Non-Ischemic Cardiomyopathy: Indication and Timing for ICD and CRT

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1. Introduction
2. SCA in non-ischemic cardiomyopathy
3. Secondary Prevention of SCA
4. Primary Prevention of SCA
5. CRT in non-ischemic cardiomyopathy
6. Summary
Introduction

• Dilated cardiomyopathy is responsible for approximately 10000 deaths in US each year
• Second most common cause of HF (16.5%) in SA
• Associated with significant mortality and morbidity

Severity of Heart Failure Modes of Death

<table>
<thead>
<tr>
<th>NYHA Class</th>
<th>SCA</th>
<th>Pump Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II</td>
<td>64%</td>
<td>12%</td>
</tr>
<tr>
<td>Class III</td>
<td>59%</td>
<td>26%</td>
</tr>
<tr>
<td>Class IV</td>
<td>33%</td>
<td>56%</td>
</tr>
</tbody>
</table>

Underlying Arrhythmias of SCA

- Monomorphic VT 62%
- Polymorphic VT 13%
- Bradycardia 17%
- Primary VF 8%

SCA Relationship to HF and Reduced LVEF

• Reduced left ventricular ejection fraction (LVEF) remains the single most important risk factor for overall mortality and SCD\(^1\)

\(^3\) Sweeney MO, *PACE.*, 2001;24:871-888.
SCD Risks in HF Patients with LV Dysfunction

Total Mortality ~15 to 40%; SCD accounts for ~50% of Total Deaths
Relation of LVEF to Risk of SCA

Note: 56.5% of all SCA victims had an LVEF > 30%

<table>
<thead>
<tr>
<th>LVEF</th>
<th>% Sudden Cardiac Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30%</td>
<td>7.5%</td>
</tr>
<tr>
<td>31-40%</td>
<td>5.1%</td>
</tr>
<tr>
<td>41-50%</td>
<td>2.8%</td>
</tr>
<tr>
<td>&gt; 50%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

Inherited cardiomyopathies:
- Long QT
- Short QT
- WPW
- Brugada
- ARVC
- HCM
- DCM

Common genetic variants

Prior infarct

Pre-existing myocardial damage

Cellular and tissue proarrhythmia
- Scar
- Focal fibrosis
- Hypertrophy
- Altered ion homeostasis
- Loss of intercellular connection

Leading to focal electrical activity conduction disturbance

Acute ischaemia

Autonomic imbalance

Acute strain

VT

VF
SCA Chain of Survival Statistics

Even in the best EMS/early defibrillation programs, it is difficult to achieve high survival times due to any SCA events not being witnessed and the difficulty of reaching victims within 6-8 minutes.

- 48% to 58% SCAs not witnessed\(^1,2\)
- 85% SCAs occur at home/non-public\(^1\)
- 4.6% to 8% estimated SCA out-of-hospital survival\(^1,2\)

Secondary Prevention of Sudden Cardiac Arrest
Patient Case #1

**History**
- 47 y.o. Saudi male
- Non ischemic cardiomyopathy for 2 years
- NYHA Class I
- LVEF 40% per echo
- Smoker; has COPD
- Stable on optimal medical therapy
- Syncopal episodes; with documented episodes of VT
Patient Case #1

Prevention of SCD:

• Should this patient be referred for an ICD evaluation? Why?
Arrhythmic Death in VT/VF Patients
AVID Results in Non-ICD Arm

# Randomized Clinical Trials

## ICD Therapy for the Secondary Prevention of SCA

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>Mean Age (yrs)</th>
<th>Mean LVEF (%)</th>
<th>Follow-up (mos)</th>
<th>Control Therapy</th>
<th>Control</th>
<th>ICD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVID¹</td>
<td>1016</td>
<td>65 ± 10</td>
<td>35</td>
<td>18 ± 12</td>
<td>Amiodarone or sotalol</td>
<td>24.0</td>
<td>15.8</td>
<td>.02</td>
</tr>
<tr>
<td>CIDS²</td>
<td>659</td>
<td>64 ± 9</td>
<td>34</td>
<td>36</td>
<td>Amiodarone</td>
<td>29.6</td>
<td>25.3</td>
<td>.14</td>
</tr>
<tr>
<td>CASH³</td>
<td>288</td>
<td>58 ± 11</td>
<td>45</td>
<td>57 ± 34</td>
<td>Amiodarone or metoprolol</td>
<td>44.4</td>
<td>36.4</td>
<td>.08</td>
</tr>
</tbody>
</table>

Secondary Prevention Trials: Reduction in Mortality with ICD Therapy

- **AVID**\(^1\): 31% mortality reduction with ICD Rx
- **CASH**\(^2\): 23%* mortality reduction with ICD Rx
- **CIDS**\(^3\): 20%* mortality reduction with ICD Rx

<table>
<thead>
<tr>
<th>Study</th>
<th>Overall Death</th>
<th>Arrhythmic Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVID(^1)</td>
<td>56%</td>
<td>31%</td>
</tr>
<tr>
<td>CASH(^2)</td>
<td>58%</td>
<td>23%*</td>
</tr>
<tr>
<td>CIDS(^3)</td>
<td>33%</td>
<td>20%*</td>
</tr>
</tbody>
</table>

*Statistically significant results.

