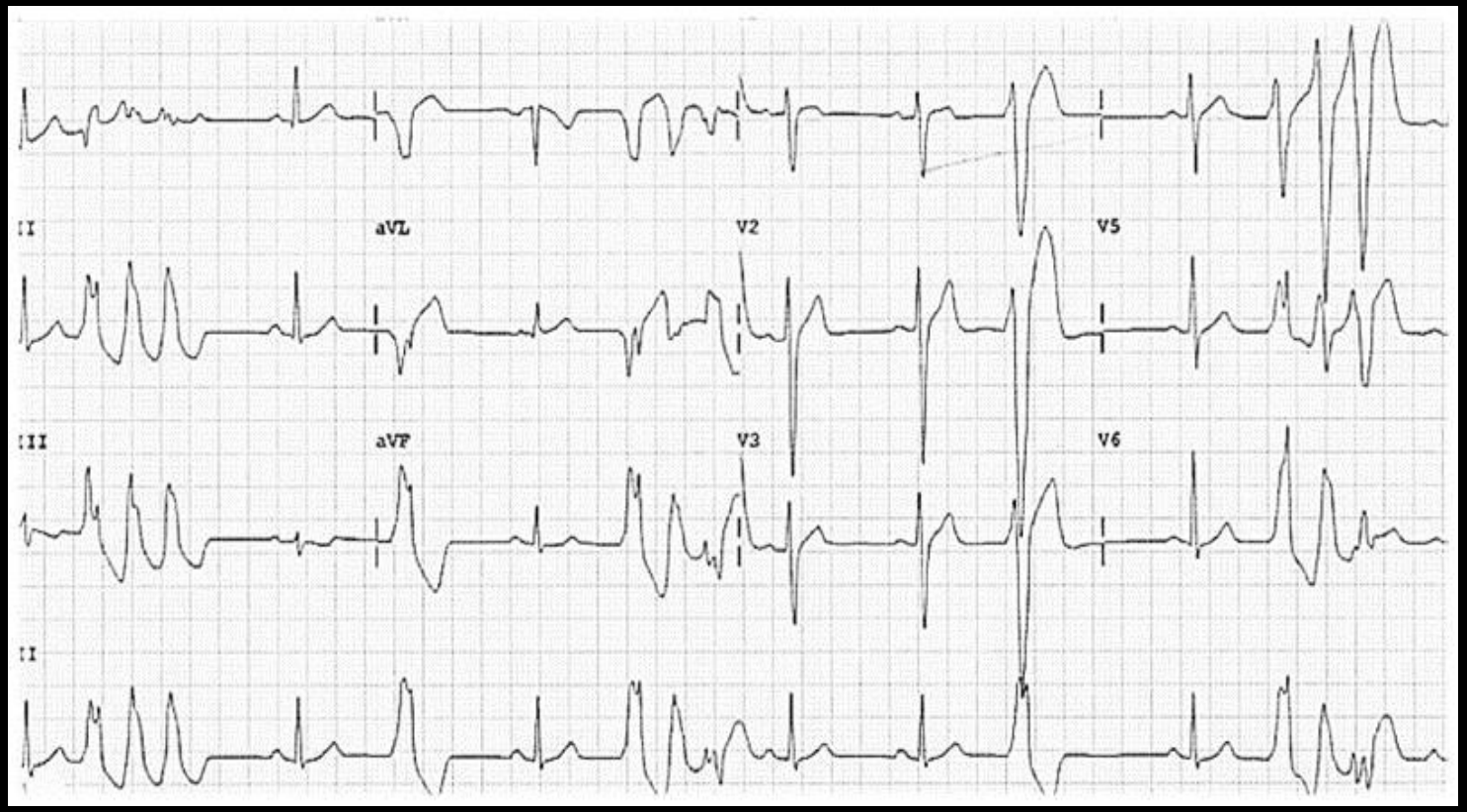
Ενδείξεις και κλινικό ιστορικό :

Ο κος. [redacted] και υποβλήθηκε σε CT στεφανιογραφία πρόσφατα λόγω ενοχλημάτων προκάρδιου άλγους και δύσπνοιας τα οποία εμμένουν για αρκετά έτη. Το προκάρδιο άλγος και η δύσπνοια δεν χειροτερεύουν με την κόπωση. Επίσης αναφέρει ότι έπαιζε ποδόσφαιρο και ήταν γυμναστής. Αρνείται συγκοπτικά επεισόδια.

Premature Coronary Artery Disease



ARRHYTHMIAS



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WILLIAMS & WILKINS

EUROPEAN
SOCIETY OF
CARDIOLOGY

Position Paper

ESC Study Group of Sports Cardiology Recommendations for participation in leisure-time physical activities and competitive sports for patients with hypertension

Robert H. Fagard[a], Hans H. Björnstad[b], Mats Børjesson[c], François Carré[d], Asterios Deligiannis[e] and Luc Vanhees[a,f]

[a]Hypertension and Cardiovascular Rehabilitation Unit, KULeuven, Leuven, Belgium, [b]Department of Heart Disease, Haukelund University Hospital, Bergen, Norway, [c]Department of Medicine, Sahlgrens University Hospital/Östra, Gothenburg, Sweden, [d]Unité Biologie et Médecine du Sport, Hôpital Pontchaillou, Rennes, France, [e]Sports Medicine Division, Aristotle University, Thessaloniki, Greece and [f]Department of Rehabilitation Sciences, KULeuven, Leuven, Belgium.

