Advances in Atrial Fibrillation Management and Electrophysiology

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@JDMossMD
## Disclosures

- **Medtronic**
  - Consulting (modest)
- **Abbott**
  - Consulting (modest)
- **Boston Scientific**
  - Consulting (modest)
- **Biosense Webster**
  - Consulting (modest)

These companies make devices I used commonly in practice, some of which will be discussed during this presentation.
Agenda

- Atrial fibrillation
  - What’s new in antiarrhythmic drug therapy for atrial fibrillation?
  - When and how should I anticoagulate my patient with atrial fibrillation?
  - Should I refer for catheter ablation for atrial fibrillation?

- Other advancements in electrophysiology in 2020
  - Non-invasive VT ablation
  - His-bundle and left-bundle pacing
  - Leadless pacemakers
Agenda

- Atrial fibrillation
  - What’s new in antiarrhythmic therapy for atrial fibrillation? *Not much, but*…
  - When and how should I anticoagulate my patient with atrial fibrillation?
  - Should I refer for catheter ablation for atrial fibrillation?

- Other advancements in electrophysiology in 2020
  - Non-invasive VT ablation
  - His-bundle and left-bundle pacing
  - Leadless pacemakers
...losing weight may be the most powerful antiarrhythmic of all!

Table 1. Baseline Demographics and Clinical Characteristics

<table>
<thead>
<tr>
<th>Baseline Characteristic</th>
<th>Catheter Ablation (n = 1108)</th>
<th>Drug Therapy (n = 1096)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index, median (Q1, Q3)c</td>
<td>30 (27, 34)</td>
<td>30 (26, 35)</td>
</tr>
</tbody>
</table>
Impressive effects of lifestyle modification and weight loss

- Of 1415 consecutive AF patients, 825 with BMI ≥ 27 were offered weight and risk factor management.
- Results were stratified by degree of weight loss.

![Graph showing change in AF type between groups](Figure 2: Change in AF type between groups. Pie graphs demonstrating baseline and follow-up of patients change in AF type. AF, atrial fibrillation; WL, weight loss.)
Impressive effects of lifestyle modification and weight loss

- Of 1415 consecutive AF patients, 825 with BMI $\geq$ 27 were offered weight and risk factor management.
- Results were stratified by degree of weight loss.

![Graph showing progression and reversal of AF types after weight loss](image)

**Figure 3** Atrial fibrillation disease progression and reversal. Bar charts showing change in AF type at following weight loss. With green representing Group 1, blue representing Group 2, and orange representing Group 3. AF, atrial fibrillation; WL, weight loss.
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- Other advancements in electrophysiology in 2020
  - Non-invasive VT ablation
  - His-bundle and left-bundle pacing
  - Leadless pacemakers
Thromboembolism and atrial fibrillation
Thromboembolism and *non-valvular* atrial fibrillation

<table>
<thead>
<tr>
<th>CHADS₂ score</th>
<th>OFF anticoagulation (per 100 patient-years)</th>
<th>ON anticoagulation (per 100 patient-years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.49</td>
<td>0.25</td>
</tr>
<tr>
<td>1</td>
<td>1.52</td>
<td>0.72</td>
</tr>
<tr>
<td>2</td>
<td>2.50</td>
<td>1.27</td>
</tr>
<tr>
<td>3</td>
<td>5.27</td>
<td>2.20</td>
</tr>
<tr>
<td>4</td>
<td>6.02</td>
<td>2.35</td>
</tr>
<tr>
<td>5-6</td>
<td>6.88</td>
<td>4.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHA₂DS₂-VASc score</th>
<th>Stroke rate (%/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>3</td>
<td>3.2</td>
</tr>
<tr>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td>5</td>
<td>6.7</td>
</tr>
<tr>
<td>6</td>
<td>9.8</td>
</tr>
<tr>
<td>7</td>
<td>9.6</td>
</tr>
<tr>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>9</td>
<td>15.2</td>
</tr>
</tbody>
</table>

Gage BF et al. *JAMA* 2001; 285: 2864
Go AS et al. *JAMA* 2003; 290: 2685
Lip GY et al. *Chest* 2010; 137: 263
Rhythm “control” did not improve stroke risk in AF

