Electrophysiology update for the Non-Electrophysiologist

AKA: “You burn what? Where?”
or “Who gets what and why?”

Jennifer Cummings, MD FACC FHRS
Mercy Cardiovascular Institute
Associate Professor of Medicine
Canton, OH
Introduction

- There is a growing need within general internal medicine to understand electrophysiology
  - The disease processes are rapidly expanding
  - The treatment is rapidly evolving/changing
  - Those where were once hopeless have hope
  - There is a often gap between that which is now available and that which is often offered by physicians
Objectives

- Review Prevalence of Atrial fibrillation
  - Growing in population, cost, and danger
  - Update on treatment options of atrial fibrillation (AKA: “You burn what? Where?”)
  - What do the guidelines say?
  - What is the science behind the guidelines
- Electrophysiology and Heart failure – partners
Atrial Fibrillation
Prevalence Estimates

- AF is the most common form of arrhythmia
  - 2.3 million people in the United States
  - 4.5 million people in the European Union
- AF is associated with high rates of morbidity and mortality
  - 1 of every 6 strokes occurs in patients with AF
- It is estimated that 10-30% of patients with CHF have AF

Atrial Fibrillation: Prevalence Estimates

Projected number of persons with AF (millions)

Year


5.1 5.6 6.1 6.6 7.5 8.4 9.4 10.3 11.1 11.7 12.1

Turpie A. New oral anticoagulants in atrial fibrillation. EHJ 2007; 29:155-65
Atrial Fibrillation: a growing problem

Atrial fibrillation is a deadly problem: Framingham Heart Study

- 40 year follow-up patients with and without atrial fibrillation.
- Adjustment for age, hypertension, diabetes, CHF, valvular disease & myocardial infarction.
- Odds ratio for death: 1.5 in men, 1.8 in women
Atrial Fibrillation & Risk of Death: Framingham Heart Study

Odds ratio for death: 1.5 in men, 1.8 in women
Current strategies for atrial fibrillation

ACCF/AHA/HRS FOCUSED UPDATE

2011 ACCF/AHA/HRS Focused Update on the Management of Patients With Atrial Fibrillation (Update on Dabigatran)

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

2011 WRITING GROUP MEMBERS
L. Samuel Wann, MD, MACC, FAHA, Chair*; Anne B. Curtis, MD, FACC, FAHA*;
Kenneth A. Ellenbogen, MD, FACC, FHRS†; N.A. Mark Estes III, MD, FACC, FHRS‡§;
Michael D. Ezekowitz, MB, ChB, FACC*§; Warren M. Jackman, MD, FACC, FHRS*;
Craig T. January, MD, PhD, FACC*; James E. Lowe, MD, FACC*;
Richard L. Page, MD, FACC, FHRS, FAHA†; David J. Slotwiner, MD, FACC†§;
William G. Stevenson, MD, FACC, FAHA||; Cynthia M. Tracy, MD, FACC*

What are the cornerstones in the management of the patient with Atrial Fibrillation?

- Stroke/Thromboembolism Prevention
- Ventricular Rate Control
- Rhythm Control
The AFFIRM Trial

Is it worth struggling to maintain sinus rhythm?

4060 pts with AFib

Rate Control

- No difference in mortality, stroke risk or quality of life
- More frequent hospitalization and adverse drug effects in Rhythm Control arm

Rhythm Control

Rate Control for All!

Rate Control for ALL halted progress in AF treatment options.....

Clinical Application of AFFIRM applied to EVERYONE

Halted Progress!!!!!
The Rate Control Strategy: Problems with AFFIRM

- Mean age: 69.7 +/- 9 years
  - Young patients were underrepresented
- 45% of those screened declined enrollment
  - Were highly symptomatic patients underrepresented?
- AFFIRM was not a trial of sinus rhythm versus atrial fibrillation: It was a trial of the strategy
  - 62% of “Rhythm Control” patients were in NSR
  - 35% of “Rate Control” patients were in NSR
Errors in Patient Management Due to Misinterpretation of AFFIRM Trial Results

- Dooming patient without heart disease to lifelong drug therapy and coumadin
- Not attempting cardioversion in patients with “New Onset” AF because rate control is “preferred therapy”
- Forcing patient to accept rate controlling drug side effects as “part of aging process” (fatigue, loss of mental clarity, insomnia, constipation)
AFFIRM did apply to

- Asymptomatic Patients
- Elderly Patients
- No CHF
- In THIS population:
  - Rate and rhythm control strategies result in similar outcomes with respect to
    - mortality
    - stroke
    - functional capacity*
    - quality of life*
Ironically . . .

