The Overlap of Heart Failure & Atrial Fibrillation

M. Eyman Mortada, MD, FACC, FHRS

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Normal electrical pathways

Sinus (SA) node

Atrioventricular (AV) node

Normal sinus rhythm

Abnormal electrical pathways

Atrial fibrillation
Pathophysiology
Mechanisms of AF

Extracardiac Factors:
- Hypertension
- Obesity
- Sleep apnea
- Hyperthyroidism
- Alcohol/drugs

Atrial Structural Abnormalities:
- Fibrosis
- Dilation
- Ischemia
- Infiltration
- Hypertrophy

Inflammation
Oxidative stress

AF

Atrial tachycardia remodeling

RAAS activation

Genetic Variants:
- Channelopathy
- Cardiomyopathy

Atrial Electrical Abnormalities:
- ↑Heterogeneity
- ↓Conduction
- ↓Action potential duration/refractoriness
- ↑Automaticity
- Abnormal intracellular Ca^{++} handling

Autonomic nervous system activation
AF and heart failure (HF): a vicious pathophysiological cycle

Epidemiology
AF Epidemiology

• **Prevalence (Globally 2010):**
  33.5 million
  20.9 million men
  12.6 million women

• **Incidence (Globally 2010):**
  4.7 million new cases/year
AF in Our Practice

35088 inpatients with arrhythmia
In 3 Aurora hospitals (2009)
Prevalence of AF by age

Go et al, JAMA May 2001, 285(18):2370-75

The 3rd National Health and Nutrition Examination Survey (NHANES III)
American Heart Association: Heart Disease and Stroke Statistics- 2003
Association between AF & HF

• Prevalence of AF in heart failure 13%-27% *

• In the Framingham Heart Study: 26% developed both AF & heart failure **

• The prevalence of AF increases in parallel with the severity of the HF (systolic/diastolic): ***

***Maisel et al: AF in HF. Am J Cardiol 2003; 91:2D-8D
Prevalence of atrial fibrillation in several major CHF trials

Neuberger H et al. Eur Heart J 2007;28:2568-2577
The onset of AF is associated with:

- highly significant worsening of the:
  - New York Heart Association function class
  - peak oxygen consumption
  - cardiac index

- Increase mitral and tricuspid regurgitation

Restoration of sinus rhythm improves:

- cardiac output
- Exercise capacity
- Maximal oxygen consumption

Ventricular reverse remodelling in an 18-year-old patient with unrecognized atrial tachycardia-induced cardiomyopathy


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Classification
Classification of A Fib

First detected

**Paroxysmal**
(self-terminating)
Episodes that generally last less than or equal to 7 days; may be recurrent

**Persistent**
(not self-terminating)
Usually more than 7 days; may be recurrent

**Permanent**
(cardioversion failed or not attempted)

Diagnosis
Clinical Presentation

• **Symptoms**
  – None to severe
  (fatigue, palpitation, light-headedness, angina, dyspnea)

• **Thromboembolic events**
  – stroke (5% to nearly 20%)
  – 70,000 strokes in the US each year as a result of AF

• **Heart failure**
  – Tachycardia-induced CMP
  – Diastolic dysfunction + lose of Atrial kick

• **Mortality**
  – Two folds higher in patients with A fib
76 year old female

Atrial Fibrillation

F waves

Irregular Irregular Rhythm
Differential Diagnosis

1. Atrial flutter
   - Regularly irregular
   - P-waves: same morphology & intervals

2. Multifocal Atrial tachycardia
   - Irregularly irregular
   - P-wave before each QRS with ≥3 morphologies
   - HR ≥100 bpm

3. Wondering Atrial rhythm
   - Irregularly irregular
   - P-wave before each QRS with ≥3 morphologies
   - HR <100 bpm

4. Sinus rhythm with multiple PACs

5. Artifact
Atrial Flutter
Multifocal Atrial tachycardia
Premature Atrial Captures
Management
Upstream Therapy

• The following can reduce the incidence and recurrence rates of AF in patients with heart failure (class IIa):
  – ACE-I
  – Angiotensin receptor-1 blockers*
  – Beta-blockers**
  – Statin***

