Echocardiographic Assessment of the Athlete

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CONCENTRIC HYPERTROPHY

ECCENTRIC HYPERTROPHY

AFTERLOAD

PRELOAD

WALL THICKNESS

CAVITY / VOLUME

Cardiac Adaptation

Sex

Age

Genetics

Ethnicity

Type of Sport and Level

Training Volume

Body Size

Type of Sport and Level

Normal

Concentric
Defining Left Ventricular Geometry

Utomi et al 2014; *HEART*

Brown et al; *in preparation*
Phenotype
ATHLETES HEART

Phenotype
CARDIOMYOPATHY

LESS MARKED PHENOTYPE

MORE EXTREME ATHLETIC ADAPTATION
CASE 1

• A 22 year old male professional boxer of West African ethnicity is referred for pre-participation screening. The athlete engages in predominantly dynamic (endurance) exercise training for approximately 25 hours per week. He has no symptoms but a family history of an explained death in a sibling at the age of 22 years old.

• On examination his blood pressure is 120/60 mmHg. His height is 170 cm with a body mass of 70 kg.
The ECG

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Heart Rate: 48 bpm</th>
<th>Findings and Interpretations (Unknown)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR: 1250 ms</td>
<td></td>
<td>Summary: 811: Sinus Bradycardia711: Abnormal Q Wave(III,aVF)621: Inverted T Wave(V5)</td>
</tr>
<tr>
<td>QRS: 91 ms</td>
<td></td>
<td>8-8-31-3-4(III,aVF)/4 5-5-0(II)/5-2-1(V5)/5-5-0(II)/9-4-2(V4)</td>
</tr>
<tr>
<td>QT/QTc: 410 / 373 ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P/PR: 123 ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P/QRS/T: 67º / 80º / -2º</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagram showing ECG tracings from different leads (aVR, V1, V4, aVL, V2, V5, aVF, V3, V6) with annotated measurements and findings.
Echocardiography Key Findings

- LV size (61mm) when indexed for BSA (LV mass index is 188g/m² and RWT of 0.43)
- Maximum LV wall thickness = 13mm but no evidence of asymmetric hypertrophy or outflow obstruction
- Good systolic function but reduced E/A ratio and myocardial diastolic velocities (Septal E’ = 7cm/s)
- Normal RV structure and function

![Diagram of echocardiography key findings with concentric remodelling, concentric hypertrophy, normal geometry, and eccentric hypertrophy categories, along with normal and abnormal ranges for males and females based on left ventricular mass index (g/m²) values](image.png)
This athlete was referred for further investigations and diagnosed with a mild phenotype HCM.
CASE 2

• A 23 year old male elite footballer of caucasian ethnicity is referred for pre-participation screening. The athlete engages in predominantly dynamic (endurance) exercise training for approximately 32 hours per week. He has no symptoms and no family history.

• On examination his blood pressure is 125/70 mmHg. His height is 183 cm with a body mass of 85 kg.
Echocardiography Key Findings

- Normal LV size (49 mm)
  - LV mass index is 103 g/m² and RWT of 0.46
- Maximum LV wall thickness = 12 mm at the apex and basal posterior wall – visually increased systolic thickening at the apex and cavity obliteration.
- Good systolic and diastolic function
- Normal RV structure and function

This athlete was referred for further investigations and NORMAL apex was seen on cMRI.
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KEY POINTS

• Expect enlarged left sided chambers
• Wall thickness very rarely exceeds 12-13mm
• Provide a description of LV geometry
• Functional assessment is key – diastolic function
• Consider an exercise stimulus
Cardiac Adaptation

Factors influencing Cardiac Adaptation:
- Sex
- Age
- Ethnicity
- Genetics
- Type of Sport and Level
- Training Volume
- Body Size

Variables:
- Afterload
- Preload
- Wall Thickness
- Cavity / Volume

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Pathology
- ARVC
Diagnosis of Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia

Proposed Modification of the Task Force Criteria

Frank I. Marcus, MD, Chair; William J. McKenna, MD, DSc, Co-Chair; Duane Sherrill, PhD; Cristina Basso, MD, PhD; Barbara Bauce, MD; David A. Bluemke, MD, PhD; Hugh Calkins, MD; Domenico Corrado, MD, PhD; Moniek G.P.J. Cox, MD; James P. Daubert, MD; Guy Fontaine, MD, PhD; Kathleen Gear, RN; Richard Hauer, NW, MD; Andrea Nava, MD; Michael H. Picard, MD; Nikos Protonotarios, MD; Jeffrey E. Saffitz, MD, PhD; Danita M. Yoeger Sanborn, MD, MMSc; Jonathan S. Steinberg, MD; Harikrishna Tandri, MD; Gaetano Thieme, MD; Jeffrey A. Towbin, MD; Adalena Tsatsopoulou, MD; Thomas Wichter, MD; Wojciech Zareba, MD, PhD

