Management of syncope in athletes

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DECLARATION OF CONFLICT OF INTEREST

• No conflict of interest with regard to this presentation.
Physical inactivity increases

Percentage of physical inactive men and women in Europe
Definition athlete

... one who participates in an organized team or individual sport that requires regular competition against others as a central component, places high premium on excellence and achievement and requires some form of systematic training

„Non“ athlete

...participating in a variety of informal recreational sports and circumstances engage in a range of exercise levels on regular or an inconsistent basis...

Maron et al., JACC 1994;24:845-899 ; 26th Bethesda Conference
Estes et al., JCE 2001; Report NASPE Policy Conference
Maron et al., AHA Scientific statement; Circulation 2004
Pathophysiology of the "Athlete's Heart"

- Physical activity
- Sympathetic tone ↑
  - Hemodynamic factors
    - Pressure/volume load
    - Myocardial stretch ↑
    - Heart rate ↑
- Metabolic factors
  - Electrolytes ↓, pH ↓
  - O₂ demand ↑
  - Serum catecholamines ↑
- Anatomic and functional substrate
- Electrophysiologic factors
- Syncope/SCD
  - CHD, DCM
  - Primary electrical disease
Syncope in athletes

- Presents a unique challenge
- Causes vary from benign neurocardiogenic episodes to life-threatening conditions (e.g. VT)
- Important to identify etiologies
- Implications with regard to prognosis, recurrence, and possible cardiac death
- Impact on subsequent athletic participation
- Risk of misdiagnosing a benign condition as one that is more severe, thereby unnecessarily restricting athletic activity
In athletes, the etiologies of syncope are generally the same as in the wider population.

ACC/AHA/ESC 2006 Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

3. Athletes presenting with syncope should be carefully evaluated to uncover underlying cardiovascular disease or rhythm disorder. (Level of Evidence: B)

4. Athletes with serious symptoms should cease competition while cardiovascular abnormalities are being fully evaluated. (Level of Evidence: C)

ESC Guidelines for the diagnosis and management of syncope; Eur Heart J 2009
Epidemiology: syncope in athletes

- Syncope is very common in the general population
- Defined as transient global cerebral hypoperfusion
- Significant proportion of emergency hospital visits
- In the Framingham study, 3% of men and 3.5% of women experienced one or more syncopal events during a 26-year period
- Prevalence in the elderly (5.6%) was significantly greater than in young subjects (0.7%)
- Very little known about the prevalence and incidence of syncope specifically among athletes

ESC Guidelines for diagnosis and management of syncope; Eur Heart J 2009
Hedrich et al., Syncope in athletes, 2005
Savage et al., Stroke 1985
It is important to separate athletes who faint due to innocent causes from those who are at risk of sudden cardiac death.
Distribution by age of sports-related sudden deaths in the overall population (blue) and among young competitive athletes (red)
Epidemiology: SCD in athletes

- very rare
- men > female (ratio of 10:1)
- 0.5 in 100,000 per year (high-school athletes)
- 2.3 in 100,000 amongst athletes in Northern Italy
- 1:15,000 - 50,000 (in older athletes)
- more than 90% of SCD occur in the context of recreational sports

- risk of myocardial infarction and sudden cardiac death about 6 times higher during exercise
- but: regular training reduces risk

Maron et. al., JACC 1998
Corrado et al., JACC 2003
Marijon et al., Circulation 2011
Importance of evaluation of syncope in athletes

- In a retrospective study of all sudden, non-traumatic deaths occurring over a 12 yrs period in young Israeli soldiers (n=44; age 17-22 years), it was found that 23% had experienced at least one syncope prior to death.
- Syncope occurred 1h to 4 yrs before death.
- Maron et al. reported an incidence of syncope of 17% in a cohort of 29 young athletes who die suddenly.
- In 16%, syncope had occurred during exercise.

