Αθλητική καρδιά ή μυοκαρδιοπάθεια

Κών/νος Ριτσάτος

Μονάδα κληρονομικών και σπάνιων καρδιαγγειακών νοσημάτων
Ωνάσειο καρδιοχειρουργικό κέντρο
Is this a cardiomyopathy?
The case:

17y o male

- Soccer player athlete
- Totally asymptomatic
- No family history
- Pre-participation screening
$E/E_a : 4$
The Question:

Is this myocardial morphology representative of primary LVNC or hypertrabeculation without clinical significance?
Athlete’s Heart

**ELECTRICAL**
- Bradycardia
- Repolarisation anomalies
- Voltage criteria for chamber enlargement
- Arrhythmias

**FUNCTIONAL**
- Enhanced diastolic filling
- Augmentation of stroke volume

**STRUCTURAL**
- Increased chamber wall thickness and cavity size
Athlete’s heart (structural remodelling)

- 40-50% increase in LV mass
- 6-10% increase in LV cavity size
- 10-14% increase in RV cavity size
- 15-20% increase in LV wall thickness
Athlete’s Heart vs HCM

LVH 16mm

Papadakis M et al Eur Heart 2011
Bizarre patterns of LVH

LV cavity > 54 mm

LA > 50 mm

LV outflow obstruction

Impaired diastolic function

Isolated Sokolow-Lyon LVH

ST depression/Deep T wave inversion

Female gender

Absence of HCM in first degree relatives

Peak VO2 > 50 ml/kg/min
Athlete’s heart vs DCM

Left Ventricular end diastolic cavity

Pellicia et al. Ann Int Med 1999
DCM vs ATHLETE’S HEART

DCM

Symptoms
- Family history
- Low E’
- Low Es
- Abnormal ECG
- Low peak VO2

Athlete’s Heart

Asymptomatic
- Exercise echo shows excellent LV function
- Isolated Sokolow Lyon voltage criterion for LVH
- High peak VO2

Enlarged LV Cavity
- Low Ejection Fraction

Low E'

Low Es

Abnormal ECG

Low peak VO2
**ARVC vs Athlete’s heart**

NORMAL RV FUNCTION
NO SEGMENTAL HYPOKINESIS
NO ARRHYTMIAS

Zaidi et al Circulation 2013
Comes from a sedentary control population
Mean number of trabeculations plus 2-SD (0.76+/−1.1)

\[ \geq 3 \text{ trabeculations} \]

Tamborini G et al J Am Soc Echocardiogr 2004
LV trabeculation in highly trained athletes:

Is there need for more stringent criteria for the diagnosis of LVNC in athletes?

Gati, Sharma et al Heart 2013

- 1146 athletes competitive athletes
- ECG and Echocardiogram
- Age 20.9 (14-35yo)
- Gender: 80% male
- 80% Caucasian
- In comparison with:
  - 415 controls non-athletes,
  - 75 LVNC pts
Hypertrabeculation in athletes

- LVHT more common in athletes vs controls
  Athletes 18.5% vs 7% controls

- No gender differences in athletes
  Males 20.7% vs Females 18.1%

- LVHT more common in black athletes
  Black athletes 28.8% vs white athletes 16.3%

Gati S, Sharma S et al Heart 2013
Gati S, Sharma S et al Heart 2013
LVNC - ECHO CRITERIA
8.1% of athletes met both criteria for LVNC

Non of the controls fullfilled the LVNC criteria
Heart Failure
Ventricular arrhythmias
Systematic embolic events
LVNC
Based on very small cohorts
Not prospectively derived
Not validated
Measurements performed in different phases of the cardiac cycle
Athlete’s LV Cavity