**Table 3. Adverse Events.**

<table>
<thead>
<tr>
<th>Event</th>
<th>Overall (N=4060)</th>
<th>Rate-Control Group (N=2027)</th>
<th>Rhythm-Control Group (N=2033)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of patients (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary end point (death)</td>
<td>666 (26.3)</td>
<td>310 (25.9)</td>
<td>356 (26.7)</td>
<td>0.08†</td>
</tr>
<tr>
<td>Secondary end point (composite of death, disabling stroke, disabling grade hemiparesis)</td>
<td>861 (32.8)</td>
<td>416 (32.7)</td>
<td>445 (32.0)</td>
<td>0.33</td>
</tr>
<tr>
<td>Central nervous system event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>211 (8.2)</td>
<td>105 (7.4)</td>
<td>106 (8.9)</td>
<td>0.93</td>
</tr>
<tr>
<td>Ischemic stroke§</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After discontinuation of warfarin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During warfarin but with INR &lt;2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent atrial fibrillation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary intracerebral hemorrhage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subdural or subarachnoid hemorrhage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Pvalues 72 hours after mitral valve replacement.

§Information on warfarin therapy was missing for two patients in the rate-control group and three patients in the rhythm-control group. Information on the presence of atrial fibrillation with the event was missing for 10 patients in the rate-control group and 13 patients in the rhythm-control group.
The association of stroke to AF burden is not straightforward

- **TRENDS study:**
  - 2486 patients with at least 1 stroke risk factor and a device indication had AT/AF burden closely monitored
  - 40 patients (1.6%) experienced a stroke or TIA (37), or systemic embolus (3) and had 30-days of data prior

<table>
<thead>
<tr>
<th>AT/AF Burden Subset</th>
<th>Annualized TE Rate (95% CI), %</th>
<th>Excluding TIA (95% CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero AT/AF burden</td>
<td>1.1 (0.8–1.6)</td>
<td>0.5 (0.3–0.9)</td>
</tr>
<tr>
<td>Low AT/AF burden (&lt;5.5 h)</td>
<td>1.1 (0.4–2.8)</td>
<td>1.1 (0.4–2.8)</td>
</tr>
<tr>
<td>High AT/AF burden (5.5 h)</td>
<td>2.4 (1.2–4.5)</td>
<td>1.8 (0.9–3.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Variable</th>
<th>Hazard Ratio (95% CI)*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT/AF burden</td>
<td>Low burden vs zero burden</td>
<td>0.98 (0.34, 2.82)</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>High burden vs zero burden</td>
<td>2.20 (0.96, 5.05)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Glotzer TV et al. *Circ Arrhythmia Electrophysiol* 2009
The association of stroke to AF burden is not straightforward

- Sub-study (40 pts): Temporal relationships analyzed

- 73% of patients had no AT/AF detected within 30 days prior to event!

- In the 20 patients with any AT/AF prior to event, 70% were not in AT/AF at time of event (last AT/AF: 3 – 642 days before)

Daoud EG et al. Heart Rhythm 2011
Though a strategy of arrhythmia-guided anticoagulation may still have merit...

Continuous versus tailored approach to OAC
- No strokes or TIAs
- Only 309 days average follow-up per patient...
- Control group eliminated due to lack of enrollment
“..adherence to AF anticoagulation guidelines is recommended for patients who have undergone an AF ablation procedure, regardless of the apparent success or failure of the procedure (Class I, LOE C-EO)”

1. Both symptomatic and asymptomatic AF can recur after AF ablation procedures
2. Late recurrence of AF is observed in 50% or more patients by 5 years
3. Absence of symptomatic AF after ablation does not necessarily indicate an absence of asymptomatic AF or a low risk of stroke

Unanswered Questions (in need of further study)

- “The CHA2DS2-VASc score was developed for patients with clinical AF. If a patient has received a successful ablation such that he/she no longer has clinical AF (subclinical, or no AF), then what is the need for ongoing OAC? Are there any patients in whom successful ablation could lead to discontinuation of OAC?”
Atrial fibrillation and stroke
Some take home points