European Journal of Cardiovascular Prevention and Rehabilitation 2005, 12:326–331

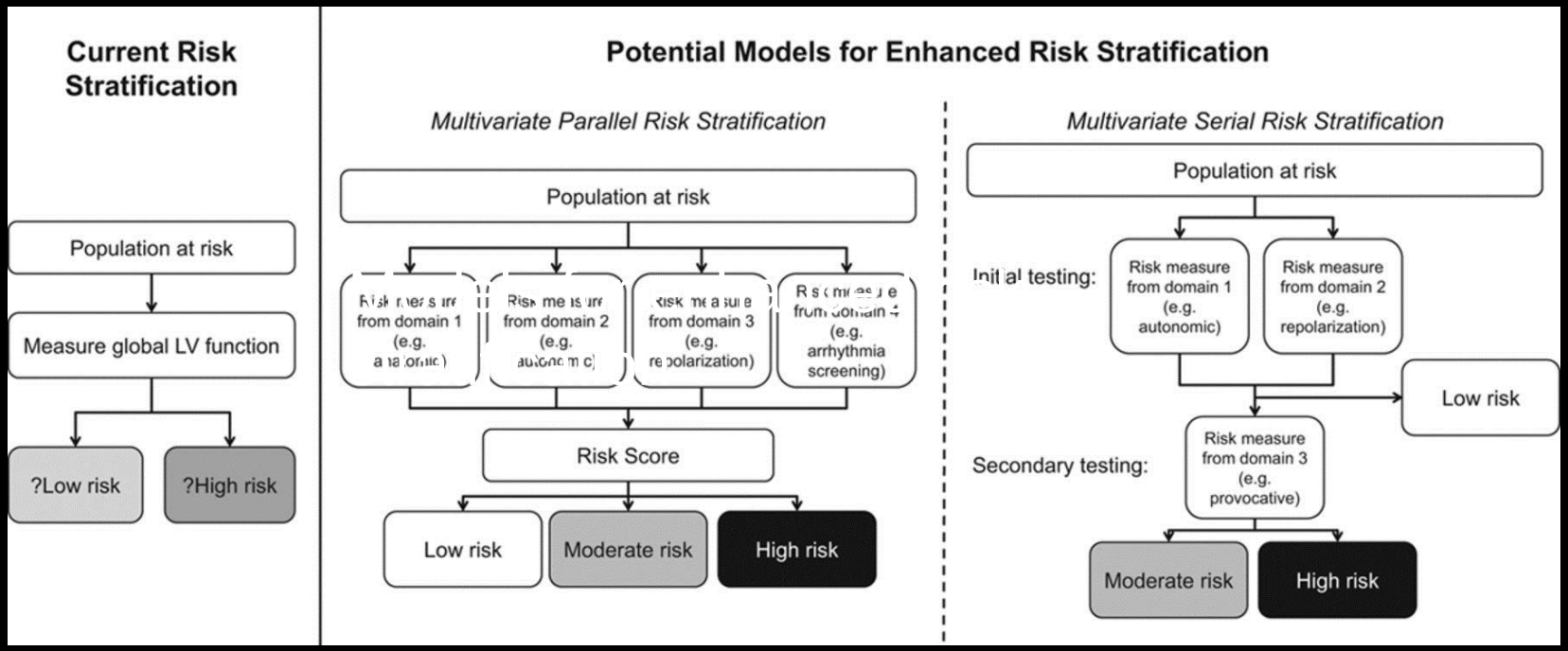
Risk category	Evaluation	Criteria for eligibility	Recommendations	Follow-up
Low added risk	History, PE, ECG, ET, Echo	Well controlled BP	All sports	Yearly
Moderate added risk	History, PE, ECG, ET, Echo	Well controlled BP and risk factors	All sports, with exclusion of high static, high dynamic sports (III C)	Yearly
High added risk	History, PE, ECG, ET, Echo	Well controlled BP and risk factors	All sports, with exclusion of high static sports (III A–C)	Yearly
Very high added risk	History, PE, ECG, ET, Echo	Well controlled BP and risk factors; no associated clinical conditions	Only low-moderate dynamic, low static sports (I A–B)	6 months

BP, blood pressure; PE, physical examination, including repeated blood pressure measurements according to guidelines; ECG, 12-lead electrocardiography; ET, exercise testing; Echo, echocardiography at rest.