MAJOR CRITERIA

Regional RV akinesis / dyskinesis or aneurysms

AND 1 OF THE FOLLOWING

- PLAX RVOT $\geq 32\text{mm}$ or $\geq 19\text{mm/m}^2$
- PSAX RVOT $\geq 36\text{mm}$ or $\geq 21\text{mm/m}^2$
- RV FAC $\leq 33\%$

MINOR CRITERIA

Regional RV akinesis or dyskinesis

AND 1 OF THE FOLLOWING

- PLAX RVOT $\geq 29$ to $< 32\text{mm}$ or $\geq 16$ to $< 19\text{mm/m}^2$
- PSAX RVOT $\geq 32$ to $< 36\text{mm}$ or $\geq 18$ to $< 21\text{mm/m}^2$
- RV FAC $\geq 33\%$ to $\leq 40\%$
CASE 3

• An 18 year old academy elite rugby football league of Caucasian ethnicity is referred for pre-participation screening. The athlete engages in a mixed static/dynamic exercise training for approximately 25 hours per week. He has no symptoms and no family history

• On examination his blood pressure is 130/65 mmHg. His height is 180 cm with a body mass of 75 kg.
Echocardiography Key Findings

• Dilated RV outflow (40mm)
• Normal RVFAC / TAPSE
• Dyskinetic Apex - ?Major criteria for ARVC

This athlete was referred for further investigations and cMRI demonstrated normal right heart.
NORMAL STUDY
Gene Positive ARVC Patient

Athlete

Diagnostic Dilemma
KEY POINTS

- Expect enlarged right sided chambers – more likely to get RV inflow dilation
- Athletes often have a single criteria for ARVC
- Functional assessment is key – normal function
- Some athletes present with ?dyskinesis (may be normal / but must seek additional testing).
A Guideline for the Practice of Echocardiography in the Cardiovascular Screening of Sports Participants

A Joint Policy Statement of the British Society of Echocardiography and Cardiac Risk in the Young

**Lead Authors:**
- Dr. David Cohrson
- Dr. Abbas Zaidi
- Dr. Savita Ganti
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- Dr. Thomas Mehdow
- Dr. Kevin O’Gallagher
- Dr. Aashfa Rana
- Dr. Liam Rigney
- Julie Sandelev
- Martin Stewart
- Gill Whallenton
- Dr. Richard Wheeler

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### Trans thoracic Echocardiography Proforma

<table>
<thead>
<tr>
<th>Name</th>
<th>Rate + Rhythm</th>
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<tbody>
<tr>
<td>Chlb / ID</td>
<td>DOB</td>
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<tr>
<td>Operator</td>
<td>Date of screen</td>
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#### LV Wall Thickness

<table>
<thead>
<tr>
<th>LV Dataset</th>
<th>MV</th>
<th>PM</th>
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<tbody>
<tr>
<td>LVED</td>
<td>mm</td>
<td>AV Vmax</td>
</tr>
<tr>
<td>LVES</td>
<td>mm</td>
<td>LVOT Vmax</td>
</tr>
<tr>
<td>Ao sin Valv/Aoe</td>
<td>cm</td>
<td>LVOT VT1</td>
</tr>
<tr>
<td>LCA ostium</td>
<td>not seen</td>
<td>AR</td>
</tr>
<tr>
<td>RCA ostium</td>
<td>not seen</td>
<td>MR</td>
</tr>
<tr>
<td>Lateral F’/A’</td>
<td>/</td>
<td>Dec-T</td>
</tr>
<tr>
<td>Septal E’/A’</td>
<td>/</td>
<td>LA Volume</td>
</tr>
<tr>
<td>EF</td>
<td>%</td>
<td>Desc Ao Vmax</td>
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</table>

#### Right Heart

<table>
<thead>
<tr>
<th>RV Dataset</th>
<th>RA size</th>
<th>RVFmax</th>
<th>mm</th>
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<tbody>
<tr>
<td>RVOT1</td>
<td>mm</td>
<td>TAPSE</td>
<td>mm</td>
</tr>
<tr>
<td>RVOT2</td>
<td>mm</td>
<td>TV E/A</td>
<td>cm/s</td>
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<tr>
<td>RVOT</td>
<td>m/s</td>
<td>TR max PG</td>
<td>mmHg</td>
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<tr>
<td>PR end PG</td>
<td>mmHg</td>
<td>TR</td>
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<tr>
<td>PR</td>
<td>0.4</td>
<td>RV FAC</td>
<td>%</td>
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<tr>
<td>RVDA1</td>
<td>mm</td>
<td>≤ 42</td>
<td>IVC (max min)</td>
</tr>
<tr>
<td>RVDA2</td>
<td>mm</td>
<td>≤ 35</td>
<td>IAS</td>
</tr>
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<td>RVDA3</td>
<td>mm</td>
<td>≤ 86</td>
<td>PFO</td>
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**Comments:**