- Stroke risk not yet been *proven* to be mitigated by rhythm control
- Stroke is not always temporally associated with arrhythmia episodes
- Guidelines for catheter ablation of AF recommend anticoagulation based on risk factors, not perceived procedural success
- 2019 updated AF management guidelines*:
  - NOACs (dabigatran, rivaroxaban, apixaban, edoxaban) are preferred to warfarin (unless moderate-to-severe MS or mechanical heart valve) — Class I, Level A
  - Apixaban recommended for CKD (CrCl < 15) or HD — Class IIb, Level B-NR
  - Implanted loop recorder reasonable for AF detection after cryptogenic stroke

Atrial fibrillation and stroke
A side note on NOACs and bleeding risk

Apixaban in Patients with Atrial Fibrillation

- 5599 patients in whom VKA “unsuitable”
  - INR couldn’t be maintained
  - CHADS2 only 1
  - Patient didn’t want to take
- Randomized to apixaban 5 BID or ASA 81-324

Connolly SJ et al. AVERROES Study. NEJM 2011
Atrial fibrillation and stroke
A side note on the Apple Heart Study

- >400,000 patients enrolled!
- 2,161 got notification of irregular rhythm
- 945 completed 1st telehealth visit
- 658 had patch sent
- 450 wore and returned patch for analysis
- 34% of patches yielded diagnosis of AF
- Simultaneous monitoring: 0.84 PPV of irregular tachogram for true AF
- Actual sensitivity for AF unknown
- 5% false positives – could be dangerous in a large population

NEW YORK POST
Apple Watch saved a grandma’s life by catching heart condition

By Lauren Steussy
November 23, 2019 | 11:36pm
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  - What’s new in antiarrhythmic drug therapy for atrial fibrillation?
  - When and how should I anticoagulate my patient with atrial fibrillation?
  - Should I refer for catheter ablation for atrial fibrillation?

- Other advancements in electrophysiology in 2020
  - Non-invasive VT ablation
  - His-bundle and left-bundle pacing
  - Leadless pacemakers
The 4 basic personality types

- The glass is half full!
- The glass is half empty.
- Half full... No! Wait! Half empty!... No, half... what was the question?
- Hey! I ordered a cheeseburger!
The 4 approaches to AF

Ablation cures all!

Ablation never works!

What’s atrial fibrillation?

Ablation is a powerful tool, the potential risks and benefits of which should be considered early in the management of many patients with AF.
Top myths about AF ablation

1. Why bother? *AFFIRM* proved rate control is just as good as rhythm control.
2. It doesn’t really work any better than drug therapy.
3. It’s too risky.
4. Patients with heart failure are contraindicated.
5. What’s the rush? There’s plenty of time to titrate rate-control medications and try multiple antiarrhythmic drugs.
6. If I refer my patient to EP, they will recommend ablation no matter what.
AFFIRM: rate control is just as good as rhythm control... right?

AFFIRM Investigators. *NEJM* 2002; 347(23): 1825-1833
AFFIRM: rhythm control did not improve overall mortality … BUT:

1. The mean age of patients was 70-years-old; more than 75% were older than 65

2. Rhythm control was “achieved” (poorly) with antiarrhythmic drugs – mostly amio (used in 63% at some time in the study) and sotalol, with ~20% on class Ic agents. Sinus rhythm was associated with improved survival in subanalysis.

3. >25% of rhythm-control patients crossed-over to rate control, mostly due to inability to maintain SR or drug intolerance

4. Patients and their physicians had to agree to be in the study – what would you do if you (or your patient) had frequent or severe symptoms from atrial fibrillation?

AFFIRM Investigators. NEJM 2002; 347(23): 1825-1833
Catheter ablation is superior to drug therapy for rhythm control

- 294 patients randomized to ablation or drug as 1st line therapy for PAF
- Increasing difference over time between ablation and drug groups

- 1108 randomized to ablation therapy; 102 (9.2%) crossed over to the drug therapy.
- 1096 randomized to drug therapy; 301 (27.5%) crossed over to ablation
And may have hard endpoint benefits for younger patients
Death, disabling stroke, serious bleeding, or cardiac arrest