Hedrich et al., Syncope in athletes, 2005
Kramer et al., Chest 1988
Maron et al., Circulation 1980
Clinical characteristics of syncope in athletes

- Syncope not related to exercise
- Syncope immediately after exercise
- Syncope during exercise
Epidemiology and prognostic implications of syncope in young competing athletes

7568 athletes

Athletes without syncope
7094 (93.8%)

Athletes with syncope
474 (6.2%)

Syncope unrelated with exercise
411 (86.7%)

Vasovagal syncope
362 (88.0%)

Situational syncope
49 (12.0%)

Post-exertional syncope
57 (12.0%)

Post-exertional postural hypotension
57 (100%)

Exertional syncope
6 (1.3%)

Hypertrophic cardiomyopathy
1 (16.6%)

Right ventricular outflow tract tachycardia
1 (16.6%)

Exercise-induced neurally mediated syncope
4 (66.6%)

Colivicchi et al., Eur Heart J 2004
Fig. 2  Kaplan–Meier estimates of first recurrence of syncope in athletes with non-exertional and post-exertional syncope.
Leading causes of SCD in young competitive athletes

a) Hypertrophic cardiomyopathy
b) ARVD
c) Artherosclerotic coronary heart disease
d) Congenital coronary anomaly

Corrado et al., Eur Heart J 2011
Comparisons of etiologies of SCD in athletes in the US and Italy

Link and Estes III, Prog Cardiovasc Diseases, 2008
Young competitive athletes

- fa. & personal history
- physical examination,
  12-lead ECG !!

eligible for competition

Further examinations
(echo, stress test, 24-h Holter, cardiac MRI, angio, EPS

management according to established protocols

ESC Report; Corrado et al., Eur Heart J 2005
Impact of pre-participation screening on mortality

**Figure 4** Annual incidence rates of sudden cardiovascular death per 100,000 person-years, among screened competitive athletes and unscreened non-athletes 12–35 years of age in the Veneto Region of Italy, from 1979 to 2004. During the study period (the nationwide pre-participation screening programme was initiated in 1982), the annual incidence of sudden cardiovascular death declined by 89% in screened athletes ($P$ for trend $<0.001$). In contrast, the incidence of sudden cardiovascular death did not demonstrate consistent changes over that time in unscreened non-athletes. Modified from Corrado et al.\textsuperscript{12}
Young competitive athletes

- fa. & personal history physical examination, 12-lead ECG !!

eligible for competition

- no evidence of cardiovascular disease

management according to established protocols

Further examinations (echo, stress test, 24-h Holter, cardiac MRI, angio, EPS)

diagnosis of cardiovascular disease

+ (e.g. syncope)

ESC Report; Corrado et al., Eur Heart J 2005
Clinical characteristics helpful in differentiating arrhythmic from non-arrhythmic syncope

<table>
<thead>
<tr>
<th></th>
<th>Neuorocardiogenic syncope or Nonarrhythmic</th>
<th>Arrhythmic</th>
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<tbody>
<tr>
<td>Prodrome</td>
<td>Light headedness (LH), warmth, nausea</td>
<td>None or brief LH</td>
</tr>
<tr>
<td>No. of episodes</td>
<td>Multiple</td>
<td>Few or one Exertional</td>
</tr>
<tr>
<td>Situational factors</td>
<td>Fear, fright, upright posture</td>
<td>unrelated to posture</td>
</tr>
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<td>Post syncope symptoms</td>
<td>Frequently fatigue</td>
<td>Usually none</td>
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<tr>
<td>Injury</td>
<td>Unusual</td>
<td>Common</td>
</tr>
<tr>
<td>Underlying heart disease</td>
<td>Unusual</td>
<td>Common</td>
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</tbody>
</table>
Early repolarization syndrome

Recommendations for interpretation of 12-lead electrocardiogram in the athlete

Interpretation of the Electrocardiogram of Young Athletes

Abhimanyu Uberoi, MD, MS; Ricardo Stein, MD, ScD; Marco V. Perez, MD; David Hadley, PhD; Jonathan Drezner, MD; Sanjay Sharma, FRCP; Antonio Pelliccia, MD; Domenico Corrado, MD; Josef Niebauer, MD, PhD, MBA; N.A. Mark Estes III, MD; Euan Ashley, MRCP, DPhil*; Victor Froelicher, MD*