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2008 ACC/AHA/HRS Class I ICD
Secondary Prevention Guidelines for the Management of Ventricular Arrhythmias

1. History of SCA, VF, hemodynamically unstable sustained VT (exclude reversible causes)

2. Structural heart disease and spontaneous sustained VT, whether hemodynamically stable or unstable

3. Syncope of undetermined origin with clinically relevant, hemodynamically significant sustained VT or VF induced at EP study

4. Non-sustained VT due to prior MI, LVEF < 40% and inducible VT at EP study

Primary Prevention of Sudden Cardiac Arrest
Patient Case #2

History

• 66 y.o. saudi female
• Type II DM, mild renal dysfunction
• Non ischemic cardiomyopathy for one year
• NYHA Class III
• LVEF is 32% (echo)
• Compliant with meds: beta blocker, ACE-I, diuretics, statin, DM regimen
Patient Case #2

Prevention of SCD:

• Should this patient be referred for an ICD evaluation?

• Is there anything else you’d want to know before making the decision?
Randomized Clinical Trials
Supporting Device Therapy

ICD and CRT-D for the Primary Prevention of SCA

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>Mean Age (yrs)</th>
<th>Mean LVEF (%)</th>
<th>Mean Follow-up (mos)</th>
<th>Control Therapy</th>
<th>Mortality (%)</th>
<th>Control</th>
<th>ICD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCD-HeFT 1,2</td>
<td>2,521</td>
<td>60.1</td>
<td>25</td>
<td>45.5</td>
<td>Optimal Medical Therapy</td>
<td>36.1</td>
<td>28.9</td>
<td>.007</td>
<td></td>
</tr>
<tr>
<td>COMPANION 3</td>
<td>1,520</td>
<td>67</td>
<td>21</td>
<td>12-16 months</td>
<td>Optimal Medical Therapy</td>
<td>19</td>
<td>12 (CRT-D)</td>
<td>.0003</td>
<td></td>
</tr>
<tr>
<td>MUSTT 4</td>
<td>704</td>
<td>67</td>
<td>30</td>
<td>39</td>
<td>No EP-guided Therapy</td>
<td>48</td>
<td>24</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>MADIT II 5</td>
<td>1,232</td>
<td>64</td>
<td>23</td>
<td>20</td>
<td>Optimal Medical Therapy</td>
<td>19.8</td>
<td>14.2</td>
<td>.007</td>
<td></td>
</tr>
</tbody>
</table>

2 Packer DL. *Heart Rhythm*. 2005;2:S38-S39
Primary Prevention Post-MI and HF Trials
Reduction in Mortality with ICD or CRT-D Therapy

**% Mortality Reduction w/ ICD Rx**

- SCD-HeFT: 64%
- COMPANION: 56%
- MUSTT: 73%
- MADIT-II: 62%

**Overall Death**

- SCD-HeFT: 23%
- COMPANION: 36%
- MUSTT: 55%
- MADIT-II: 31%

**Arrhythmic Death**

- SCD-HeFT: 41%
- COMPANION: 20%
- MUSTT: 18%
- MADIT-II: 31%

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Cardiac Resynchronization Therapy (CRT-D/P)
Cardiac Resynchronization Therapy (CRT-D/P)

Left Bundle Branch Block More Prevalent with Impaired LV Systolic Function

- Preserved LV Systolic Function (1): 8%
- Impaired LV Systolic Function (1): 24%
- Moderate/Severe Heart Failure (HF) (2): 38%
Cardiac Resynchronization Therapy (CRT-D/P)

One year mortality

- 11% QRS < 120 msec
- 16% QRS > 120 msec
- 34% QRS < 120 msec
- 49% QRS > 120 msec

45 months mortality

Luliano et al. AHJ 2002; 143: 1085-91
Cardiac Resynchronization Therapy (CRT-D/P)

- PATH-CHF I & II N 200
- MUSTIC N 60
- INSYNC ICD N 103
- PAVE N 360
- VECTOR N 201
- INSYNC ICD N 103
- PAVE N 360
- VIGOR CHF N 84
- MIRACLE I 1, II, III N 600
- CONTAK CD N 1100
- COMPANION N 2200
- RHYTHM ICD N 126
- VECTOR N 201
- COMPANION N 2200
- MIRACLE ICD N 1000
- CARE HF N 800
- REVERSE MADIT-CRT RAFT
Cardiac Resynchronization Therapy

Timing? Patient selection?

