Contemporary Strategies for Catheter Ablation of Atrial Fibrillation

Suneet Mittal, MD
Director, Electrophysiology
Medical Director, Snyder Center for Atrial Fibrillation
The Arrhythmia Institute at The Valley Hospital
Ridgewood, NJ; New York, NY

www.valleymedicalgroup.com
@drsumeet
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Disclosure: Consultant to Boston Scientific, Medtronic, and St. Jude Medical
**Epidemiology of AF**

- Most common sustained cardiac arrhythmia observed in clinical practice
- Prevalence of AF in the US (2010 estimates) ranges from ≈ 2.7 to 6.1 million
- Prevalence expected to increase to 12.1 million by 2050 (could be 15.9 million)
- Increased prevalence with increasing age
- Lifetime risk of developing AF: 1 in 4 for adults \( \geq 40 \) years of age

Aging World Population
2005-2025

By year 2030: >20% of the US population (~71.5 million) will be 65 years or older

Jahangir A et al.
J Appl Physiol 2007
103 (6): 2120-2128
The Shape of Things to Come

Hypertension  Diabetes  Sleep Apnea
Effect of Weight Reduction and Cardiometabolic Risk Factor Management on Symptom Burden and Severity in Patients With Atrial Fibrillation

A Randomized Clinical Trial

Figure 3. Changes in Atrial Fibrillation Symptom Scale (AFSS) Scores Over Study Follow-up

Error bars indicate 95% confidence intervals. A. Between-group level of significance: P = .41 at time 0, P = .12 at 3 months, P < .001 at 6, 9, 12, and 15 months. B. Between-group level of significance: P = .49 at time 0, P = .17 at 3 months, P < .001 at 6, 9, 12, and 15 months.
Stress Reduction
Rate vs. Rhythm Control

FAFIRM Trial

TABLE 2. Covariates Significantly Associated With Survival Results With Echocardiographic Data Included

<table>
<thead>
<tr>
<th>Covariate</th>
<th>P</th>
<th>HR</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at enrollment*</td>
<td>&lt;0.0001</td>
<td>1.06</td>
<td>1.05</td>
<td>1.08</td>
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<tr>
<td>Coronary artery disease</td>
<td>&lt;0.0001</td>
<td>1.56</td>
<td>1.20</td>
<td>2.04</td>
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<tr>
<td>Congestive heart failure</td>
<td>&lt;0.0001</td>
<td>1.57</td>
<td>1.18</td>
<td>2.09</td>
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<tr>
<td>Diabetes</td>
<td>&lt;0.0001</td>
<td>1.56</td>
<td>1.17</td>
<td>2.07</td>
</tr>
<tr>
<td>Stroke or transient ischemic attack</td>
<td>&lt;0.0001</td>
<td>1.70</td>
<td>1.24</td>
<td>2.33</td>
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<tr>
<td>Smoking</td>
<td>&lt;0.0001</td>
<td>1.78</td>
<td>1.25</td>
<td>2.53</td>
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<tr>
<td>Left ventricular dysfunction</td>
<td>0.0065</td>
<td>1.36</td>
<td>1.02</td>
<td>1.81</td>
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<tr>
<td>Mitral regurgitation</td>
<td>0.0043</td>
<td>1.36</td>
<td>1.03</td>
<td>1.80</td>
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<tr>
<td>Sinus rhythm</td>
<td>&lt;0.0001</td>
<td>0.53</td>
<td>0.39</td>
<td>0.72</td>
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<tr>
<td>Warfarin use</td>
<td>&lt;0.0001</td>
<td>0.50</td>
<td>0.37</td>
<td>0.69</td>
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<tr>
<td>Digoxin use</td>
<td>0.0007</td>
<td>1.42</td>
<td>1.09</td>
<td>1.86</td>
</tr>
<tr>
<td>Rhythm-control drug use</td>
<td>0.0005</td>
<td>1.49</td>
<td>1.11</td>
<td>2.01</td>
</tr>
</tbody>
</table>

*Per year of age.
Recommendations for Catheter Ablation

Recommendations

- AF catheter ablation is useful for symptomatic paroxysmal AF refractory or intolerant to at least 1 class I or III AAD when a rhythm-control strategy is desired

- AF catheter ablation is reasonable for some patients with symptomatic persistent AF refractory or intolerant to at least 1 class I or III AAD

- In patients with recurrent symptomatic paroxysmal AF, catheter ablation is a reasonable initial rhythm-control strategy before therapeutic trials of AAD therapy, after weighing the risks and outcomes of drugs and ablation

January CT et al. JACC 2014; 64: e1-76
Pulmonary Vein Isolation: Radiofrequency Ablation

