PREPARTICIPATION SCREENING IN ATHLETES AND THE GENERAL POPULATION

TOWARDS A STRATEGY FOR THE PREVENTION OF SUDDEN CARDIAC DEATH IN THE YOUNG AND ATHLETES

Unit of Inherited and Rare Cardiac Diseases
Section of Sports Cardiology
Onassis Cardiac Surgery Centre
NATIONAL NETWORK FOR THE PREVENTION OF SCD IN THE YOUNG

STUDENT CARD – ΑΔΥΜ
ATHLETES CARD – PRE ATHLETIC SCREENING

HIGH RISK GROUPS IN THE POPULATION

SCD FAMILIES
INHERITED CV DISEASES

FAMILY SCREENING

FIRST AID IN THE COMMUNITY- BLS
MEDICAL DOCTORS - ALS
ΕΚΕ
ΕΚΕΠΥ -ΕΚΑΕ

Ε.Σ.Υ – stent for life , ανεξαρτητα ΤΕΠ
ΠΡΟΛΗΠΤΙΚΗ, ΠΡΩΤΟΒΑΘΜΙΑ, ΔΕΥΤΕΡΟΒΑΘΜΙΑ ΚΑΙ ΤΡΙΤΟΒΑΘΜΙΑ
ΑΝΤΙΜΕΤΩΠΙΣΗ ΚΑΡΔΙΟΛΟΓΙΚΩΝ ΝΟΣΗΜΑΤΩΝ - PRIMARY PCI

ΕΚΑΒ
ΠΡΟΝΟΣΚΟΜΕ ΙΑΚΗ ΑΝΤΙΜΕΤΩΠΙΣ Η OEM
Sudden death in athletes
Incidence of SCD in youth
1 in 4,000 → 1 in 200,000 person-years

<table>
<thead>
<tr>
<th>Author</th>
<th>Country</th>
<th>Population</th>
<th>Age Range</th>
<th>Incidence of SCD</th>
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<td>Eckart; 2004</td>
<td>USA</td>
<td>Military recruits</td>
<td>18-35</td>
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Extreme variability according to the cohort studied
**Naxos disease: Cyclades and Euboea**

Total Population: 265,153

- **Homozygotes**: 1/5000
- **Homozygotes**: <1:2000
- **Homozygotes**: 1:5000

- **Naxos (18,340)**
  - **heterozygotes**: 5/100
  - **homozygotes**: 1/800

- **Mountain areas**

The locality of rare Inherited CV diseases
PREVENTING SCD
IN THE YOUNG AND ATHLETES

• Causes of SCD in young

• Pre participation screening

• Cases difficult to identify

• National strategy
Distribution of cardiovascular causes of sudden death in 1435 young competitive athletes

Sudden unexplained death in the young: epidemiology, aetiology and value of the clinically guided genetic screening

Aris Anastasakis\textsuperscript{1*}, Efstathios Papatheodorou\textsuperscript{1,2}, Konstantinos Ritsatos\textsuperscript{1}, Nikos Protonotarios\textsuperscript{1}, Vasiliki Rentourni\textsuperscript{1}, Konstantinos Gatzoulis\textsuperscript{1}, Loizos Antoniades\textsuperscript{3}, Emmanuel Agapitos\textsuperscript{4}, Philippos Koutsafitis\textsuperscript{5}, Chara Spiliopoulou\textsuperscript{6}, and Dimitrios Tousoulis\textsuperscript{1}
**INHERITED CARDIOMYOPATHIES**

1\textsuperscript{ST} CAUSE OF SCD IN AGE < 20 Y OLD

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- 2002-2010 Attica region
- 1,500,000 young population
- 349 Sudden Deaths
- 3-4 young deaths per month in Attica
- **10 young deaths at LEAST every month**

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**CAUSES OF SD BY AGE GROUP**

- **Age 1-20**
  - Arrhythmogenic RV
  - Congenital Heart Disease
  - Undiagnosed Cardiomyopathy
  - Marfan's
  - Connective tissue disorder
  - Marfan's
  - Non-Cavitary
  - Hypertrophic
  - SED

- **Age 21-35**
  - Arrhythmogenic RV
  - Congenital Heart Disease
  - Undiagnosed Cardiomyopathy
  - Marfan's
  - Connective tissue disorder
  - Marfan's
  - Non-Cavitary
  - Hypertrophic
  - SED

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**EUROPACE 2018**
Sudden Cardiac Death in Sport

Hypertrophic Cardiomyopathy

Arrhythmogenic right ventricular cardiomyopathy
Sudden Cardiac Death with a Normal Heart

LQTS

Brugada

WPW
What causes SADS?