Relationships Between Sinus Rhythm, Treatment, and Survival in the Atrial Fibrillation Follow-Up Investigation of Rhythm Management (AFFIRM) Study

The AFFIRM Investigators*

Background—The AFFIRM Study showed that treatment of patients with atrial fibrillation and a high risk for stroke or death with a rhythm-control strategy offered no survival advantage over a rate-control strategy in an intention-to-treat analysis. This article reports an “on-treatment” analysis of the relationship of survival to cardiac rhythm and treatment as they changed over time.

Methods and Results—Modeling techniques were used to determine the relationships among survival, baseline clinical variables, and time-dependent variables. The following baseline variables were significantly associated with an increased risk of death: increasing age, coronary artery disease, congestive heart failure, diabetes, stroke or transient ischemic attack, smoking, left ventricular dysfunction, and mitral regurgitation. Among the time-dependent variables, SR and AF were the only two variables that changed during follow-up and were significantly associated with survival. The estimated hazards ratio for AF compared with SR was 2.02 (1.52-2.66) and remained significant even after adjustment for the baseline variables.

Conclusions—Warfarin use improves survival. SR is either an important determinant of survival or a marker for other factors associated with survival that were not recorded, determined, or included in the survival model. Currently available AADs are not associated with improved survival, which suggests that any beneficial antiarrhythmic effects of AADs are offset by their adverse effects. If an effective method for maintaining SR with fewer adverse effects were available, it might be beneficial. (Circulation. 2004;109:1509-1513.)

Key Words: antiarrhythmia agents ■ anticoagulants ■ arrhythmia ■ fibrillation
Management of the patient with Atrial Fibrillation

- Stroke/Thromboembolism Prevention
- Ventricular Rate Control
- Rhythm Control
Management of Atrial Fibrillation: Rhythm Control

- Antiarrhythmic drugs +/- DC cardioversion
- AF catheter ablation (PVAI)
- Atrial Segmentation
  - Surgical Maze procedure
  - Catheter Maze procedure: "Linear AF ablation"
- Pacing
  - Prevention/Suppression algorithms
  - Treatment (termination) algorithms
MAINTENANCE OF SINUS RHYTHM

No (or minimal) heart disease

Hypertension

Coronary artery disease

Heart failure

LVH = left ventricular hypertrophy.

Fuster V et al. J Am Coll Cardiol. 2006;48:e149-246
Wann S et al Heart Rhythm vol 8 No 1 Jan 2011.
Problem? They aren’t that effective
Time to recurrence of atrial fibrillation: Sotalol versus class I drugs

Number of Recurrences (% Without Recurrence)

<table>
<thead>
<tr>
<th></th>
<th>Sotalol:</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 (100%)</td>
<td>41 (49%)</td>
<td>52 (35%)</td>
<td>57 (28%)</td>
<td>61 (22%)</td>
<td>64 (13%)</td>
</tr>
<tr>
<td>Class I:</td>
<td>0 (100%)</td>
<td>50 (46%)</td>
<td>58 (37%)</td>
<td>62 (31%)</td>
<td>64 (28%)</td>
<td>67 (19%)</td>
</tr>
</tbody>
</table>

The AFFIRM First Antiarrhythmic Drug Substudy Investigators, J Am Coll Cardiol 2003;42:20-29
Problem? They aren’t that safe

Epstein, et al, Circ, 2004
You’re going to burn What? Where?

What is all this ablation about?
Dual Substrate Model of Atrial Fibrillation

Substrate for AF Initiation

Substrate for AF Maintenance

Stretch
Autonomic Tone
Inflammation
Toxins
Fibrosis
Electrical Remodelling (AF)

Modulating Factors
Pulmonary Vein Triggers Initiating Atrial Fibrillation
From Maze to PV’s

Pulmonary Veins Antrum Isolation (PVAI): Circular Mapping
Pulmonary Veins Antrum Isolation: Circular Mapping Technique
Before PV Antrum Isolation

After PV Antrum Isolation
Impact of type of atrial fibrillation (AF) and repeat catheter ablation on long term freedom from AF: Results from a Multicenter Study