Kuck KH et al. *NEJM* 2016
Pulmonary Vein Isolation: Cryoballoon Ablation

Kuck KH et al. NEJM 2016
Paroxysmal Atrial Fibrillation: Catheter Ablation vs AADs

- **AAD**
  - Either flecainide or propafenone in 71% of patients
  - Amiodarone use not permitted

- **Catheter ablation**
  - PVI was required in all patients
  - Additional lesions sets were at the discretion of the operator

Wilber DJ et al. JAMA 2010; 303: 333-340
Paroxysmal Atrial Fibrillation: Catheter Ablation vs AADs

STOP-AF Trial

Packer DL et al. JACC 2013; 61: 1713-1723
Pulmonary Vein Isolation: RF vs. Cryoballoon Ablation

Kuck KH et al. *NEJM* 2016
Why Do We Fail?

• Flawed definition of "failure"
Success or Failure

Clinical Trial Success

Isolated Recurrence

Frequent Recurrences

Recurrence
Why Do We Fail?

- Flawed definition of "failure"
- We do not ablate enough tissue
Hybrid Catheter Ablation
Why Do We Fail?

• Flawed definition of "failure"
• We do not ablate enough tissue
• We are not able to identify the particular “spot” within the diseased heart that provides the nidus for atrial fibrillation in a given patient
Endocardial Rotors

- 58 year old man with hypertension, diabetes mellitus, and obstructive sleep apnea
- 5 year history of AF
  - Initially PAF
  - Evolved into persistent
  - PAF on dofetilide
- LA 4.9 cm; EF 45%
- Presented in sinus rhythm; AF induced

Former LS PeAF, failed PVI
  Initial term at RA rotor
  Final term at this LA rotor (<5 min)
Epicardial Rotors

Sensor Array
Multi-electrode Vest

Patient Cable (x4)

252-channel Amplifier

Isolation Transformer

Monitor

PC

The Snyder Center for Comprehensive Atrial Fibrillation

Valley Health System

In affiliation with

Cleveland Clinic
Heart and Vascular Institute
Epicardial Rotors

Phase Map displays activation patterns as they progress through the heart

Composite Map

Driver Activity Detection
1. Focal detections (white dots)
2. Rotational area (orange areas)
Why Do We Fail?

- Flawed definition of “failure”
- We do not ablate enough tissue
- We are not able to identify the particular “spot” within the diseased heart that provides the nidus for atrial fibrillation in a given patient
- We are not able to identify disease tissue that provides the substrate for atrial fibrillation
Cardiac MRI

Marrouche NF et al. JAMA 2014 311; 498-506
Why Do We Fail?

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- We are not able to identify disease tissue that provides the substrate for atrial fibrillation
- We are looking in the wrong place
Left Atrial Appendage

**LAA Triggers**

Automaticity cells identified in the LAA that leads to AT

Guo et al. 
Heart Rhythm 
11:17–25, 2014

**Reentrant Circuits**

Heterogeneous fiber orientation and the presence of trabeculated muscle influence wave propagation and favor the formation of conduction block/slow conduction and initiation of reentry

**Thrombus**

In affiliation with

Cleveland Clinic 
Heart and Vascular Institute
The aMaze Trial

**Primary Effectiveness Endpoint**
Freedom from episodes of AF > 30 seconds with no requirement for new Class I or III AAD therapy at 12 months post PVI, as measured by 24-hr Holter or symptomatic event monitoring.

**Primary Safety Endpoint**
The incidence of significant LARIAT device or procedure-related SAEs occurring within 30 days after the LAA ligation procedure.

In affiliation with:
- Valley Health System
- Cleveland Clinic Heart and Vascular Institute
The Symplicity AF Trial
Why Do We Fail?

- Flawed definition of "failure"
- We do not ablate enough tissue
- We are not able to identify the particular "spot" within the diseased heart that provides the nidus for atrial fibrillation in a given patient
- We are not able to identify disease tissue that provides the substrate for atrial fibrillation
- We are looking in the wrong place
- We waited too long
Benefits of Earlier Ablation

Bunch TJ et al.
*Heart Rhythm* 2013
10: 1257-1262

Days After AF Diagnosis
- 30-180 (n= 1152)
- 181-545 (n=856)
- 546-1825 (n=1326)
- >1825 (n=1201)

Log rank $P=0.003$
A Patient Centered, Team Directed, Approach

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>An integrated approach with structured organization of care and follow-up should be considered in all patients with AF, aiming to improve guidelines adherence and to reduce hospitalizations and mortality.</td>
<td>IIA</td>
<td>B</td>
</tr>
<tr>
<td>Placing patients in a central role in decision-making should be considered in order to tailor management to patient preferences and improve adherence to long-term therapy.</td>
<td>IIA</td>
<td>C</td>
</tr>
</tbody>
</table>