** CHARM trial. Am Heart J 2006;152:86-92
**** Young-Xu et al. Am J Cardiol 2003;92:1379-1383
I. Prevention of TE event

- Anti-platelet Therapy

- Anticoagulation
  (Warfarin/Heparin/New Novel drug)
Indication for Anti-Coag Rx

1. Thrombus

2. Mitral Valvular disease
   • Stenosis
   • Mechanical valve

3. Conversion
   electrical or pharmacological

4. Hypertrophic Cardiomyopathy

5. High risk:
   CHA$_2$DS$_2$-VASc score $\geq$2
**CHA_{2}DS_{2}-VASC Score**

- Congestive heart failure (1)
- Hypertension (1)
- Age $\geq 75$ years (2)
- Diabetes (1)
- Stroke or TIA history (2)
- Vascular disease (1)
  - (prior MI, PVD, aortic plaque)
- Age 65-75 years (1)
- Sex Category (female) (1)

Anticoagulate if $\geq 2$ and NO contraindication

Lip et al. CHEST 2010(Feb); 137(2):263-272
Therapeutic Range

Ischemic Stroke

<table>
<thead>
<tr>
<th>INR</th>
<th>OR</th>
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<tbody>
<tr>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>1.5</td>
<td>3.3</td>
</tr>
<tr>
<td>1.3</td>
<td>6.0</td>
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## New Oral Anticoagulants

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dabigatran (Pradaxa)</th>
<th>Rivaroxaban (Xarelto)</th>
<th>Apixaban (Eliquis)</th>
<th>Edoxaban (Savaysa)</th>
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<tbody>
<tr>
<td><strong>Target</strong></td>
<td>Thrombin</td>
<td>FXa</td>
<td>FXa</td>
<td>FXa</td>
</tr>
<tr>
<td><strong>Dosing</strong></td>
<td>CrCl &gt; 30: 150</td>
<td>CrCl &gt; 50: 20</td>
<td>5, 2.5 (Age &gt; 80, wt &lt; 60, Creat &gt; 1.5)</td>
<td>CrCl &gt; 50: 60</td>
</tr>
<tr>
<td></td>
<td>CrCl 15-30: 75</td>
<td>CrCl 15-50: 15</td>
<td></td>
<td>CrCl 15-50: 30</td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td>BID</td>
<td>QD</td>
<td>BID</td>
<td>QD</td>
</tr>
<tr>
<td><strong>Reversibility</strong></td>
<td>None (dialysis)</td>
<td>None Prothrombine</td>
<td>None Prothrombine</td>
<td>None Prothrombine</td>
</tr>
<tr>
<td><strong>T1/2</strong></td>
<td>12-17</td>
<td>9-12</td>
<td>8-15</td>
<td>8-11</td>
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TE Event Prevention

WATCHMAN

Thoracoscopic Clip of LAA


Courtesy of Marc Gillinov, M.D.
II. Rate vs. Rhythm control

Odds ratio for all-cause mortality

<table>
<thead>
<tr>
<th>Trial</th>
<th>Rate</th>
<th>Rhythm</th>
<th>0.1</th>
<th>1</th>
<th>10</th>
</tr>
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<tbody>
<tr>
<td>HOT CAFE⁸</td>
<td>1/101</td>
<td>3/104</td>
<td></td>
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<tr>
<td>PIAF⁴,¹³</td>
<td>2/125</td>
<td>2/127</td>
<td></td>
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<tr>
<td>RACE⁷</td>
<td>18/256</td>
<td>18/266</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>STAF⁶</td>
<td>8/100</td>
<td>4/100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFFIRM⁵,¹²</td>
<td>310/2027</td>
<td>356/2033</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>339/2609</td>
<td>383/2630</td>
<td></td>
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</tbody>
</table>

Percentage
- Rate: 13.0
- Rhythm: 14.6

OR, 0.87 (95% CI; 0.74 - 1.02), P=.09
AFFIRM Trial

Variable

- Age
  - <65 yr (n = 969)
  - ≥65 yr (n = 3091)
- Congestive heart failure
  - No (n = 3121)
  - Yes (n = 939)
- Overall (n = 4050)

Hazard Ratio
Rate vs. Rhythm

- AF-CHF trial (1376 with AF & CMP):
  - F/U 3 y
  - Randomized rhythm vs. rate
  - No improvement of mortality, hospitalization from CHF, or stroke

