Updates on Atrial Fibrillation Management and Ablation

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Disclosures

• Research Support: Medtronic, Abbott, Biosense Webster, Boston Scientific

• Teaching Faculty: Medtronic, Abbott, Boston Scientific

• Consultant: Medtronic, Abbott, Biosense Webster
• Brief overview of impact

• Updates on Stroke Prevention
  • Anticoagulant updates
  • LAA Occlusion

• AF ablation indication updates

• New AF ablation strategies and modalities
Projected Number of Adults With Atrial Fibrillation in the United States Between 1995 and 2050

Atrial fibrillation increases mortality in men and women

Among 5209 subjects in the Framingham Heart Study, the mortality after a 10 year follow-up was higher in both men and women, aged 55 to 74, who had atrial fibrillation (AF) compared to those without AF (p<0.001). A similar relationship was seen in subjects between the ages of 75 and 94 (not shown).

• Affects > 20 million patients worldwide
  – 1.2 million new cases are diagnosed annually
• Increases your risk for stroke
  – 800,000 cases annually worldwide and 80,000 cases in the U.S. alone
• Can lead to congestive heart failure
• Linked to premature dementia
• Decreases overall quality of life and increases chance of death
AF Stroke Prevention Updates: Anticoagulation

- We remain guided by the CHADS2-VASc score:

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Score</th>
<th>CHADS2-VASc score and Annual stroke risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
<td>Score 1 = 1.3</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
<td>2 = 2.2</td>
</tr>
<tr>
<td>Age &gt; 75 years</td>
<td>2</td>
<td>3 = 3.2</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
<td>4 = 4</td>
</tr>
<tr>
<td>Stroke/TIA/systemic embolism</td>
<td>2</td>
<td>5 = 6.7</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>1</td>
<td>6 = 9.8</td>
</tr>
<tr>
<td>Age 65 to 74 years</td>
<td>1</td>
<td>7 = 9.6</td>
</tr>
<tr>
<td>Sex (female)</td>
<td>1</td>
<td>8 = 6.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 = 15.2</td>
</tr>
</tbody>
</table>
AF Stroke Prevention Updates: Anticoagulation

- *However…*
  - Aspirin is being seen as less of an option for low CHADS2VASc Scores
  - No longer appears on European guidelines
  - Likely confers little to no stroke prevention benefit in AF
    - SPAF is out-dated
AF Stroke Prevention Updates: Anticoagulation

NOACs are now the preferred agent, over coumadin

Section 4.1.1 - Selection of Antithrombotic Regimen

NOACs are recommended over warfarin where eligible except in those patients with moderate - severe mitral stenosis or a mechanical heart valve.
AF Stroke Prevention Updates: Anticoagulation

<table>
<thead>
<tr>
<th>Study name</th>
<th>Risk ratio</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARISTOTLE</td>
<td>0.74</td>
<td>0.47</td>
<td>1.16</td>
<td>-1.32</td>
<td>0.187</td>
</tr>
<tr>
<td>ROCKET AF</td>
<td>0.82</td>
<td>0.62</td>
<td>1.07</td>
<td>-1.49</td>
<td>0.136</td>
</tr>
<tr>
<td>RE-LY</td>
<td>0.63</td>
<td>0.36</td>
<td>1.09</td>
<td>-1.66</td>
<td>0.097</td>
</tr>
<tr>
<td>ENGAGE AF-TIMI 48</td>
<td>0.93</td>
<td>0.60</td>
<td>1.47</td>
<td>-0.30</td>
<td>0.767</td>
</tr>
<tr>
<td></td>
<td>0.80</td>
<td>0.66</td>
<td>0.96</td>
<td>-2.34</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Risk ratio and 95% CI

- Favours NOAC
- Favours Warfarin
AF Stroke Prevention Updates: LAAO

- Left Atrial Appendage Occlusion has become mainstream
- Watchman Device is currently the only FDA approved LAAO
The WATCHMAN Device is indicated to reduce the risk of thromboembolism from the left atrial appendage in patients with non-valvular atrial fibrillation who:

- Are at increased risk for stroke and systemic embolism based on CHADS$_2$ or CHA$_2$DS$_2$-VASc scores and are recommended for anticoagulation therapy;