Deep T wave ↓
↓ EF

Left ventricular non-compaction

LV cavity

LVH
↑ LVED

Epiphenomenon to ↑ LV preload

EXERCISE

TIME

Gati S et al Heart 2013
The pregnancy model
Pregnancy model results

- De novo LV trabeculations occurred in 25% of pregnant women
- 8 women fulfilled both the Jenni and Chin criteria
- During a follow-up period of two years 85% showed regression toward normal morphology
### Athletes fulfilling LVNC vs LVNC patients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Athletes Fulfilling LVNC Criteria</th>
<th>LVNC Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>0%</td>
<td>65%</td>
</tr>
<tr>
<td>Inverted T-waves</td>
<td>16%</td>
<td>31%</td>
</tr>
<tr>
<td>Inferior T wave inversion</td>
<td>5.4%</td>
<td>20%</td>
</tr>
<tr>
<td>Lateral T wave inversion</td>
<td>2.2%</td>
<td>28%</td>
</tr>
<tr>
<td>Mean LVED (mm)</td>
<td>$51.4 \pm 5.5$</td>
<td>$57.8 \pm 11.7$</td>
</tr>
<tr>
<td>LVEF</td>
<td>$63% \pm 8.3$</td>
<td>$46.3% \pm 19$</td>
</tr>
<tr>
<td>S’ Septal</td>
<td>$8.6 \pm 1.5$</td>
<td>$6.4 \pm 1.7$</td>
</tr>
<tr>
<td>S’ Lateral</td>
<td>$11.6 \pm 3.5$</td>
<td>$7.0 \pm 2.5$</td>
</tr>
</tbody>
</table>
Athletes with LVNC criteria - twi

Both Chin et al and Jenni et al criteria
n=93
(8.1%)

Black
n=16
(11.0%)

Caucasian
n=77
(8.4%)
P=0.342

T-wave ↓
n=5
(3.4%)
P=0.042

EF<50%
n=5
(3.4%)
P=0.012

T-wave ↓
n=10
(1.1%)

EF<50%
n=5
(0.5%)
Features of athletes that present with LVNC and abnormal LV function

Table 5  Demographic data on the 10 athletes with LVNC criteria and reduced systolic function

<table>
<thead>
<tr>
<th>Athlete</th>
<th>Age (years)</th>
<th>BSA (m²)</th>
<th>Ethnicity</th>
<th>Sex</th>
<th>Sport</th>
<th>Hrs of training</th>
<th>LVNC CRITERIA</th>
<th>EF REDUCED</th>
<th>TW INVERSION</th>
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<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>1.76</td>
<td>Black</td>
<td>M</td>
<td>Boxing</td>
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<td>3</td>
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<td>Black</td>
<td>F</td>
<td>Netball</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>2.26</td>
<td>Black</td>
<td>M</td>
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<td></td>
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<td>6</td>
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<td>M</td>
<td>Soccer</td>
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</tbody>
</table>

LVNC, left ventricular non-compaction. BSA, Body Surface Area; E/A, ratio of early diastolic mitral valve peak inflow to peak early diastolic mitral annular velocity; EF, Ejection Fraction; LVED, Left Ventricular End-Diastolic Dimension; Max-LVWT, Maximum Left Ventricular Wall Thickness; E/E’ (septal), E/E’ (lateral wall), E’/E’ ratio of early diastolic mitral inflow velocity to early diastolic mitral annular velocity; LVNC, Left Ventricular Non-Compaction; LVNC, Left Ventricular Non-Compaction.
Athlete with LVNC-like morphology risk stratification and management

Caseli et al I J Cardiology 2016

LVNC criteria in asymptomatic athletes

Left Ventricular Function

EF > 50%
- Negative family history
- Normal LV diastolic function
- No ECG abnormalities
- No arrhythmias/syncope
- No additional testing. No LVNC. No restriction for sport participation. Follow-up advised

EF < 50%
- Positive family history
- ECG abnormalities
- Ventricular tachyarrhythmias
- CMR with LGE
- Genetic testing
- Normal CMR and negative genetic testing: LVNC unlikely. Sport participation allowed, with periodic follow-up
- Positive CMR and/or genetic testing: LVNC likely. Restrict sport participation
ECG 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
- 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 ≥ 140 ms duration
- Epsilon wave
- Ventricular pre-excitation
- Prolonged QT interval
- Brugada Type 1 pattern
- Profound sinus bradycardia < 30 bpm
- PR interval ≥ 400 ms
- Mobitz Type II 2° AV block
- 3° AV block
- ≥ 2 PVCs
- Atrial tachyarrhythmias
- Ventricular arrhythmias

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

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

In isolation

2 or more

Further evaluation required to investigate for pathologic cardiovascular disorders associated with SCD in athletes

S. Sharma et al Eur Heart J 2017
Overlapping between subclinical forms of cardiomyopathies and athletes heart exist

The increased isolated LV trabeculation are apparently benign, suggesting a cardiac morphologic variant more than a true pathologic condition

The combination of marked ECG repolarization with LV dysfunction merits further evaluation
Ευχαριστώ για την προσοχή σας !!!

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