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<th>Drug Therapy (n = 1096)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, median (Q1, Q3), y</td>
<td></td>
<td>68 (62, 72)</td>
<td>67 (62, 72)</td>
</tr>
<tr>
<td>&lt;65</td>
<td>375 (33.8)</td>
<td>391 (35.7)</td>
<td></td>
</tr>
<tr>
<td>65-&lt;75</td>
<td>577 (52.1)</td>
<td>553 (50.5)</td>
<td></td>
</tr>
<tr>
<td>≥75</td>
<td>156 (14.1)</td>
<td>152 (13.9)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of Events/Patients (Person-Years)</th>
<th>Hazard Ratio (95% CI)</th>
<th>Favors Catheter Ablation</th>
<th>Favors Drug Therapy</th>
<th>Interaction P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65</td>
<td>14/375 (1483)</td>
<td>0.52 (0.27-1.00)</td>
<td>-</td>
<td></td>
<td>.07</td>
</tr>
<tr>
<td>≥65 and &lt;75</td>
<td>50/577 (2159)</td>
<td>0.84 (0.57-1.23)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥75</td>
<td>25/156 (514)</td>
<td>1.46 (0.80-2.67)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risky? Systematic reviews & meta-analyses ca. 2009:

### Catheter ablation

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death overall</td>
<td>0.7%</td>
</tr>
<tr>
<td>Procedure-related death</td>
<td>0.0%</td>
</tr>
<tr>
<td>Hematoma</td>
<td>0.5%</td>
</tr>
<tr>
<td>Pseudoaneurysm</td>
<td>0.5%</td>
</tr>
<tr>
<td>Peri-procedure stroke</td>
<td>0.3%</td>
</tr>
<tr>
<td>Peri-procedure TIA</td>
<td>0.2%</td>
</tr>
<tr>
<td>Tamponade</td>
<td>0.8%</td>
</tr>
<tr>
<td>A-E fistula</td>
<td>0.0%</td>
</tr>
<tr>
<td>PV stenosis</td>
<td>1.6%</td>
</tr>
<tr>
<td>Need for pacemaker</td>
<td>0.1%</td>
</tr>
<tr>
<td><strong>Total with events</strong></td>
<td>4.9%</td>
</tr>
</tbody>
</table>

### Antiarrhythmic therapy

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death overall</td>
<td>2.8%</td>
</tr>
<tr>
<td>Sudden death</td>
<td>0.6%</td>
</tr>
<tr>
<td>Treatment-related death</td>
<td>0.5%</td>
</tr>
<tr>
<td>Adverse CV events</td>
<td>3.7%</td>
</tr>
<tr>
<td>Adverse GI events</td>
<td>6.5%</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>5.0%</td>
</tr>
<tr>
<td>Thyroid dysfunction</td>
<td>3.3%</td>
</tr>
<tr>
<td>Torsades</td>
<td>0.7%</td>
</tr>
<tr>
<td>QT prolongation</td>
<td>0.2%</td>
</tr>
<tr>
<td>Discontinuation due to AE</td>
<td>10.4%</td>
</tr>
<tr>
<td><strong>Total with events</strong></td>
<td>29.8%</td>
</tr>
</tbody>
</table>

### Ablation

<table>
<thead>
<tr>
<th>Event</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter Insertion</td>
<td>39 (3.9)</td>
</tr>
<tr>
<td>Hematoma</td>
<td>23 (2.3)</td>
</tr>
<tr>
<td>Pseudo aneurysm</td>
<td>11 (1.1)</td>
</tr>
<tr>
<td>Atrial venous fistula</td>
<td>4 (0.4)</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>DVT</td>
<td>0</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>0</td>
</tr>
<tr>
<td>Catheter Manipulation Within the Heart</td>
<td>34 (3.4)</td>
</tr>
<tr>
<td>Pericardial effusion not requiring intervention</td>
<td>22 (2.2)</td>
</tr>
<tr>
<td>Cardiac tamponade with perforation</td>
<td>8 (0.8)</td>
</tr>
<tr>
<td><strong>TIA</strong></td>
<td>3 (0.3)</td>
</tr>
<tr>
<td>Coronary occlusion</td>
<td>0</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Complete heart block</td>
<td>0</td>
</tr>
<tr>
<td>Valvular damage</td>
<td>0</td>
</tr>
<tr>
<td>Ablation-related Events</td>
<td>18 (1.8)</td>
</tr>
<tr>
<td>Severe pericardial chest pain</td>
<td>11 (1.1)</td>
</tr>
<tr>
<td>Esophageal ulcer</td>
<td>5 (0.5)</td>
</tr>
<tr>
<td><strong>Pulmonary Vein Stenosis &gt; 75%</strong></td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Phrenic nerve injury</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Atrial esophageal fistula</td>
<td>0</td>
</tr>
<tr>
<td>Medication-related Events</td>
<td>0</td>
</tr>
<tr>
<td>Heparin induced bleeding</td>
<td>0</td>
</tr>
</tbody>
</table>