- Are deemed by their physicians to be suitable for warfarin; and

- Have an appropriate rationale to seek a non-pharmacologic alternative to warfarin, taking into account the safety and effectiveness of the device compared to warfarin.
## AF Stroke Prevention Updates: LAAO

<table>
<thead>
<tr>
<th>Key Trials</th>
<th>N</th>
<th>Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROTECT AF&lt;sup&gt;1&lt;/sup&gt; (2005-2008)</td>
<td>707</td>
<td>Prospective, randomized 2:1, non-inferiority trial of LAA closure vs. warfarin.</td>
</tr>
<tr>
<td>CAP&lt;sup&gt;2&lt;/sup&gt; (2008-2010)</td>
<td>566</td>
<td>Prospective registry allowing continued access to the WATCHMAN Device and gain further information prior to PMA approval.</td>
</tr>
<tr>
<td>PREVAIL&lt;sup&gt;3&lt;/sup&gt; (2010-2012)</td>
<td>407</td>
<td>Prospective, randomized 2:1, non-inferiority trial to collect additional information on the WATCHMAN Device.</td>
</tr>
<tr>
<td>CAP2 (2012-2014)</td>
<td>579</td>
<td>Prospective registry allowing continued access to the WATCHMAN Device prior to PMA approval.</td>
</tr>
<tr>
<td>EWOLUTION (2013-2015)&lt;sup&gt;4*&lt;/sup&gt;</td>
<td>1025</td>
<td>Prospective registry allowing all patients receiving a WATCHMAN Device at participating centers in Europe, Middle East and Russia</td>
</tr>
</tbody>
</table>

**Total patients**  >3,000  ~9,000 Patient-Years of Follow-up
PROTECT AF, PREVAIL 5 Year data

<table>
<thead>
<tr>
<th>Event</th>
<th>HR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy</td>
<td>0.82</td>
<td>0.3</td>
</tr>
<tr>
<td>All stroke or SE</td>
<td>0.96</td>
<td>0.9</td>
</tr>
<tr>
<td>Ischemic stroke or SE</td>
<td>1.7</td>
<td>0.08</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>0.2</td>
<td>0.0022</td>
</tr>
<tr>
<td>Ischemic stroke or SE &gt;7 days</td>
<td>1.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Disabling/Fatal Stroke (MRS change of ≥2)</td>
<td>0.45</td>
<td>0.03</td>
</tr>
<tr>
<td>Non-Disabling Stroke</td>
<td>1.38</td>
<td>0.35</td>
</tr>
<tr>
<td>CV/unexplained death</td>
<td>0.59</td>
<td>0.03</td>
</tr>
<tr>
<td>All-cause death</td>
<td>0.73</td>
<td>0.04</td>
</tr>
<tr>
<td>Major bleed, all</td>
<td>0.91</td>
<td>0.6</td>
</tr>
<tr>
<td>Major bleeding, non procedure-related</td>
<td>0.48</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