*Cleveland Clinic, Cleveland, OH, USA; †Sutter Pacific Heart Center, San Francisco, CA, USA; ‡Umberto I Hospital, Mestre-Venice, Italy; **Southlake Regional Health Center, Newmarket, Ontario, Canada; †Texas Cardiac Arrhythmia Institute at St. David’s Medical Center, Austin, TX, USA; ‡Akrnon General Medical Center, Akron, OH, USA; # Department of Cardiology, University of Foggia, Foggia, Italy; *** Texas Cardiac Arrhythmia Center at St David Medical Center, Austin, TX, USA, Stanford University, Palo Alto, CA, USA, Case Western Reserve University, Cleveland, OH, USA.
AF Ablation: Long term data

- N = 1,404 patients
  - 728 PAF
  - 676 non-PAF
    - 293 Persistent
    - 383 Long standing (chronic)
- 12 operators at 4 different centers
- Technique: intracardiac echo (ICE) guided circular mapping radiofrequency catheter ablation

Table 2: Freedom from AF after initial and repeat catheter ablations

<table>
<thead>
<tr>
<th>SN</th>
<th>Variable</th>
<th>Paroxysmal (1)</th>
<th>NPAF (2)</th>
<th>P-value (1 vs. 2)</th>
<th>Persistent (3)</th>
<th>Long lasting persistent (4)</th>
<th>P-value (1 vs. 3 vs. 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Primary recurrence</td>
<td>163/728</td>
<td>222/676</td>
<td>/</td>
<td>71/293</td>
<td>151/383</td>
<td>/</td>
</tr>
<tr>
<td>2</td>
<td>Primary freedom from AF</td>
<td>77.6%</td>
<td>67.2%</td>
<td>&lt;0.001</td>
<td>75.8%</td>
<td>60.6%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3</td>
<td>Redo ablation done</td>
<td>121(74.2%)</td>
<td>166(74.8%)</td>
<td>0.904</td>
<td>51(71.8%)</td>
<td>115(76.2%)</td>
<td>0.782</td>
</tr>
<tr>
<td>4</td>
<td>Recurrence after redo (Sec)</td>
<td>13/121</td>
<td>52/166</td>
<td>/</td>
<td>15/51</td>
<td>37/115</td>
<td>/</td>
</tr>
<tr>
<td>5</td>
<td>Total recurrence (Sec)*</td>
<td>57/728</td>
<td>114/676</td>
<td>/</td>
<td>36/293</td>
<td>78/383</td>
<td>/</td>
</tr>
<tr>
<td>6</td>
<td>Secondary freedom from AF</td>
<td>92.2%</td>
<td>83.1%</td>
<td>&lt;0.001</td>
<td>87.7%</td>
<td>79.6%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Figure 1

- Freedom from AF (%)
  - Paroxysmal: 77.6
  - Persistent: 75.8
  - Long Lasting Persistent: 60.5

Primary Cure Rate vs. Secondary Cure Rate:
- p < 0.001
- p < 0.001

So what are the risks?
Atrial Fibrillation Ablation Complications
Perforation / Tamponade

- Intracardiac Echocardiography
- Rapid diagnosis
- Evaluate for RA / RV collapse
Pulmonary Vein Stenosis

- 1-2% Incidence
- CT Scans
  - 3 months
  - 6 months if stenosis seen at 3 months
- Angioplasty / Stenting warranted in cases >70% or if Significant decrease in perfusion <25% in affected lung
- Complete occlusion can be asymptomatic

\(^1\)DiBiase L, Cummings JE et al  J Am Coll Cardiol. 2006 Dec 19;48(12):2493-9
Stroke

- 1-2% Incidence
- Char and/or Thrombus
- Intra-procedure echo
- Anticoagulation
Radiation Exposure

- Procedures are long (especially second procedures) requiring significant amounts of fluoroscopy.
- Increased risk for both physician and patient.
- Especially if additional imaging performed prior procedure.
Esophageal Complications: Esophageal-Atrial Fistula

- <50 reported in the world
- First reported in surgical literature (open atrial ablation)
- First case reports in following percutaneous procedures were in 2005-2006
- Injury presumed to be thermal in nature

Esophageal complications

- The damage is presumed to be thermal
- The esophagus is clearly in the way of placing lesions in the regions NECESSARY to achieve pulmonary vein isolation
- So the dilemma will be where to ablate successfully with minimal risk

²Donaldson D et al Heart Rhythm Vol 7 no 2 Feb 2010
Esophageal Complications

- Blinded surveys from active atrial fibrillation centers
- Collected information on 9 cases
  - Insidious onset presenting 10-16 days post procedure
  - Presented as:
    - Sepsis
    - Stroke
    - GI bleed
- Mortality nearly 100%