### Drugs

<table>
<thead>
<tr>
<th>Event</th>
<th>Pts Receiving Drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyper- or hypothyroidism</td>
<td>17 (1.6)</td>
</tr>
<tr>
<td>Hypotension</td>
<td>3 (0.3)</td>
</tr>
<tr>
<td>Major proarrrhythmic event (VT, VF)</td>
<td>9 (0.8)</td>
</tr>
<tr>
<td>Torsades des pointes</td>
<td>0</td>
</tr>
<tr>
<td>Atrial proarrrhythmic event</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>0</td>
</tr>
<tr>
<td>Allergic reaction</td>
<td>7 (0.6)</td>
</tr>
<tr>
<td>Gastrointestinal abnormality</td>
<td>3 (0.3)</td>
</tr>
<tr>
<td>Moderate or severe diarrhea</td>
<td>0</td>
</tr>
<tr>
<td>Liver injury/failure</td>
<td>3 (0.3)</td>
</tr>
<tr>
<td>Pulmonary toxicity</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Blindness</td>
<td>0</td>
</tr>
<tr>
<td>Kidney damage</td>
<td>0</td>
</tr>
<tr>
<td>Renal failure</td>
<td>0</td>
</tr>
<tr>
<td>Severe headache</td>
<td>0</td>
</tr>
</tbody>
</table>

Packer DL et al. CABANA trial. *JAMA* 2019; 321: 1261-1274
Catheter ablation can have dramatic effects in heart failure and cardiomyopathy

**Arrhythmia/Electrophysiology**

**Ablation Versus Amiodarone for Treatment of Persistent Atrial Fibrillation in Patients With Congestive Heart Failure and an Implanted Device**

Results From the AATAC Multicenter Randomized Trial

Luigi Di Biase, MD, PhD; Prasant Mohanty, MBBS, MPH; Sanghamitra Mohanty, MD; Paquale Santangeli, MD; Chinmin Treveth, MD, MPH; Dhanunjaya Lakkireddy, MD; Madhu Reddy, MD; Pierre Jais, MD; Saba Themistocli, MD; Antonio Dello Russo, MD; Michela Cacilia, MD; Gemma Pelagomia, MD; Maria Lucia Narducci, MD; Robert Schwamment, MD; Petr Nenzi, MD; Javier Sanchez, MD; Rodney Honan, MD; Sawa Behniai, RN; Richard Hongo, MD; Steven Hoo, MD; Antonio Rosillo, MD; Giovanni Forfo, MD; Claudio Tondo, MD; J. David Burkhardt, MD; Michel Haissaguerre, MD; Andrea Natale, MD

- 203 patients with persistent AF, EF < 40% + ICD, and NYHA II-III randomized to ablation or amiodarone
- **1° endpoint:** recurrence of AF
- **2° endpoints:** mortality and hospitalization

<table>
<thead>
<tr>
<th>No Recurrence (n=91)</th>
<th>Recurrence (n=86)</th>
<th>P (Comparing Change Between Groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVEF, %</td>
<td>Baseline</td>
<td>Change (Median)</td>
</tr>
<tr>
<td>28.8±10</td>
<td>9.6±7.4 (9.4)</td>
<td>30.2±19</td>
</tr>
<tr>
<td>347±113</td>
<td>27±38 (24)</td>
<td>352±128</td>
</tr>
<tr>
<td>MLHFQ</td>
<td>53±24</td>
<td>−14±18 (−12)</td>
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</tbody>
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Catheter ablation can have dramatic effects in heart failure and cardiomyopathy