## Watchman: Safety Profile

<table>
<thead>
<tr>
<th>Event</th>
<th>PROTECT-AF</th>
<th>PREVAIL</th>
<th>CAP</th>
<th>CAP2</th>
<th>EVOLUTION</th>
<th>Post-FDA Approval</th>
<th>Aggregate Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pericardial Tamponade</strong></td>
<td>20 (4.3%)</td>
<td>5 (1.9%)</td>
<td>8 (1.4%)</td>
<td>11 (1.9%)</td>
<td>3 (0.29%)</td>
<td>39 (1.02%)</td>
<td>86 (1.28%)</td>
</tr>
<tr>
<td>Treated with pericardiocentesis</td>
<td>13 (2.8%)</td>
<td>4 (1.5%)</td>
<td>7 (1.2%)</td>
<td>n/a</td>
<td>2 (0.20%)</td>
<td>24 (0.63%)</td>
<td></td>
</tr>
<tr>
<td>Treated surgically</td>
<td>7 (1.5%)</td>
<td>1 (0.4%)</td>
<td>1 (0.2%)</td>
<td>n/a</td>
<td>1 (0.10%)</td>
<td>12 (0.31%)</td>
<td></td>
</tr>
<tr>
<td>Resulted in death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3 (0.78%)</td>
<td></td>
</tr>
<tr>
<td>Pericardial effusion – no intervention</td>
<td>4 (0.9%)</td>
<td>0</td>
<td>5 (0.9%)</td>
<td>3 (0.5%)</td>
<td>4 (0.39%)</td>
<td>11 (0.29%)</td>
<td>27 (0.40%)</td>
</tr>
<tr>
<td><strong>Procedure-related stroke</strong></td>
<td>5 (1.15%)</td>
<td>1 (0.37%)</td>
<td>0</td>
<td>2 (0.35%)</td>
<td>1 (0.10%)</td>
<td>3 (0.078%)</td>
<td>12 (0.18%)</td>
</tr>
<tr>
<td><strong>Device embolization</strong></td>
<td>3 (0.6%)</td>
<td>2 (0.7%)</td>
<td>1 (0.2%)</td>
<td>0</td>
<td>2 (0.20%)</td>
<td>9 (0.24%)</td>
<td>17 (0.25%)</td>
</tr>
<tr>
<td>Removed percutaneously</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Removed surgically</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Death</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure-related mortality</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (0.1%)</td>
<td>3 (0.078%)</td>
<td>4 (0.06%)</td>
</tr>
<tr>
<td>Additional mortality within 7 days</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (0.17%)</td>
<td>3 (0.29%)</td>
<td>1 (0.026%)</td>
<td>5 (0.07%)</td>
</tr>
</tbody>
</table>
Indications for AF Ablation

• Traditionally:
  • Symptomatic AF refractory or intolerant to at least one antiarrhythmic medication
Indications for Catheter AF Ablation — New

• In some clinical situations, it may be appropriate to perform AF ablation as first line therapy:
  • CASTLE-HF trial
    • Patients with atrial fibrillation (AF) and symptomatic (NYHA II-IV) systolic heart failure (LVEF ≤ 35%)
    • 16.1% absolute reduction in HF hospitalization or death
  • Several trials are ongoing to determine using ablation as first line as a routine prior to failure of AAD (eg: STOP AF: First)
Indications for Catheter AF Ablation — CASTLE-HF

• Inclusions:
  • Symptomatic paroxysmal or persistent AF
  • Failure or intolerance to ≥ 1 or unwillingness to take AAD
  • LVEF ≤ 35%
  • NYHA class ≥ II
Indications for Catheter AF Ablation — CASTLE-HF
# Indications for Catheter AF Ablation — CASTLE-HF

## Table 2. Primary and Secondary Clinical End Points.*

<table>
<thead>
<tr>
<th>End Point</th>
<th>Ablation (N=179)</th>
<th>Medical Therapy (N=184)</th>
<th>Hazard Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number (percent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Primary†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary death</td>
<td>51 (28.5)</td>
<td>82 (44.6)</td>
<td>0.62 (0.43–0.87)</td>
<td>0.007</td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death from any cause</td>
<td>24 (13.4)</td>
<td>46 (25.0)</td>
<td>0.53 (0.32–0.86)</td>
<td>0.01</td>
</tr>
<tr>
<td>Heart-failure hospitalization</td>
<td>37 (20.7)</td>
<td>66 (35.9)</td>
<td>0.56 (0.37–0.83)</td>
<td>0.004</td>
</tr>
<tr>
<td>Cardiovascular death</td>
<td>20 (11.2)</td>
<td>41 (22.3)</td>
<td>0.49 (0.29–0.84)</td>
<td>0.009</td>
</tr>
<tr>
<td>Cardiovascular hospitalization</td>
<td>64 (35.8)</td>
<td>89 (48.4)</td>
<td>0.72 (0.52–0.99)</td>
<td>0.04</td>
</tr>
<tr>
<td>Hospitalization for any cause</td>
<td>114 (63.7)</td>
<td>122 (66.3)</td>
<td>0.99 (0.77–1.28)</td>
<td>0.96</td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td>5 (2.8)</td>
<td>11 (6.0)</td>
<td>0.46 (0.16–1.33)</td>
<td>0.15</td>
</tr>
</tbody>
</table>

