Hypertrophic Cardiomyopathy
When and How to Follow?

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HCM: natural history

1. Genotype (+), Phenotype (-)
   Longitudinal Follow-up

2. No or Mild Symptoms (with or without obstruction)
   No Treatment or Drug Therapy

3. Sudden Death
   ICD

4. AF & Stroke
   Drugs, Warfarin, CV RFA

5. Progressive Heart Failure
   Drug-Refractory (NYHA Class III/IV)
   Heart Failure Symptoms
   Obstructive (Rest and/or Provocation) ≥30 mm Hg
   Drugs, Myectomy, Alcohol Ablation
   Nonobstructive (Rest/Provocation) <30 mm Hg
   EF ≥50%
   Drugs, Transplant

End-Stage (EF <50%)
   Drugs, BIV Pacing (if possible), Transplant
HCM: natural history

Preclinical HCM

1. After Puberty 10-20 y: 1-2 y

2. After Adolescent > 20 y: 2-5 y

3. Before Puberty < 10 y
   Malignant FH; FH of early disease onset; SX; intense sports

   - Clinical assessment + ECG + Echocardiography
Preclinical HCM

CMR: Diagnosis

- Establish diagnosis $^1$?? Echo : (2) apical HCM ; (3) anterolateral LVH
- Rule out the others
CMR: Fibrosis

- Patchy distribution & Correlates with WT
- Subendocardium is not necessarily affected (unlike IHD)
- LGE typically more diffuse; not specific to mid-wall (unlike DCM)

RV insertion point enhancement

CMR: Diagnosis

Myocardial crypts

CMR: Diagnosis

Elongated MV Leaflets

HCM: natural history
## Evaluation - Investigations

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>FU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ECG</strong></td>
<td>✓</td>
<td>(75 - &gt; 90%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Every 1-2 year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Worsening of SX</td>
</tr>
<tr>
<td><strong>TTE</strong></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Every 1-2 year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Change in clinical status</td>
</tr>
<tr>
<td><strong>24-48-Holter</strong></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Every 1-2 year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Every 6-12 month (NSR + LA &gt; 4.5 cm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o SX</td>
</tr>
<tr>
<td><strong>Treadmill exercise</strong></td>
<td></td>
<td>o Functional capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Risk stratification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o + echo: &gt; 30 - &gt; 50 mmHg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Every 2-3 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Progressive SX</td>
</tr>
<tr>
<td><strong>C. Cath</strong></td>
<td></td>
<td>o Not needed (rarely in cases with discrepancy: TTE / clinical)</td>
</tr>
<tr>
<td><strong>SPECT</strong></td>
<td></td>
<td>o Reversible defects (50%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Fixed defects (scar)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o False defects in non-hypertrophied segments</td>
</tr>
</tbody>
</table>

## SOB

- LVOTO ; MR ; diastolic dysfunction ; ischemia; DCM
- Mitral flow Doppler : little value
- E/E’ ratio: not reliable
- BNP: little value
Counseling

- **Pregnancy:**
  - Generally safe; Class III: Severe SX LVOTO / Severe systolic dysfunction
  - Risk: > 50 mmHg OR symptoms (referred to high risk obstetrician)
  - Issue of counseling

- **Exercise:**
  a. Low-intensity aerobic exercise (healthy lifestyle)
  b. avoiding strenuous activity or competitive athletics

- **Medications:** VDs; + diuretics; digoxin; NE; (use: phenylaphrine)

- **Occupations:** # : commercial motor vehicle driver; pilot

HCM: natural history

[Diagram showing the natural history of HCM with various pathways and stages, including Sudden Death, ICD, Normal Longevity, Longitudinal Follow-up, No or Mild symptoms (with or without obstruction), No Treatment or Drug Therapy, AF & Stroke, Progressive Heart Failure, End-Stage (EF<40%), Drugs/ Warfarin/ CV RFA, Obstructive (Rest and/or Provocation) >30 mm Hg, Nonobstructive (Rest/Provocation) <30 mm Hg EF ≥50%, Drugs Myectomy/(alcohol ablation), and Drugs Transplant.]
SCD in HCM: Challenges

- Young patients

- Without warnings
  - Asymptomatic, mildly symptomatic
  - Most occur during mild exertion or rest.

SCD in HCM: Importance

Maron BJ, et al., JAMA 2007;298:405
RFs of SCD in HCM

- Prior cardiac arrest (VF)
- Spontaneous sustained VT
- Family history of SCD
- Unexplained syncope
- LV thickness ≥30 mm
- Abnormal exercise BP
- NSVT
- LV outflow obstruction
- Apical aneurysm
- Late gadolinium enhancement
- High risk mutations
- AF
- Myocardial ischaemia
- End-stage phase
- ASA
- Competitive physical exercise
- Paced ventricular electrogram fractionation
- Surface ECG score
- Diastolic dysfunction
- Myocardial bridge

SCD risk modifiers
1. LVOTO
2. LGE on CMR
3. Genetic mutations
4. Apical aneurysm

ACCF/AHA Hypertrophic Cardiomyopathy Guidelines
Circulation 2011;58:e212
LV wall thickness and SCD

Maximal LV Wall Thickness and the Risk of SCD in 480 Patients

P=0.001 for trend

75% of those who died suddenly had a maximum wall thickness < 30 mm

Interpretation: The risk of sudden death associated with a wall thickness of 30 mm or more in patients without other risk factors is insufficient to justify aggressive prophylactic therapy. Most sudden deaths occurred in patients with wall thickness less than 30 mm, so the presence of mild hypertrophy cannot be used to reassure patients that they are at low risk.