Catheter Ablation Versus Medical Rate Control in Atrial Fibrillation and Systolic Dysfunction

The CAMERA-MRI Study

- 68 patients with persistent AF, idiopathic CM, and EF ≤ 45%
- Rate control optimized, then CMRI, then randomized to ablation or continued rate control
- 1° endpoint: change in EF at 6 months

Prabhu S et al. CAMERA-MRI trial. JACC 2017
Catheter ablation can have dramatic effects in heart failure and cardiomyopathy

Prabhu S et al. CAMERA-MRI trial. JACC 2017

- 68 patients with persistent AF, idiopathic CM, and EF ≤ 45%
- Rate control optimized, then CMRI, then randomized to ablation or continued rate control
- 1st endpoint: change in EF at 6 months
Catheter ablation can have dramatic effects in heart failure and cardiomyopathy

- 363 patients with EF ≤ 35%, NYHA ≥ II, and symptomatic AF (paroxysmal or persistent)
- Randomized to ablation or medical tx (rate or rhythm control)

Marrouche NF et al. CASTLE-AF trial. NEJM 2018
Catheter ablation can have dramatic effects in heart failure and cardiomyopathy

- 363 patients with EF ≤ 35%, NYHA ≥ II, and symptomatic AF (paroxysmal or persistent)
- Randomized to ablation or medical tx (rate or rhythm control)
• Pulsed field ablation (PFA): non-thermal ablative modality
  • Ultrarapid high-voltage electrical fields applied to destabilize cell membranes
  • Irreversible nanoscale pores → leakage of contents → cell death
  • Tissue specific, based on susceptibility to different field strengths; cardiomyocytes very susceptible
• Improved lesion durability and reduced collateral tissue damage compared RF and cryo
But why not try a few drugs, or 2 (or 3, or 4) cardioversions first?

Increasing time between first diagnosis of atrial fibrillation and catheter ablation adversely affects long-term outcomes

T. Jared Bunch, MD, Heidi T. May, PhD, Tami L. Bair, RN, David L. Johnson, PAC, J. Peter Weiss, MD, Brian G. Crandall, MD, Jeffrey S. Osborn, MD, Jeffrey L. Anderson, MD, J. Brent Muhlestein, MD, Donald L. Lappe, MD, John D. Day, MD, FHRS

From the Intermountain Heart Institute, Intermountain Medical Center, Murray, Utah.

- 4535 patients
- 1 year and 3 year rates of AF recurrence increased with increasing time of diagnosis to ablation

Diagnosis to ablation: 30 to 180 days 181 to 545 days 546 to 1825 days >1825 days

Bunch TJ et al. HeartRhythm 2013; 10: 1257-1262
Top myths about AF ablation

1. **AFFIRM** proved rate control is just as good as rhythm control – not for symptomatic patients, and drugs (especially amiodarone) are not ideal!

2. It doesn’t really work any better than drug therapy – false; way better

3. It’s too risky – serious complications can occur, but they are rare

4. Patients with heart failure are contraindicated – actually, they stand to gain the most and are excellent candidates

5. What’s the rush? *Time is not on your side* – AF begets AF

6. An EP will recommend ablation no matter what – no, an EP is in the best position to help with shared decision making
What are the guidelines?

- **Class I:** The perfect patient – symptomatic, paroxysmal AF, failed 1 AAD treatment
- **Class IIa:** symptomatic, persistent AF, failed 1 AAD treatment
  - paroxysmal as 1st line therapy before AAD
- **Class IIb:** symptomatic, long-standing persistent AF, failed 1 AAD
  - persistent as 1st line therapy
  - HFpEF to lower mortality and reduce HF hospitalizations

Who is *not* a good candidate?

- Patient who cannot be treated with anticoagulant during and after procedure
- Patient in whom sole purpose of ablation is to avoid long-term anticoagulation
- Elderly patient with asymptomatic AF, reasonable HR control, normal LV function, and no amio
- Patient with unrealistic expectations of “cure” with 1 procedure

January CT et al. ACC AHA HRS Guidelines. JACC 2014
January CT et al. ACC AHA HRS Focused Updated. JACC 2019
Agenda

- Atrial fibrillation
  - What’s new in antiarrhythmic drug therapy for atrial fibrillation?
  - When and how should I anticoagulate my patient with atrial fibrillation?
  - Should I refer for catheter ablation for atrial fibrillation?