* All numbers and percentages represent the total numbers of events and raw event rates after a median follow-up of 37.8 months. Deaths and cerebrovascular accidents were evaluated at baseline and 12 weeks after baseline for hospitalizations in the two groups (the “blanking period”). For Kaplan–Meier estimates at 12, 36, and 60 months, see Table S6 in the Supplementary Appendix.
† The primary end point is a composite of death from any cause or hospitalization for worsening heart failure.
AF Ablation: Technique

- Ablation strategies which target Pulmonary veins and PV antrum are the cornerstone for most AF ablation procedures
Adapted from Beldner S et al. Minerva Cardioangiol 2004; 52:95
New Ablation strategies: Modalities
So Many Options!
Substrate-Guided Ablation

- Target key atrial regions responsible for perpetuating AF rather than targeting the triggers
  - Targeting CFAE during AF
    - “pivot” points, “rotor” points
    - Fractionated electrograms composed of 2 deflections or more and continuous deflection of baseline
    - Atrial EGMs with very short CL <120 msec

Nademane et al, JACC 43(11), 2004
New AF ablation strategies: Posterior wall isolation

- May be the location of:
  - Non-PV triggers
  - Ganglionic plexi locations
  - Rotors
New AF ablation strategies: Posterior wall isolation

- Posterior wall isolation may be the location of:
  - Non-PV triggers
  - Ganglionic plexi locations
  - Rotors

### a) Atrial Fibrillation Recurrence

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>PVI + PWI Events</th>
<th>PVI Events Total</th>
<th>PWI Events Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aryana et al.</td>
<td>44</td>
<td>222</td>
<td>68</td>
<td>116</td>
<td>0.49 [0.36, 0.68]</td>
<td>0.49 [0.36, 0.68]</td>
</tr>
<tr>
<td>Bai et al.</td>
<td>6</td>
<td>32</td>
<td>15</td>
<td>20</td>
<td>0.25 [0.12, 0.54]</td>
<td>0.25 [0.12, 0.54]</td>
</tr>
<tr>
<td>Kim et al.</td>
<td>10</td>
<td>60</td>
<td>22</td>
<td>60</td>
<td>0.45 [0.24, 0.88]</td>
<td>0.45 [0.24, 0.88]</td>
</tr>
<tr>
<td>Lim et al.</td>
<td>29</td>
<td>110</td>
<td>43</td>
<td>110</td>
<td>0.67 [0.46, 1.00]</td>
<td>0.67 [0.46, 1.00]</td>
</tr>
<tr>
<td>Tamburero et al.</td>
<td>23</td>
<td>60</td>
<td>24</td>
<td>60</td>
<td>0.96 [0.61, 1.50]</td>
<td>0.96 [0.61, 1.50]</td>
</tr>
<tr>
<td>Thomas et al.</td>
<td>3</td>
<td>41</td>
<td>7</td>
<td>41</td>
<td>0.43 [0.12, 1.54]</td>
<td>0.43 [0.12, 1.54]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>525</td>
<td>460</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td>115</td>
<td>179</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $Tau^2 = 0.09; Chi^2 = 11.87, df = 5 (P = 0.04); I^2 = 58%$
Test for overall effect: $Z = 3.50 (P = 0.0005)$