At Risk for Heart Failure

STAGE A
At high risk for HF but without structural heart disease or symptoms of HF
- e.g. Patients with:
  - HTN
  - Atherosclerotic disease
  - DM
  - Obesity
  - Metabolic syndrome
  - Patients with history of cardiovascular disease
  - Using cardioactive agents
  - With family history of cardiomyopathy

STAGE B
Structural heart disease but without signs or symptoms of HF
- e.g. Patients with:
  - Previous MI
  - LV remodeling including LVH and low EF
  - Asymptomatic valvular disease

STAGE C
Structural heart disease with prior or current symptoms of HF
- e.g. Patients with:
  - Known structural heart disease and HF signs and symptoms

Heart Failure

STAGE D
Refractory HF
- e.g. Patients with:
  - Marked HF symptoms at rest
  - Recurrent hospitalizations despite GOFT

Therapy

Goals
- Heart healthy lifestyle
- Prevent vascular, coronary disease
- Prevent LV structural abnormalities

Drugs:
- ACEI or ARB as appropriate
- Beta blockers as appropriate
- Calcium channel blockers if indicated

In selected patients:
- ICD
- Revascularization or valvular surgery as appropriate

In selected patients:
- CRT
- ICD
- Revascularization or valvular surgery as appropriate

Therapy

Goals
- Control symptoms
- Patient education
- Prevent hospitalization
- Prevent mortality
- Drugs for routine use
- Diuretics for fluid retention
- ACEI or ARB
- Beta blockers
- Aldosterone antagonists

Drugs for use in selected patients
- Intravenous nesiritide
- ACEI and ARB
- Digoxin

In selected patients:
- CRT
- ICD
- Revascularization or valvular surgery as appropriate

Therapy

Goals
- Control symptoms
- Improve HRQoL
- Reduce hospital readmissions
- Establish patient’s end-of-life goals
- Options
- Advanced care measures
- Heart transplant
- Chronic inotropes
- Permanent or temporary MCS
- Experimental surgery or drugs
- Palliative care and hospice
- ICD deactivation
Cardiac Resynchronization Therapy
Timing? Patient selection?

Patient with cardiomyopathy on GDMT for ≥8 mo or on GDMT and ≥40 d after MI, or with implantation of pacing or defibrillation device for special indications

LVEF ≤35%

Evaluate general health status

Acceptable noncardiac health

Evaluate NYHA clinical status

NYHA class I
- LVEF ≤30%
- QRS ≥150 ms
- LBBB pattern
- Ischemic cardiomyopathy
- QRS ≤150 ms
- Non-LBBB pattern

NYHA class II
- LVEF ≤35%
- QRS ≥150 ms
- LBBB pattern
- Sinus rhythm
- LVEF ≤35%
- QRS 120-149 ms
- LBBB pattern
- Sinus rhythm
- LVEF ≤35%
- QRS ≤150 ms
- Non-LBBB pattern
- Sinus rhythm

NYHA class III & Ambulatory class IV
- LVEF ≤35%
- QRS ≥150 ms
- LBBB pattern
- Sinus rhythm
- LVEF ≤35%
- QRS 120-149 ms
- LBBB pattern
- Sinus rhythm
- LVEF ≤35%
- QRS ≤150 ms
- Non-LBBB pattern
- Sinus rhythm

Special CRT Indications
- Anticipated to require frequent ventricular pacing (>40%)
- Atrial fibrillation, if ventricular pacing is required and rate control will result in near 100% ventricular pacing with CRT
ICD and CRT-D
Treatment Algorithms
ICD and CRT Treatment Algorithms

Does patient have history of cardiac arrest, VF, or symptomatic VT?

**YES**
- Consult EP for possible ICD

**NO**
- NYHA Class II or III CHF
  - Is patient on optimal medical therapy?
    - **YES**
      - Consult EP for possible CRT-D
    - **NO**
      - Non-Ischemic
        - 3 months post diagnosis
        - Consult EP for possible ICD
      - Ischemic
        - 40 days post MI
        - Consult EP for possible CRT-D
      - EF ≤ 35%
        - Consult EP for possible ICD
      - EF > 35%
        - Consult EP for possible ICD

Is patient on optimal medical therapy?

**YES**
- Consult EP for possible ICD

**NO**
- Optimize therapies or consult HF specialist

NYHA Class I CHF
- 40 days post MI with EF ≤ 30%
- Consult EP for possible ICD

**Note:** Pathway only begins after optimal medical therapy & coronary evaluation/intervention as appropriate

Clas s III or IV CHF and QRS > 120 ms
- Consult EP for possible ICD

EF
- ≥ 35%
  - Consult EP for possible CRT-D
- < 35%
  - Consult EP for possible CRT-D

1. Consider referral to HF Specialist or HF Program.
2. Repeat diagnostics with change of symptoms.
Summary
Summary

1. SCA is a leading cause of death in patient with Heart Failure.

2. Predictors of SCD: low LVEF, prior MI and prior SCA or VT/VF event.

1. ICD is the only effective treatment for SCA.
Summary

4. CRT-D/P improves mortality and morbidity in properly selected patients with CM

5. Surface ECG is the primary selection tool for CRT candidate