<table>
<thead>
<tr>
<th>Table 1. Characteristics of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
</tr>
<tr>
<td>Male sex, n</td>
</tr>
<tr>
<td>Mean time to presentation (range), d</td>
</tr>
<tr>
<td>Deaths, n/n</td>
</tr>
<tr>
<td>Presenting symptoms, n/n</td>
</tr>
<tr>
<td>Sepsis</td>
</tr>
<tr>
<td>Neurologic symptoms</td>
</tr>
<tr>
<td>Myocardial infarction or ischemia</td>
</tr>
<tr>
<td>Overt gastrointestinal bleeding</td>
</tr>
<tr>
<td>Computed tomography performed, n/n</td>
</tr>
<tr>
<td>Diagnosis by computed tomography, n/n</td>
</tr>
<tr>
<td>Diagnosis confirmed by autopsy, n/n</td>
</tr>
<tr>
<td>Diagnosis only by autopsy, n/n</td>
</tr>
</tbody>
</table>
Summary: AF Catheter Ablation Candidates

- Symptomatic AF (paroxysmal or persistent)
- At least one antiarrhythmic medication failure
- Younger patients with “lone” paroxysmal AF are the best candidates, but patients with persistent AF, older patients and those with co-morbidities such as structural heart disease and heart failure may also be appropriate candidates.
Summary: AF Catheter Ablation: Potentially Poor Candidates

- Asymptomatic or minimally symptomatic AF
- No trial of antiarrhythmic drug
- Left atrial cardiomyopathy
- Goal of undergoing ablation is to get off warfarin
- Frail, elderly patients
- Severe structural heart disease, mechanical mitral valve, etc.
Device Based Therapies of Congestive Heart Failure

- The evolution of devices in the treatment of congestive heart failure
CHF and EP: The chicken and the egg…..

- Heart failure is a chronic, progressive, debilitating disease in which the heart muscle weakens and gradually loses the ability to pump blood effectively. It can result from any structural or functional cardiac disorder that impairs the ability of the ventricles to fill with or eject blood.

- CHF leads to high risk electrophysiologic abnormalities: Sudden Cardiac Death
- EP Conduction changes contribute to CHF
How does CHF affect EP?  
Risk of Sudden Cardiac Death (SCD)

- SCD claims an estimated 325,000 lives each year
  - 1,000 lives every day, one life every two minutes
- In people with CHF, SCD occurs at 6-9 times the rate of the general population

How does CHF affect EP?  
What is Sudden Cardiac Death?

Actual Holter monitor strip from a patient who did not have a defibrillator. ¹

He died at 6:11 a.m. on the golf course ¹.

Heart Failure Mortality
Sudden Cardiac Death

Mechanism of Death in Heart Failure

NYHA Class II
n = 103 deaths

SCD 64%
CHF 12%
Other 24%

NYHA Class III
n = 232 deaths

SCD 59%
CHF 26%
Other 15%

NYHA Class IV
n = 27 deaths

SCD 33%
Other 11%
CHF 56%

Device Therapy in CHF: Can we prevent Sudden Death

- Internal Cardiac Defibrillators (ICD)
MADIT-I: Demonstrating the Potential of ICD Therapy

**Clinical Question**
Can prophylactic implantable cardioverter defibrillator (ICD) therapy improve survival in high-risk patients? ¹

**MADIT-I**
- Size: 196 patients
- Endpoint: All-cause mortality
- Published: NEJM 1996

54%
Reduction in mortality rate in the defibrillator group with OPT as compared to the conventional therapy group. (p=0.009) ¹

Clinical Question
Can heart attack survivors with impaired heart function (EF<30%), and no other risk stratification, benefit from ICD therapy?

Reduction in the risk of death in heart attack survivors with ICDs & OPT, when compared to optimal pharmacologic therapy (OPT) alone (p value 0.016).

Presented at HRS 2009 – At 8 years:
- 37% relative reduction in the risk of death for ICD patients*
- Number Needed to Treat = 6 (vs. 17 at 2 years)

SCD-HeFT

Size: 2521 patients in North America

- Endpoint: All-cause mortality
- Published: NEJM 2005

Clinical Question

Does ICD therapy, used in combination with conventional drug therapy (CDT), significantly improve mortality for patients with NYHA Class II/III heart failure and EF <35%, versus either CDT + amiodarone or CDT + placebo? ¹

23%

Reduction in the risk of all-cause mortality when using an ICD, in combination with conventional drug therapy, when compared to CDT alone (p value:0.007) ¹