Circulation 2011
<table>
<thead>
<tr>
<th>Diagnosis of Heart Disease</th>
<th>ECG Abnormalities</th>
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<tbody>
<tr>
<td>Arrhythmogenic RV dysplasia</td>
<td>T-wave inversions anteriorly</td>
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<td></td>
<td>Epsilon wave</td>
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<td></td>
<td>RBBB (complete or incomplete)</td>
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<td></td>
<td>Rarely normal</td>
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<tr>
<td>HCM</td>
<td>LV hypertrophy</td>
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<td></td>
<td>Pseudoinfarct with q waves anteriorly</td>
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<tr>
<td></td>
<td>Rarely normal</td>
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<tr>
<td>Idiopathic dilated cardiomyopathy</td>
<td>LBBB</td>
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<tr>
<td></td>
<td>Prolonged QT</td>
</tr>
<tr>
<td></td>
<td>Can be normal</td>
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<tr>
<td>Long QT syndrome</td>
<td>Prolonged QT</td>
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<td></td>
<td>Abnormal appearance of ST segment</td>
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<tr>
<td>Short QT syndrome</td>
<td>Short QT</td>
</tr>
<tr>
<td>Brugada Syndrome</td>
<td>RBBB (complete or incomplete)</td>
</tr>
<tr>
<td></td>
<td>ST elevation anteriorly</td>
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<tr>
<td></td>
<td>Changes can vary with time</td>
</tr>
<tr>
<td>Anomalous coronary artery</td>
<td>Typically no abnormalities</td>
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<tr>
<td>Coronary artery disease</td>
<td>Typically no abnormalities</td>
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<tr>
<td></td>
<td>Q waves</td>
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<td></td>
<td>ST segment abnormalities</td>
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<tr>
<td>WPW</td>
<td>Short PR</td>
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<td></td>
<td>Delta waves</td>
</tr>
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<td>Pseudoinfarct patterns</td>
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Adapted from *Curr Opin Cardiol* 1992.

Electrocardiographic abnormalities found in various disease states

Link and Estes III, Prog Cardiovasc Diseases, 2008
LV-Hypertrophy in Athletes

The upper limit of physiologic cardiac hypertrophy in highly trained elite athletes

- 947 Italien elite athletes (78% men)
- 25 different sports

- Maximal wall thickness 16 mm
- Wall thickness $\geq 13$ mm in 16/947 (1.7%),
  - type of sports: rowing n=15, cycling n=1
  (-> in all other sports no case with wall thickness $> 13$ mm!)
- Wall thickness smaller in women than in men

Pelliccia et al, NEJM 1991; 324:295-301
48 yr old male,
Syncope playing soccer, exercise induced VT
48 yr old male, Syncope playing soccer, exercise induced VT
48 yr old male,
Syncope playing soccer, exercise induced VT

Corrado et al., Eur Heart J 2011
31 yr old female, Syncope playing Tennis, exercise induced VT
31 yr old female, Syncope playing Tennis, exercise induced VT

- Anomalous origin of coronary artery
- Acute angle bend causing between pulmonary artery and aorta
Clinical Profile of Congenital Coronary Artery Anomalies With Origin From the Wrong Aortic Sinus Leading to Sudden Death in Young Competitive Athletes

15 yr old male Italian soccer player with a history of exertional syncope who died suddenly while running during the second half of a game

Basso et al., JACC 2000
Evaluation of syncope in the athlete

In the absence of structural heart disease, syncope mostly a benign condition

- Neurally mediated hypotension
- Neurocardiogenic syndromes
- Valsalva manoeuvre (e.g. in weight lifters)
- Dehydration
- Hyperventilation
- Dietary supplements
- Hypoglycemia
- Psychogenic disorders

management according to established protocols

ESC Report; Corrardo et al., Eur Heart J 2005
Syncope in athletes - Conclusions

• Evaluation of syncope in athletes remains a challenge
• Benign causes predominate
• Aim is to protect from recurrent episodes and SCD
• Syncope during exercise may be a sign of serious underlying condition
• Central issue is to detect structural abnormal hearts
• Non-invasive evaluation should be performed in all athletes with syncope
• Treatment recommendations are similar to syncope in non-athletes
Avoid risky sport!