- Evaluation of 1st-degree family relatives is recommended
  - Identify a probable cause of death
  - Individuals at risk of sudden death

Marfan syndrome

- ψηλό ανάστημα, μήκος ανοίγματος των άνω άκρων>ύψος σώματος
Coronary arteries and aorta
Causes of sudden cardiac death in the young

- Hypertrophic cardiomyopathy
- Arrhythmogenic right ventricular cardiomyopathy
- LQTS, BRUGADA, CPVT, SQTS
- Premature coronary artery disease
- Myocarditis
- Marfan syndrome
- Coronary artery anomalies
Network for the management of inherited CV diseases and SCD prevention in the Young

INHERITED CV DISEASES SD FAMILIES

Clinical Cardiology

MOLECULAR CARDIOLOGY

Genetics

FAMILY SCREENING

TYPICAL DISEASE

SUBCLINICAL DISEASE

GENE CARRIER
• Young man that plays football
• Age: 17 years old
• Asymptomatic
• o/e = Normal
• Personal history (-)
• Family history (-)
OTHER SPECIAL CHARACTERISTICS

- **SUBSTRATE** and **TRIGGERING FACTOR**
  - Corrado et al JACC 2003

- **NO SYMPTOMS**
  - C Glinge
  - J Cardiovasc Electrophysiology 2015

- **SUBCLINICAL FORMS**
  - Mckenna Heart 1997

- **SCD** CAN BE THE FIRST CLINICAL EXPRESSION OF THE DISEASE
PREVENTING SCD IN THE YOUNG AND ATHLETES

• Causes of SCD in young

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• National Strategy
young competitive athletes

family and personal history, physical examination, 12-lead ECG

negative findings

eligible for competition

no evidence of cardiovascular disease

further examinations (echo, stress test, 24-h Holter, cardiac MRI, angio/EMB, EPS)

diagnosis of cardiovascular disease

management according to established protocols

positive findings

FIGURE 1  International Consensus Standards for Electrocardiographic Interpretation in Athletes

**Normal ECG Findings**
- Increased QRS voltage for LVH or RVH
- Incomplete RBBB
- Early repolarization/ST segment elevation
- ST elevation followed by T wave inversion V1-V4 in black athletes
- T wave inversion V1-V3 age <16 years old
- Sinus bradycardia or arrhythmia
- Ectopic atrial or junctional rhythm
- 1° AV block
- Mobitz Type I 2° AV block

**Abnormal ECG Findings**
- T wave inversion
- ST segment depression
- Pathologic Q waves
- Complete LBBB
- QRS $\geq$ 140 ms duration
- Epsilon wave
- Ventricular pre-excitation
- Prolonged QT interval
- Brugada Type 1 pattern
- Profound sinus bradycardia $< 30$ bpm
- PR interval $\geq 400$ ms
- Mobitz Type II 2° AV block
- 3° AV block
- $\geq 2$ PVCs
- Atrial tachyarrhythmias
- Ventricular arrhythmias

**Borderline ECG Findings**
- Left axis deviation
- Left atrial enlargement
- Right axis deviation
- Right atrial enlargement
- Complete RBBB

**Benign in athletes**
- No further evaluation required in asymptomatic athletes with no family history of inherited cardiac disease or SCD

**Further evaluation required**
- To investigate for pathologic cardiovascular disorders associated with SCD in athletes

*Sharma et al JACC 2017*
HCM GENETIC SCREENING

CHD

Abn ECG

CHD - 48y

78y

HCM GENETIC SCREENING
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CPVT

SUDDEN DEATH

ECG
Dilated aorta
SUDDEN DEATH IN THE YOUNG

CORONARY ANOMALIES

- Asymptomatic, syncope, angina

NORMAL ECG
LEFT CORONARY ARTERY
COMMOTIO CORDIS
B Maron et al NEJM 2003
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INHERITED CV DISEASES

FAMILY SCREENING

FIRST AID IN THE COMMUNITY - BLS
MEDICAL DOCTORS - ALS
EKE
EKEPY - EKAE

EKAΕ
ΕΚΕ

NHS – stent for life , Accident and emergency units
- PRIMARY PCI

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ΠΡΟΝΟΣΚΟΜΕΙ ΑΚΗ ΑΝΤΙΜΕΤΩΠΙΣΗ OEM
Family screening
FATHER

ARVC

- QRSf = 127ms
- LAS = 54ms
- RMS = 11μV
Family screening

P1

P2

SD (28)  

SD (72)

SD (59)

P1 (49)

? (17)

? (21)

(29)

(55)

(59)

(28)
CLINICAL PROFIL OF SCD VICTIM

• FAMILY HISTORY OF ARVC IN FIRST DEGREE RELATIVES (1 MAJOR)

• ECG: INVERTED T WAVES (1 MINOR)

• HOLTER?
• SA ECG?
Preimplantation diagnosis

HARPER et al
UCLH 2012
PREVENTION OF SUDDEN DEATH IN THE YOUNG AND ATHLETES

A NATIONAL STRATEGY

• PRE PARTICIPATION SCREENING

• TARGET GROUP STRATEGY

CONDITIONS DIFFICULT TO IDENTIFY OR EASY TO MISS

• FIRST AID SERVICES NETWORK
FIRST AID SERVICES IN THE COMMUNITY

• PCR
• AED

ELECTRICAL DEATH
UNFAIR DEATH
MESSAGE
NATIONAL NETWORK FOR THE PREVENTION OF SCD IN THE YOUNG

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EKAEB
ΠΡΟΝΟΣΚΟΜΕΙ ΑΚΗ ΑΝΤΙΜΕΤΩΠΙΣΗ ΟΕΜ

NHS – stent for life, Accident and emergency unit
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