¹ Bardy et al. New Engl J Med. 352 (3): 225
ACC/AHA Guidelines 2005: ICD Recommendations

- Recommended as **secondary prevention** to prolong survival in patients with current or prior symptoms of HF and reduced LVEF who have a history of cardiac arrest, VF, or hemodynamically unstable VT

- Recommended for **primary prevention** to reduce total mortality by a reduction in SCD in patients with ischemic heart disease who are at least 40 days post-MI, with LVEF less than or equal to 30-35%, and with NYHA functional class II or III symptoms*

- Recommended for **primary prevention** to reduce total mortality by a reduction in SCD in patients with nonischemic cardiomyopathy, LVEF less than or equal to 30-35%, and NYHA functional class II or III symptoms*

*While undergoing chronic optimal medical therapy with reasonable expectation of survival with good functional status >1 year.

VF=ventricular fibrillation; VT=ventricular tachycardia; SCD=sudden cardiac death.

Underlining represents changes from 2001 guidelines.

Is preventing sudden death enough? Can we improve CHF symptoms?

- How does electrophysiology contribute to heart failure: Dyssynchrony
Mechanical Dyssynchrony

- Mechanical dyssynchrony means that the heart does not contract as an efficient, unified whole unit.
  - The left and right ventricles may contract at slightly different times.
  - The left ventricle may contract in segments instead of as one unit.
The likely mechanism of death in heart failure patients moves from SCD to pump failure (CHF) as the disease progresses. 

Can we take the ICD from preventing SCD to preventing CHF

- Cardiac Resynchronization Therapy (CRT)
Cardiac Resynchronization: The BiV ICD
COMPANION: Providing New Access to CRT Therapies

Clinical Question
Does CRT therapy, used in combination with optimal pharmacologic therapy (OPT), significantly improve the quality and duration of life for patients with late-stage symptomatic heart failure versus using OPT alone? ¹

20%
Reduction in the risk of all-cause mortality or first hospitalization with CRT-D, in combination with OPT, compared to OPT alone (p value:0.011) ¹

Trials Have Proven CRT Safety & Efficacy in NYHA Class III/IV
Total Enrolled Patients = Nearly 4,000!

ACC/AHA/HRS Class I Guideline*: EF≤35%; QRS≥120ms; NYHA III-IV

*Level of Evidence: “A”

Cardiac Resynchronization Therapy* in Patients With Severe Systolic
Heart Failure

For patients who have left ventricular ejection fraction (LVEF) less than or equal to 35%, a QRS duration greater than or equal to 0.12 seconds, and sinus rhythm, cardiac resynchronization therapy (CRT) with or without an ICD is indicated for the treatment of New York Heart Association (NYHA) functional Class III or ambulatory Class IV heart failure symptoms with optimal recommended medical therapy.

For patients who have LVEF less than or equal to 35%, a QRS duration greater than or equal to 0.12 seconds, and AF, CRT with or without an ICD is reasonable for the treatment of NYHA functional Class III or ambulatory Class IV heart failure symptoms on optimal recommended medical therapy.

For patients with LVEF less than or equal to 35% with NYHA functional Class III or ambulatory Class IV symptoms who are receiving optimal recommended medical therapy and who have frequent dependence on ventricular pacing, CRT is reasonable.

*All primary SCD prevention ICD recommendations apply only to patients who are receiving optimal medical therapy and have reasonable expectation of survival with good functional capacity for more than 1 year.
The next evolution: Can we prevent CHF?

Clinical Question

Does CRT with biventricular pacing reduce the risk of death or heart failure events in patients with mild cardiac symptoms, a reduced EF and a wide QRS

MADIT-CRT
Size: 1820 patients
Endpoint: All-cause mortality or non-fatal heart failure event
Published: NEJM 2009

41%

Reduction in the risk of heart-failure events (primarily in QRS duration of 150msec or more)

\[ ^1 \text{Moss AJ, et al, NEJM, 2009; 361:1329-1338} \]
MADIT-CRT- Endpoints

Kaplan-Meier Estimate of Heart Failure Free Survival Probability

- CRT-D
- ICD

Patients at risk

<table>
<thead>
<tr>
<th></th>
<th>ICD-only</th>
<th>CRT-D</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=1820</td>
<td>731 (1.00)</td>
<td>1089 (1.00)</td>
</tr>
<tr>
<td>p&lt;0.001</td>
<td>621 (0.89)</td>
<td>965 (0.92)</td>
</tr>
<tr>
<td></td>
<td>379 (0.78)</td>
<td>651 (0.86)</td>
</tr>
<tr>
<td></td>
<td>173 (0.71)</td>
<td>279 (0.80)</td>
</tr>
<tr>
<td></td>
<td>43 (0.63)</td>
<td>58 (0.73)</td>
</tr>
</tbody>
</table>