- Other advancements in electrophysiology in 2020
  - Non-invasive VT ablation
  - His-bundle and left-bundle pacing
  - Leadless pacemakers
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  - Leadless pacemakers
Non-invasive VT ablation – pilot

Noninvasive Cardiac Radiation for Ablation of Ventricular Tachycardia

Phillip S. Cuculich, M.D., Matthew R. Schill, M.D., Rojano Kashani, Ph.D., Sasa Mutic, Ph.D., Adam Lang, M.D., Daniel Cooper, M.D., Mitchell Faddis, M.D., Ph.D., Marye Gleva, M.D., Amit Noheria, M.B., B.S., Timothy W. Smith, M.D., D.Phil., Dennis Hallahan, M.D., Yoram Rudy, Ph.D., and Clifford G. Robinson, M.D.

- 5 patients with high-risk, refractory VT (6577 episodes and 55 ICD shocks in prior 3 mos; 0-4 prior ablations)
- 256-electrode ECG during NIPS + imaging used to identify target area
- Single SBRT treatment of 25Gy (11-18 min)
Non-invasive VT ablation – pilot

Noninvasive Cardiac Radiation for Ablation of Ventricular Tachycardia

Phillip S. Cuculich, M.D., Matthew R. Schill, M.D., Rojano Kashani, Ph.D., Sasa Matic, Ph.D., Adam Lang, M.D., Daniel Cooper, M.D., Mitchell Faddis, M.D., Ph.D., Marye Gleva, M.D., Amit Noheria, M.B., B.S., Timothy W. Smith, M.D., D.Phil., Dennis Hallahan, M.D., Yoram Rudy, Ph.D., and Clifford G. Robinson, M.D.

• 1 patient: fatal stroke 3 weeks post-treatment (severe CM, AF, contraindications to anticoag)
• 4 patients: 4 total episodes of VT total after 6-week blanking (99.9% reduction in burden), with 1 ICD shock
• Inflammatory changes in adjacent lung at 3 mos, nearly resolved by 12 mos
Non-invasive VT ablation – Phase I/II Trial

19 patients (17 for VT, 2 for PVC+)
- Median ablation time 15.3 minutes
- Serious adverse event in 2 patients: CHF hospitalization at 65d, pericarditis at 80d
- Frequency of VT episodes (or PVC burden) reduced in 94% of patients
- Dual AAD reduced from 59% to 12%

Robinson CG et al. ENCORE-VT trial. Circulation 2019
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Non-physiologic pacing

Normal conduction

RV-only pacing

RV lead
Non-physiologic pacing – potential consequences

- MOST, DAVID trials: risk of CHF, LV dysfunction with >40% RV-pacing
- Possible mechanisms of CHF: increased filling pressures, reduced CO, function MR, increased susceptibility to atrial arrhythmias

12 patients: dc-PM, normal EF, and intact AV node
- Serial gated blood pool studies:
  - After at least 1 week of A-pacing only (“baseline”)
  - After AV sequential pacing (2 hours, 1 week)
Non-physiologic pacing – potential consequences

Incidence of heart failure after pacemaker implantation: a nationwide Danish Registry-based follow-up study

Bhupendar Tayal 1,2,*, Patricia Fruelund 1, Peter Sogaard 1, Sam Riahi 1, Christoffer Polciwartek 1,2,*, Brett D. Atwood 3, Gunnar Gislason 4,5,6,7, Niels Riisum 8, Christian Torp-Pedersen 1,8, Lars Kober 9, and Kristian Hay Kragholt 1,8

- All patients without known CHF implanted with RV pacing lead between 2000-2014 (27704)
- Age and gender matched controls (but PM patients had more HTN, DM, CKD, COPD, AF, and prior MI)
- Outcome: incidence of CHF within first 2 years of PM implant
- Risk factors: male sex, CKD, and prior MI