QUESTION 8:

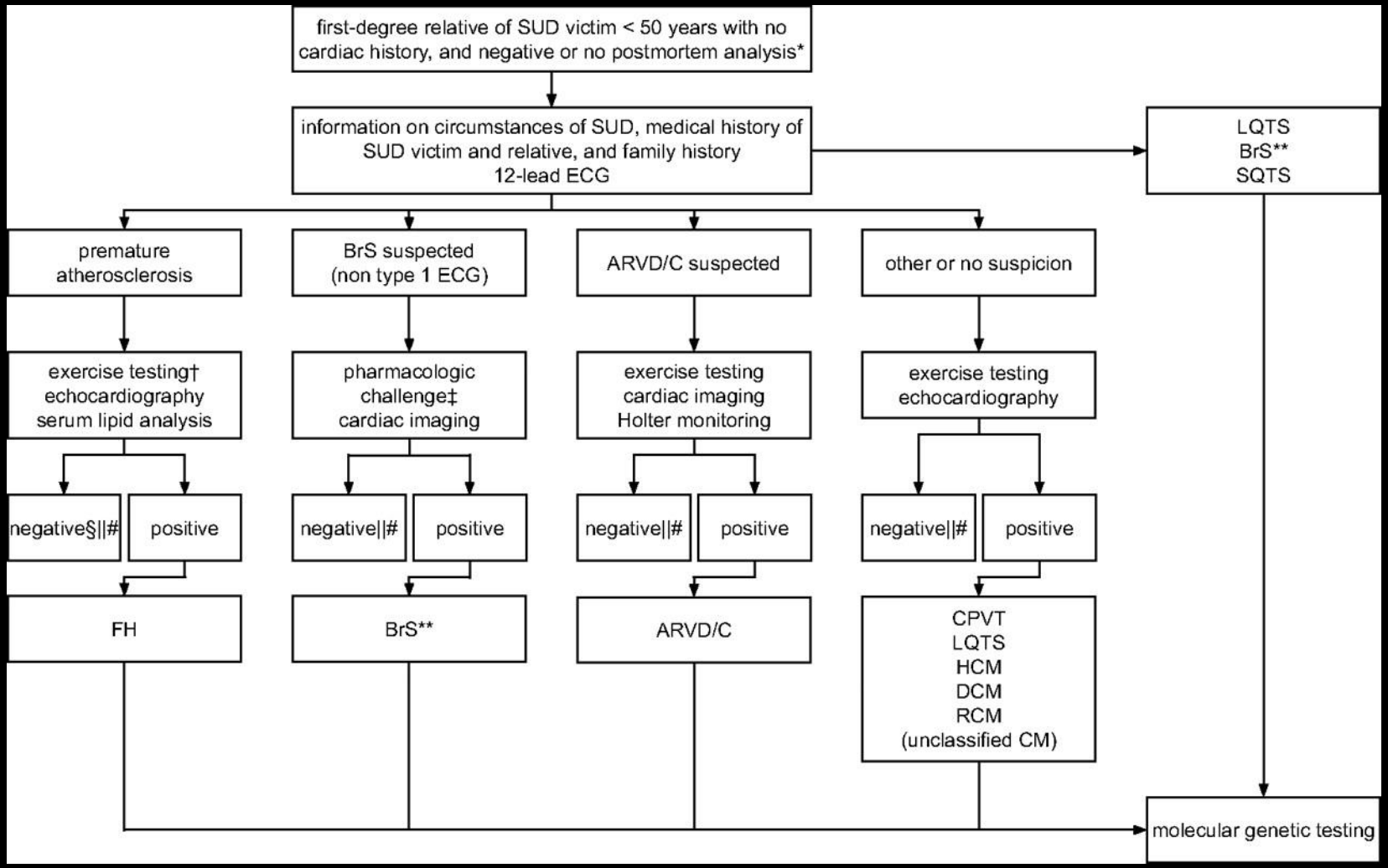
- **WHICH OTHER STRATEGIES FOR THE PREVENTION OF SCD?**
- **1. To improve the identification of individuals and families that might be at very high risk of CVD, in particular those with inherited cardiac conditions**
- **2. To improve the capacity for SCD predictability of some non-invasive investigations and methods**
- **3. To train coaching staff, referees, and student-athletes to recognize and respond to a cardiac emergency**
- **4. To establish national strategies for the prevention of SCD in young people and in athletes**

Models for enhanced risk for SCD stratification



American Heart Association.

Algorithm for cardiological and genetic examination in relatives of SCD victims



2010;3:96-104
American Heart Association.

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

Genetic Determinants of Sudden Cardiac Death

Peter A. Noseworthy and Christopher Newton-Cheh

Circulation 2008;118;1854-1863
DOI: 10.1161/CIRCULATIONAHA.108.783654
Circulation is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514

 Print ISSN: 0009-7322. Online ISSN: 1524-4539

Cardiac Risk in the Young

Tel:01737 363222 e-mail:cry@c-r-y.org.uk

Search

CRY Manifesto – CRY is calling for the government to establish a national strategy for the prevention of young sudden cardiac death.