- Rate control:
  - At rest: 60-80
  - During moderate exertion: 90-115

Rate vs. Rhythm

- **Rate Control**
  - Elderly
  - Asymptomatic
  - LAE
  - Persistent/Chronic

- **Rhythm Control**
  - Young
  - Symptomatic
  - First episode/Lone
  - PAF
  - Reversible cause (hyperthyroidism, pneumonia, etc.)
  - LV dysfunction (MI, CHF)
  - Diastolic compliance
  - Hypotension
Rate vs. Rhythm

- Rate Control
  - B-blockers
  - Ca# blockers
  - Digoxin
  - Amiodarone
  - Pacemaker
  - AV junction RFA

- Rhythm Control
  - Cardioversion
  - Antiarrhythmics
    - Flecainide
    - Propafenone
    - Sotalol
    - Dofetilide
    - Ibutilide
    - Amiodarone
    - Dronedarone
  - AF Ablation
What to use for rhythm control?

Heart disease?

- No (or minimal)
  - Flecainide
  - Propafenone
  - Dronedarone
  - Sotalol
  - Amiodarone
  - Dofetilide

- Yes
  - Hypertension
    - NO
      - LVH ≥ 1.4 cm
        - NO
          - Amiodarone
        - YES
          - Dronedarone
            - Amiodarone
  - CAD
    - Sotalol
  - Heart failure or LVEF ≤ 35%
    - Amiodarone
    - Dofetilide

ABLATION
Anti-Arrhythmic in Heart Failure
Amiodarone, Dofetilide

- K channel blockers $\rightarrow$ action potential duration $\uparrow$ + refractory periods $\downarrow$

- Contraindication:
  - **Dofetilide**: Renal failure, $\uparrow$QT
  - **Amiodarone**: Hyperthyroid, Pulmonary fibrosis
Anti-Arrhythmic in Heart Failure
Amiodarone, Dofetilide

- **Side Effects:**
  - $\uparrow$QT $\rightarrow$ initiate inpatient for Dofetilide
  - **Amiodarone:**
    - Lungs
      - CXR/y, ?PFT/2y
    - Thyroid
    - Liver
      - LFT&TSH/3-6months
    - Skin
    - Nerves
    - Optic nerve
      - Eye exam/2y
AV Junction ablation with PPM

• Should only be used if other means of rate control fail*
• All outcomes improves except for total mortality**
• 29% chance of improvement of LVEF***
• PAVE study: AVJ RFA with CRT → improvement of 6 min walk & higher LVEF

* Neuberger et al. Eur Heart J 2007;28:2568-2577
** Wood et al. Circulation 2000;101:1138-1144
*** Ozcan et al. Am J Cardiol 2003;92:33-37
AVJ RFA with PPM vs. AF RFA

• 5 years heart failure is higher in the first group (53% vs. 24%), lower LVEF (44% vs. 51%), and higher NYHA class (1.7 vs. 1.4) *

• PABA-CHF trial:
  – AF RFA (PVI) superior to AVJ RFA with CRT in patients with CHF **

Hypertrophic Cardiomyopathy

• Anticoagulation indicated independent of the CHADS-VASC score (class I)
• AARx:
  – Amiodarone or Disopyramide + BB/CCB (class IIa)
  – Sotalol, Dofetilide, & Dronedarone (class IIb)
• RFA when refractory to AARx (class IIa)

January et al. J Am Coll Cardiol 2014;64(21):2246-2280
AF Ablation
Effect of AF ablation on LVEF in 50 patients with idiopathic cardiomyopathy.

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Where to ablate?
3D mapping
In Summary
AF in CHF

- AF and HF: a vicious pathophysiological cycle
- Anticoagulation is a must in high risk
  (CHA$_2$DS$_2$-VASC$\geq2$, HOCM, thrombus, MV)
- Rate control in asymptomatic elderly
- Rhythm control in young or symptomatic patients
- AARx is Palliative & associated with high risk of side effects (Amiodarone, Dofetilide)
- Catheter Ablation (Curative!)
Anti-arrhythmics for AF in CHF

- **Dofetilide:** Initiated in hospital for $\uparrow$QT, contraindicated in renal failure

- **Amiodarone:** side effects (lung, thyroid, liver, nerves, eyes, skin)

- **Contra-indication:** Flecainide, Propafenone, Dronedarone
THANK YOU...