Tayal B et al. Danish Registry follow-up. Eur Heart J 2019
Pseudo-physiologic pacing

Normal conduction

Biventricular pacing

AV node

RV lead

CS lead

His

LBB

RBB
Physiologic pacing

Normal conduction

His-bundle pacing
Physiologic pacing – 2 examples of “non-selective” His capture
Physiologic pacing – “selective”
Physiologic pacing

Clinical Outcomes of His Bundle Pacing Compared to Right Ventricular Pacing

- All patients requiring pacemaker implant from 2013-2016
- One hospital attempted HBP, one hospital implanted RVP
- HBP successful in 92% (304 of 332); RVP in 433 patients
- 1° outcome: death, CHF hospitalization, or upgrade to BiV

Primary Outcome
(Death, Heart Failure Hospitalization, or Upgrade to Biventricular Pacing)

Mohamed Abdelrahman, MD, A Faiz A. Subzposh, MD, A Dominik Beer, DO, A Brendan Durr, DO, A Angela Naperkowski, RN, CEP, CCD, A Haiyan Sun, MS, A Jess W. Oren, MD, A Gopi Dandamudi, MD, A Pagazhendhi Vijayaraman, MD

Abdelrahman M et al. JACC 2018
Physiologic pacing

On-treatment comparison between corrective His bundle pacing and biventricular pacing for cardiac resynchronization: A secondary analysis of the His-SYNC Pilot Trial

Gaurav A. Upadhyay, MD, FHRS,1 Pugazhendhi Vijayaraman, MD, FHRS,1 Hemal M. Nayak, MD, FHRS,1 Nishant Verma, MD, MPH,1 Gopi Dandamudi, MD, FHRS,1 Parikshit S. Sharma, MD, FHRS,1,2 Moeen Saleem, MD,1,2 John Mandrola, MD,1,2 Davide Genovese, MD,1,3 Jess W. Oren, MD,1,3 Faiz A. Subzposh, MD,1,3 Zaid Aziz, MD,1 Andrew Beaser, MD,1 Dalise Shatz, BA,1 Stephanie Besser, MSAS,1 Roberto M. Lang, MD,1 Richard G. Troughton, MD, FHRS,3 Bradley P. Knight, MD, FHRS,3 Rosierick Tung, MD, FHRS,3 on behalf of the His-SYNC Investigators

- **His-SYNC**: randomized BiV versus HBP in patients needing CRT. Similar outcomes, but confounded by high crossover rates
- **On-treatment analysis** showed trend towards better echo response

Upadhyay GA et al. His-SYNC secondary analysis. *Heart Rhythm* 2019
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Medtronic Micra

- Single-chamber ventricular pacing (VVIR)
  - Patients who need infrequent pacing (occasional AV block; severe cardioinhibitory VVS)
  - Patients with permanent AF (or at least a lot of AF)

- Minimizing (initial) hardware
  - Patients with high infection risk
  - Poor vascular access or prior pocket complications
  - Acute, short term pacing need

https://www.medtronic.com
Medtronic Micra AV

- Distinguishes phases of cardiac activity via accelerometer
  - A1: isovolumic contraction and AV valve closure
  - A2: aortic/pulmonic valve closure
  - A3: passive ventricular filling
  - A4: atrial contraction

- Rectified accelerometer signal with A2 blanking and programmable A4 threshold facilitates VDD pacing

Medtronic Micra AV

- 40 patients with sinus rhythm and AV block
- AV synchrony >70% of the time in 38 patients (95%) when VDD mode enabled
- No pauses or oversensing-induced tachycardia in 75 implanted patients
- FDA approved January 2020
Take home points

- Step 1 for treatment of AF – weight loss and lifestyle modification!
- Be aggressive about stroke prevention with NOACs – and beware asymptomatic episodes
- Catheter ablation for AF is not perfect, and not curative – but it is safe, very effective for many (especially early), and evolving
- Don’t wait for ICD shocks to refer for VT ablation – mapping and ablation technology continue to improve rapidly
- Inquire about appropriateness of His-bundle (or left bundle) pacing for patients with AV block
- Micra AV is another excellent pacing tool in the right patient, minimizing hardware without sacrificing AV synchrony