CRY is calling for the government to establish a national strategy for the prevention of young sudden cardiac death.

This strategy will ensure action to increase:

- ***awareness*** amongst medical practitioners and those at risk
- ***support*** after a young sudden death, including expert cardiac pathology
- ***screening*** for young people to identify cardiac conditions
- ***research*** to inform policy and practice

The national strategy will synchronise UK policies and lead to a dramatic reduction in young sudden cardiac deaths in the UK.

CRY's Vision:

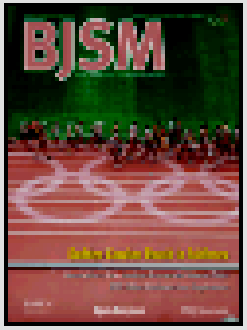
Preventing young sudden cardiac deaths through awareness, screening and research, and supporting affected families

James Cracknell OBE
"Undiagnosed cardiac conditions are a genuine risk to sports people..... it is essential to make people aware to prevent future tragedy"

Bereavement

Please call us on 01737 363222 if you have suffered a bereavement

QUESTION 9:
ARE CPR AND AED LIFESAVING IN ARENA?



Full text

Preparing for sudden cardiac arrest—the essential role of automated external defibrillators in athletic medicine: a critical review

Br J Sports Med 2009;43:9 702-707

The presence of a trained rescuer to initiate cardiopulmonary resuscitation (CPR) and access to early defibrillation through on-site automated external defibrillators (AEDs)-are critical to improving survival in sports.

Böttiger *et al. Critical Care* (2016) 20:4
DOI 10.1186/s13054-015-1156-6

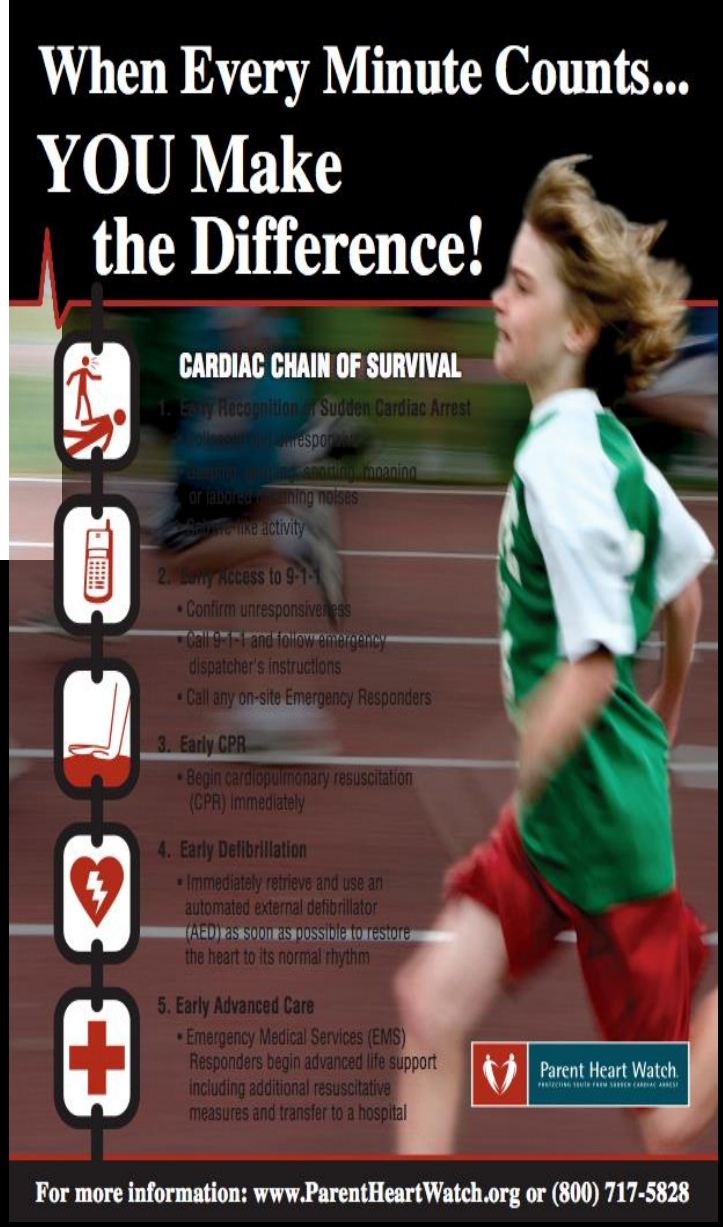
Critical Care

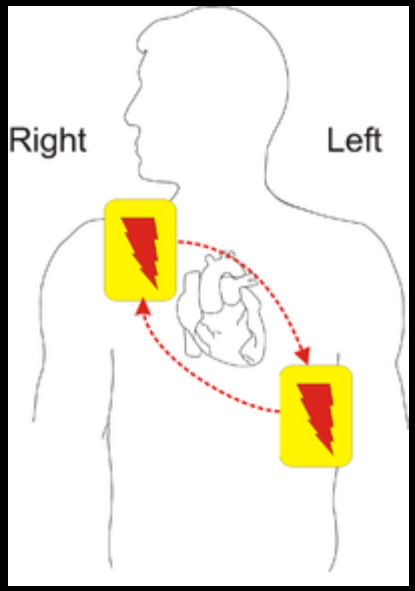
RESEARCH Open Access

Influence of EMS-physician presence on survival after out-of-hospital cardiopulmonary resuscitation: systematic review and meta-analysis