FH and SCD

**NSVT and SCD**

RR: **4.35** (95% CI: 1.54 to 12.28; p 0.006)

Lorenzo Monserrat, J Am Coll Cardiol 2003;42:87

**Syncope and SCD**

*Table 4. Multivariable Analysis of the Prognostic Importance of the Time Interval Between Unexplained Syncope and Initial Patient Evaluation at the Participating Institutions*

<table>
<thead>
<tr>
<th>Time between unexplained syncope and first patient evaluation</th>
<th>Without unexplained syncope†</th>
<th>1349</th>
<th>1 (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤6 mo</td>
<td>53</td>
<td>4.89 (2.19–10.94)</td>
<td></td>
</tr>
<tr>
<td>&gt;6 to 12 mo</td>
<td>16</td>
<td>0 (No events)</td>
<td></td>
</tr>
<tr>
<td>&gt;1 to ≤2 y</td>
<td>13</td>
<td>2.01 (0.27–14.80)</td>
<td></td>
</tr>
<tr>
<td>&gt;2 to 5 y</td>
<td>19</td>
<td>1.04 (0.14–7.57)</td>
<td></td>
</tr>
<tr>
<td>&gt;5 y</td>
<td>50</td>
<td>0.38 (0.05–2.74)</td>
<td></td>
</tr>
</tbody>
</table>

Paolo Spirito, Circulation. 2009;119:1703-1710
**Syncope and SCD**

Paolo Spirito, Circulation. 2009;119:1703-1710

< 18 y: HR: 8.01, 95% CI: 2.07-31.45

**SCD in patients ≥ 60 years**

Barry J. Maron, Circulation. 2013;127:585-593

*Conclusions*—HCM patients surviving into the seventh decade of life are at low risk for disease-related morbidity/mortality, including sudden death, even with conventional risk factors. These data do not support aggressive prophylactic defibrillator implantation at advanced ages in HCM. Other cardiac or noncardiac comorbidities have a greater impact on survival than HCM in older patients. (Circulation. 2013;127:585-593.)
ICD in HCM: Complications

2190 HCM patients with ICD for 1st or 2nd prevention (FU: 3.7 year)

Arend F.L. Schinkel. Circ Heart Fail. 2012;5:552-559
ICD in HCM: Complications

Table 2. Summary of Clinical Outcome

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Author</th>
<th>Year</th>
<th>Follow-up</th>
<th>Appropriate Intervention, %</th>
<th>Inappropriate Intervention, %</th>
<th>Lead Malfunction</th>
<th>Lead Interference</th>
<th>Lead Displacement</th>
<th>Psychological</th>
<th>Any</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event rate (95% CI)</td>
<td>13.7</td>
<td>19.0</td>
<td>6.2</td>
<td>3.1</td>
<td>2.7</td>
<td>3.0</td>
<td>14.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annualized event rate (95% CI)</td>
<td>3.3</td>
<td>4.8</td>
<td>1.5</td>
<td>0.6</td>
<td>1.0</td>
<td>0.0</td>
<td>3.4</td>
<td></td>
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</tr>
</tbody>
</table>

Arend F.L. Schinkel. Circ Heart Fail. 2012;5:552-559

HCM: natural history

1. Genotype (+), Phenotype (-)
2. Longitudinal Follow-up
3. No or Mild Symptoms (with or without obstruction)
4. Normal Longevity
5. Progressive Heart Failure
6. End-stage (EF <40%)
7. Left Ventricular Pacing (P) Transplant
8. Drug Refractory (NYHA Class III/IV)
9. Heart Failure Symptoms
10. Obstructive (Rest and/or Provocation) 
11. Nonobstructive (Rest/Provocation) <30 mm Hg
12. EF ≥50%
13. Drugs, Myectomy/(alcohol ablation)
14. Drugs, Warfarin/Cox RFA
AF

- Common: 25%
- Clinical deterioration
- Thromboembolism; stroke
- CHADVASc: no value
- OAC

AF: predictors in HCM

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Univariable analysis</th>
</tr>
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<tbody>
<tr>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Age (10 years increment)</td>
<td></td>
</tr>
<tr>
<td>NYHA II</td>
<td></td>
</tr>
<tr>
<td>NYHA III/IV</td>
<td></td>
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<tr>
<td>LA (5 mm increment)</td>
<td></td>
</tr>
<tr>
<td>MWT (mm)</td>
<td></td>
</tr>
<tr>
<td>FS (%)</td>
<td></td>
</tr>
<tr>
<td>LVOT max (mm Hg)</td>
<td></td>
</tr>
<tr>
<td>LVEDD (mm)</td>
<td></td>
</tr>
<tr>
<td>LVESD (mm)</td>
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<tr>
<td>Hypertension</td>
<td></td>
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<tr>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Vascular disease</td>
<td></td>
</tr>
<tr>
<td>Analyses with non-linear</td>
<td></td>
</tr>
<tr>
<td>MWT (mm)</td>
<td></td>
</tr>
<tr>
<td>MWT²</td>
<td></td>
</tr>
<tr>
<td>LA5</td>
<td></td>
</tr>
<tr>
<td>LA5²</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Univariable analysis for predictors of atrial fibrillation in hypertrophic cardiomyopathy.

Figure 1. Graph showing the relationship of left atrial (LA) size with risk of atrial fibrillation (AF).

Heart 2017;103:672–678.
HCM Team

- Cardiologists
- Interventional cardiologists
- EP cardiologists
- Radiologists
- Cardiac surgeons
- Genetic counselors
- Clinical pharmacists
- Nurses

Thank You