Years from Randomization

MADIT-CRT: Endpoints

- Benefit driven by **41% reduction** in the risk of heart failure events
- Similar benefit for ischemic and non-ischemic patient

34% reduction in the risk of all-cause mortality or first HF event

### Cox Analysis

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>HR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death or Heart Failure</td>
<td>0.66</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>0.67</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>0.62</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>0.59</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>HF only</td>
<td>0.59</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>0.58</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>0.59</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Death at any time</td>
<td>1.00</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>1.06</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>0.87</td>
<td>0.68</td>
</tr>
</tbody>
</table>

- Adjusted Hazard Ratio favors CRT-D vs. CRT-D
- Adjusted Hazard Ratio favors ICD vs. CRT-D

**MADIT-CRT: Endpoints**

- 34% reduction in the risk of all-cause mortality or first HF event

### MADIT-CRT: Pre-specified Subgroups

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. events/No. patients</th>
<th>Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 65 yr</td>
<td>142/852</td>
<td></td>
</tr>
<tr>
<td>≥ 65 yr</td>
<td>230/968</td>
<td></td>
</tr>
<tr>
<td>*<em>Sex</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>294/1367</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>78/453</td>
<td></td>
</tr>
<tr>
<td><strong>NYHA Class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischemic I</td>
<td>53/265</td>
<td></td>
</tr>
<tr>
<td>Ischemic II</td>
<td>186/734</td>
<td></td>
</tr>
<tr>
<td>Non-ischemic II</td>
<td>133/821</td>
<td></td>
</tr>
<tr>
<td><strong>QRS ms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 150</td>
<td>147/645</td>
<td></td>
</tr>
<tr>
<td>≥ 150</td>
<td>225/1175</td>
<td></td>
</tr>
<tr>
<td><strong>LVEF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 0.25</td>
<td>101/646</td>
<td></td>
</tr>
<tr>
<td>&gt; 0.25</td>
<td>271/1174</td>
<td></td>
</tr>
<tr>
<td><strong>LVEDV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 240 ml</td>
<td>184/828</td>
<td></td>
</tr>
<tr>
<td>&gt; 240 ml</td>
<td>184/969</td>
<td></td>
</tr>
<tr>
<td><strong>LVESV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 170 ml</td>
<td>190/835</td>
<td></td>
</tr>
<tr>
<td>&gt; 170 ml</td>
<td>178/962</td>
<td></td>
</tr>
<tr>
<td><strong>All patients</strong></td>
<td>372/1820</td>
<td></td>
</tr>
</tbody>
</table>

The benefit of CRT-D appeared to be:

- Greater in women that in men
- Greater in patients with wider QRS duration

Women v. Men in the MADIT-CRT 
Probability of Heart Failure or Death

Arshad et al. JACC 2011;57(7);813-20.
MADIT-CRT

- Although men received significant benefit from CRT-D, women had significantly better results:
  - 72% reduction in all-cause mortality
  - Even greater reduction in those with LBBB and QRS $>150$ms

- There were significant differences in baseline characteristics between women and men that could have contributed:
  - A greater proportion of the female cohort had:
    - Non-ischemic Cardiomyopathy
    - LBBB
    - Higher utilization of beta-blockers

Arshad et al. JACC 2011;57(7);813-20.
In Conclusion: DBT of CHF

- Device based therapies of congestive heart failure has evolved significantly over the last several years. We have gone from
  - Preventing sudden cardiac death
  - Improving morbidity and mortality in patients with severe CHF
  - Preventing morbidity and mortality in patients with mild CHF
- Cause of death in patients with CHF is SCD early on in patients but as the CHF progresses pump failure is more common
- Early data has demonstrated that female gender may predict a better response to CRT-D
In Conclusion: Atrial Fibrillation

- Atrial fibrillation ablation remains a viable option in symptomatic patients who have failed at least one antiarrhythmic therapy.
- Complication risk is higher as the patients' comorbidities (age, LA size, previous stroke etc) increase and thus decision for ablation still is made on a patient by patient basis.
- Over the last several years we have gone from
  - Rate control and pacemaker as an only option
  - Surgical ablation and isolation of the pulmonary veins
  - Percutaneous ablation as an option for potential cure of atrial fibrillation
The end!