Bernd W. Böttiger[1*], Michael Bernhard[2], Jürgen Knapp[3] and Peter Nagele[4]

- **It is very important the presence of a physician into the arena!**





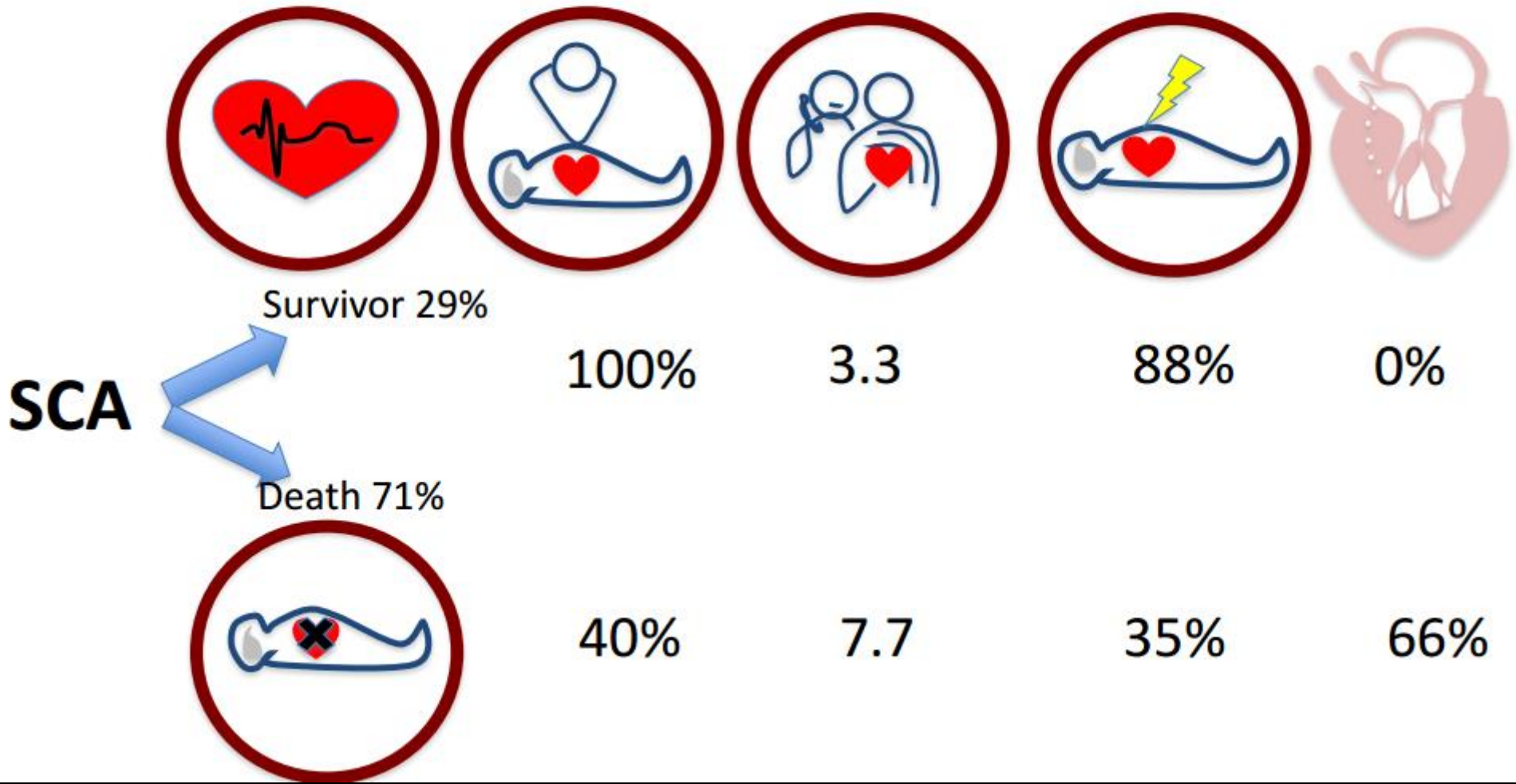
TO EQUIP ALL FIELDS WITH AUTOMATIC EXTERNAL DEFIBRILLATORS IS LIFESAVING !

ORIGINAL ARTICLE

Cardiac Arrest during Long-Distance Running Races

Jonathan H. Kim, M.D., Rajeev Malhotra, M.D., George Chiampas, D.O., Pierre d'Hemecourt, M.D., Chris Troyanos, A.T.C., John Cianca, M.D., Rex N. Smith, M.D., Thomas J. Wang, M.D., William O. Roberts, M.D., Paul D. Thompson, M.D., and Aaron L. Baggish, M.D., for the Race Associated Cardiac Arrest Event Registry (RACER) Study Group

Kim et al NEJM 2012



Effectiveness of Emergency Response Planning for Sudden Cardiac Arrest in United States High Schools With Automated External Defibrillators
Jonathan A. Drezner, Ashwin L. Rao, Justin Heistand, Megan K. Bloomingdale and Kimberly G. Harmon
Circulation published online Jul 27, 2009;
DOI: 10.1161/CIRCULATIONAHA.109.855890

Report of 1710 US high schools with an on-site AED program.
Survey relating to sudden cardiac arrest (SCA) between Jan 2006-July 2007
36 cases of SCA

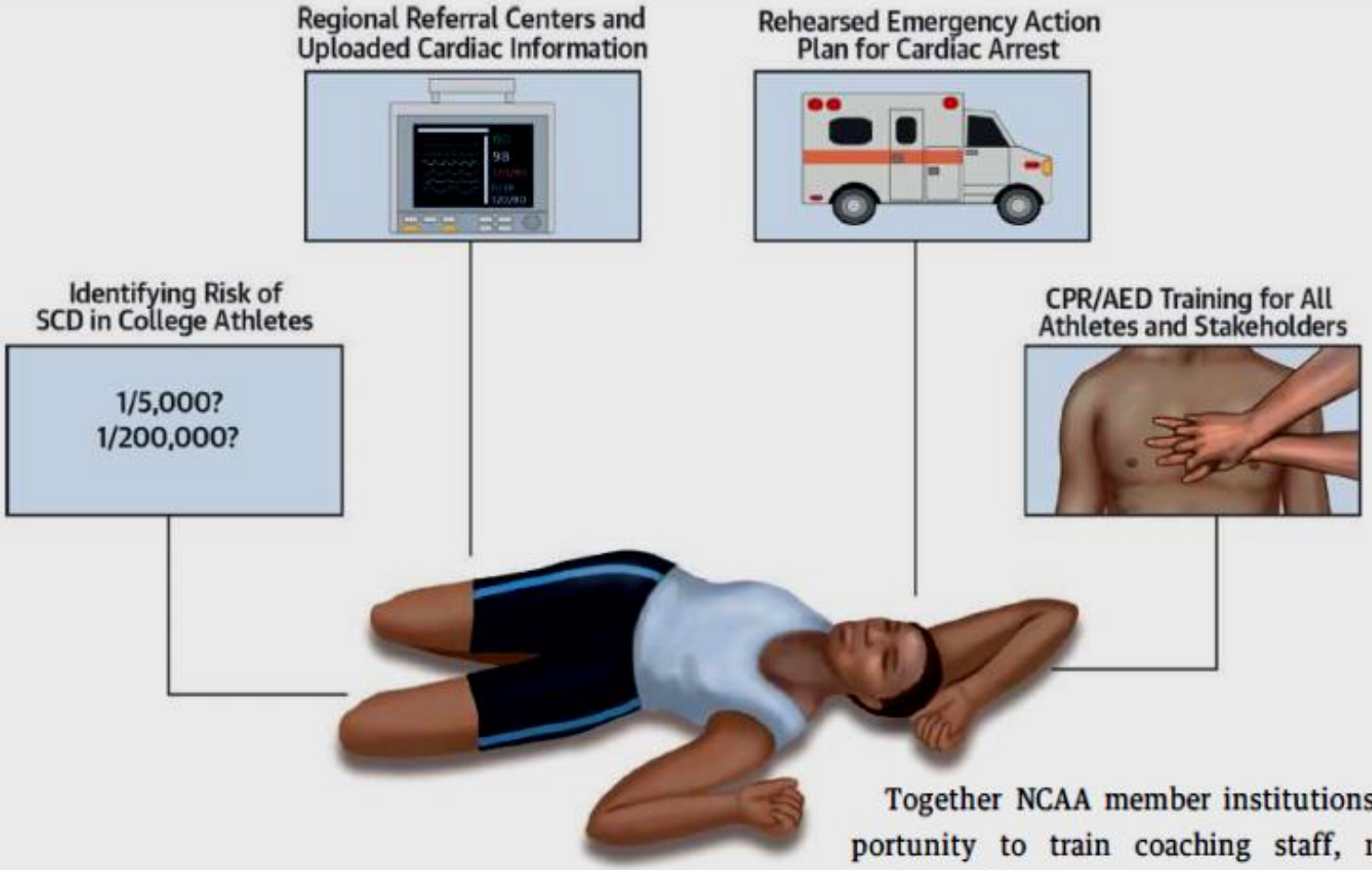
Prompt CPR 94%
AED shock 83%

14 (high school)
Mean age 16

22 older non students
Mean age 57

64% survived to hospital discharge in each group
Higher survival rates may have been to the onsite AED (79%) and smaller number of cases of hypertrophic cardiomyopathy (21%)

CENTRAL ILLUSTRATION A Summary of Cardiovascular Priorities in Collegiate Student-Athletes



Hainline, B. et al. J Am Coll Cardiol. 2016;■(■):■-■.

vascular priorities in college student-athletes range from more accurately defining the risk of S
plans. AED = automated external defibrillator; CPR = cardiopulmonary resuscitation; SCD =

Together NCAA member institutions have an opportunity to train coaching staff, referees, and student-athletes to recognize and respond to a cardiac emergency on the field and in the community and to become CPR ambassadors between the athletic programs and the larger student population. Management of cardiac arrest with prompt recognition, early activation of the emergency response system, early CPR, and early use of an AED provides the best chance of survival (Central Illustration).

Muamba who suffered a 78 minutes cardiac arrest and finally survived following successful resuscitation on time !

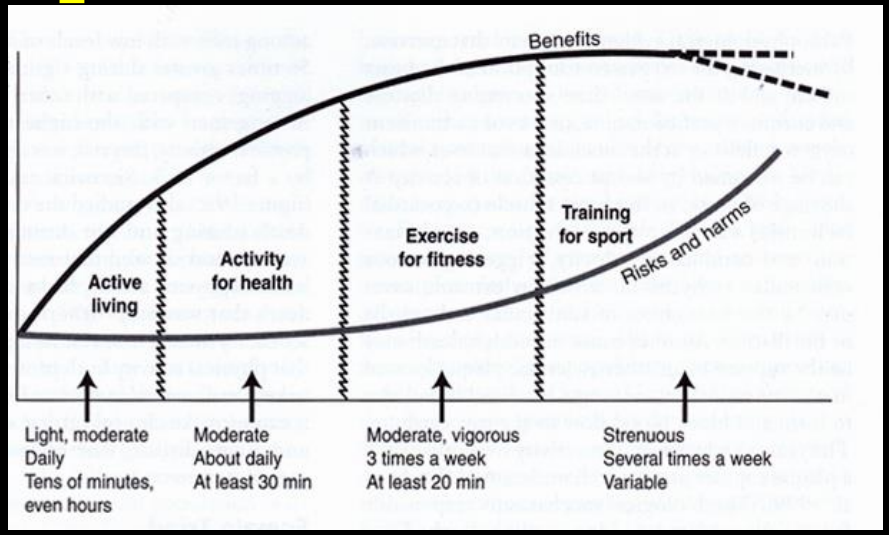
Fabrice Muamba wants 1,000 extra defibrillators to be in London's shops and gyms

The tragedy of Marc Vivien Foe

who died mayby because of the late attempt of resuscitation !

- **QUESTION 10:**

Exercise Dose- Does the ideal prescription become a bitter pill?



BENEFITS AND RISKS OF EXERCISE: THE 'PARADOX" OF EXERCISE!!

Too Much Exercise Might Harm Your Heart!

"RISK PARADOX" OF EXERCISE

In adults physical activity can be regarded as a "two-edged sword": **Vigorous exertion** increases the incidence of acute coronary events in individuals who did not exercise regularly, whereas **habitual physical activity** reduces the overall risk of myocardial infarction and sudden coronary death by preventing development of coronary artery disease and progression of coronary atherosclerotic lesions.

"CARDIAC FADIGUE" AFTER PROLONGED STRENUOUS EXERCISE

J Am Coll Cardiol. 2004 Jul 7;44(1):144-9.

Serial left ventricular adaptations in world-class professional cyclists: implications for disease screening and follow-up.

Abergel E[1], Chatellier G, Hagege AA, Oblak A, Linhart A, Ducardonnet A, Menard J.

CONCLUSIONS: Over one-half of these athletes exhibited unusual LV dilation, along with a reduced LVEF in 11.6% (17 of 147), compatible with the diagnosis of DCM. Increased WT was less common (always <15 mm) and scarce without LV dilation (<1%), eliminating the diagnosis of HCM. Serial examinations showed evidence of further LV dilation along with wall thinning. These results might have important implications for screening in athletes.

MYOCARDIAL FIBROSIS AFTER PROLONGED AND INTENSE EXERCISE

Radiology. 2009 Apr;251(1):50-7. doi: 10.1148/radiol.2511081118.

Myocardial late gadolinium enhancement: prevalence, pattern, and prognostic relevance in marathon runners.

Breuckmann F[1], Möhlenkamp S, Nassenstein K, Lehmann N, Ladd S, Schmermund A, Sievers B, Schlosser T, Jöckel KH, Heusch G, Erbel R, Barkhausen J.

Author information

Abstract

PURPOSE: To prospectively analyze the myocardial distribution of late gadolinium enhancement (LGE) with delayed-enhancement cardiac magnetic resonance (MR) imaging, to compare the prevalence of this distribution in nonprofessional male marathon runners with that in asymptomatic control subjects, and to examine the prognostic role of LGE.

MATERIALS AND METHODS: Institutional review board and ethics committee approval were obtained for this study, and all subjects provided written informed consent. Two-dimensional inversion-recovery segmented k-space gradient-echo MR sequences were performed after administration of a gadolinium-containing contrast agent in 102 ostensibly healthy male runners aged 50-72 years who had completed at least five marathons during the past 3 years and in 102 age-matched control subjects. Predominantly subendocardial regions of LGE typical of myocardial infarction (hereafter, coronary artery disease [CAD] pattern) were distinguished from a predominantly midmyocardial patchy pattern of LGE (hereafter, non-CAD pattern). Marathon runners with LGE underwent repeat cardiac MR imaging and additional adenosine perfusion imaging. Runners were followed up for a mean of 21 months +/- 3 (standard deviation) after initial presentation. The chi(2), Fisher exact, and McNemar exact tests were used for comparisons. Event-free survival rates were estimated with the Kaplan-Meier method, and overall group differences were evaluated with log-rank statistics.

RESULTS: Of the 102 runners, five had a CAD pattern of LGE, and seven had a non-CAD pattern of LGE. The CAD pattern of LGE was located in the territory of the left anterior descending coronary artery more frequently than was the non-CAD pattern (P = .0027, Fisher exact test). The prevalence of LGE in runners was higher than that in age-matched control subjects (12% vs 4%; P = .077, McNemar exact test). The event-free survival rate was lower in runners with myocardial LGE than in those without myocardial LGE (P < .0001, log-rank test).

CONCLUSION: Ostensibly healthy marathon runners have an unexpectedly high rate of myocardial LGE, and this may have diagnostic and prognostic relevance.

Symposium: Exercise and the Heart

Exercise and the Heart: Can You Have Too Much of a Good Thing?

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ABSTRACT

GEORGE, K., R. SHAVE, D. WARBURTON, J. SCHARHAG, and G. WHYTE. Exercise and the Heart: Can You Have Too Much of a Good Thing? *Med. Sci. Sports Exerc.*, Vol. 40, No. 8, pp. 1390–1392, 2008. Reports that participation in prolonged exercise can lead to a transient depression in ventricular function and/or a minor increase in biomarkers of cardiomyocyte insult have stimulated significant media and scientific attention in the last few years. Despite being of relevance to the scientist, the clinician, and a broad spectrum of athletes, these phenomena are poorly defined and controversial. Specifically, the definition and the description of these topics are quite limited, and conflicting data are available. Further, the mechanisms underpinning these events are not clear. Finally, a clear message related to the short- and the long-term impact on cardiovascular health and/or sports performance is lacking. The symposium "Exercise and the heart: Can you have too much of a good thing?" was presented at the ACSM Annual Meeting in New

cally address these issues. This initial introduction sets out the backgr

anding of these problems as well as suggest important avenues for f

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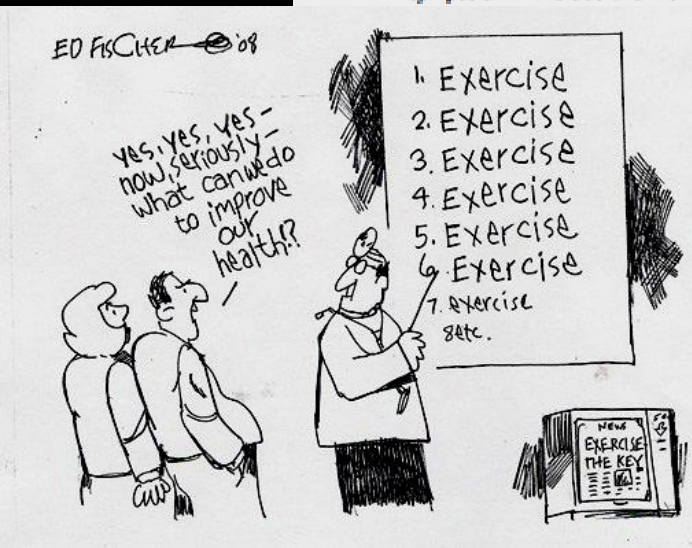

Conclusions

1. SCD in competitive athletes may result from a variety of disorders, such as inherited or congenital heart conditions, that may be detected by pre-participation screening.
2. AHA guidelines do not endorse routine pre-participation screening with noninvasive testing.
3. However, noninvasive testing plays a critical role in the evaluation of competitive athletes with positive findings on screening history and physical examination. These tests must be interpreted carefully in order to distinguish the physiological effects of exercise training from pathology.
4. The presence of a trained rescuer to initiate cardiopulmonary resuscitation (CPR) and access to early defibrillation through on-site automated external defibrillators (AEDs)-are critical to improving survival

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4. **Prompt recognition of SC Arrest, early activation of the emergency medical services system, the presence of a trained rescuer to initiate cardiopulmonary resuscitation, and access to early defibrillation are critical in the management of SCA.**

‘The right amount of nourishment and exercise, not too much, not too little, is the safest way to health’

HIPPOCRATES (460 -377 BC)
Father of Medicine
Contemporary of Pheidippides