### b) Atrial Flutter/Atrial Tachycardia Onset

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>PVI + PWI Events</th>
<th>PVI Events Total</th>
<th>PWI Events Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aryana et al.</td>
<td>18</td>
<td>222</td>
<td>24</td>
<td>169</td>
<td>0.57 [0.32, 1.02]</td>
<td>0.57 [0.32, 1.02]</td>
</tr>
<tr>
<td>Bai et al.</td>
<td>19</td>
<td>32</td>
<td>20</td>
<td>20</td>
<td>1.98 [0.96, 4.10]</td>
<td>1.98 [0.96, 4.10]</td>
</tr>
<tr>
<td>Lim et al.</td>
<td>38</td>
<td>110</td>
<td>40</td>
<td>110</td>
<td>0.95 [0.66, 1.36]</td>
<td>0.95 [0.66, 1.36]</td>
</tr>
<tr>
<td>Tamburero et al.</td>
<td>4</td>
<td>60</td>
<td>3</td>
<td>60</td>
<td>1.33 [0.31, 5.70]</td>
<td>1.33 [0.31, 5.70]</td>
</tr>
<tr>
<td>Thomas et al.</td>
<td>2</td>
<td>41</td>
<td>0</td>
<td>41</td>
<td>5.00 [0.25, 101.04]</td>
<td>5.00 [0.25, 101.04]</td>
</tr>
<tr>
<td>Yokokawa et al.</td>
<td>8</td>
<td>77</td>
<td>13</td>
<td>90</td>
<td>0.72 [0.31, 1.64]</td>
<td>0.72 [0.31, 1.64]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>542</td>
<td>490</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td>89</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $Tau^2 = 0.10; Chi^2 = 8.71, df = 5 (P = 0.12); I^2 = 43%$
Test for overall effect: $Z = 0.13 (P = 0.90)$

### c) All Atrial Arrhythmia Recurrence

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>PVI + PWI Events</th>
<th>PVI Events Total</th>
<th>PWI Events Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aryana et al.</td>
<td>67</td>
<td>222</td>
<td>91</td>
<td>169</td>
<td>0.56 [0.44, 0.72]</td>
<td>0.56 [0.44, 0.72]</td>
</tr>
<tr>
<td>Bai et al.</td>
<td>23</td>
<td>32</td>
<td>18</td>
<td>20</td>
<td>0.80 [0.61, 1.04]</td>
<td>0.80 [0.61, 1.04]</td>
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<tr>
<td>Kim et al.</td>
<td>10</td>
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<td>22</td>
<td>60</td>
<td>0.45 [0.24, 0.88]</td>
<td>0.45 [0.24, 0.88]</td>
</tr>
<tr>
<td>Lim et al.</td>
<td>53</td>
<td>110</td>
<td>57</td>
<td>110</td>
<td>0.93 [0.71, 1.21]</td>
<td>0.93 [0.71, 1.21]</td>
</tr>
<tr>
<td>Tamburero et al.</td>
<td>27</td>
<td>60</td>
<td>27</td>
<td>60</td>
<td>1.00 [0.67, 1.49]</td>
<td>1.00 [0.67, 1.49]</td>
</tr>
<tr>
<td>Thomas et al.</td>
<td>3</td>
<td>41</td>
<td>7</td>
<td>41</td>
<td>0.71 [0.25, 2.07]</td>
<td>0.71 [0.25, 2.07]</td>
</tr>
<tr>
<td>Yokokawa et al.</td>
<td>32</td>
<td>77</td>
<td>39</td>
<td>90</td>
<td>0.96 [0.67, 1.37]</td>
<td>0.96 [0.67, 1.37]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>602</td>
<td>550</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td>217</td>
<td>261</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $Tau^2 = 0.04; Chi^2 = 14.40, df = 6 (P = 0.03); I^2 = 58%$
Test for overall effect: $Z = 2.33 (P = 0.02)$
New AF ablation strategies: Posterior wall isolation

- Methods include
  - RF “box” formation (isolation of the PW from the rest of the atrium)
  - Cryoballoon application (direct ablation of the PW)
  - Convergent ablation (direct ablation of the PW via hybrid CT surgical approach)
New AF ablation strategies: Posterior wall isolation

- Convergent:
New AF ablation strategies: Posterior wall isolation
Visually-Guided Ablation
Technique and Lab Management

- If focal trigger is identified outside a PV at the time of an AF ablation procedure, it should be targeted if possible
- If additional linear lesions are applied, line completeness should be demonstrated by mapping or pacing maneuvers
- Ablation of cavotricuspid isthmus is recommended in patients with a history of typical atrial flutter or inducible cavotricuspid isthmus dependent atrial flutter
Technique and Lab Management

• If patients with longstanding persistent AF are approached, ostial PV isolation alone may not be sufficient

• Heparin should be administered during AF ablation procedures to achieve and maintain an ACT of 300 to 400 sec

• Careful identification of PV ostia is mandatory to avoid ablation within the PVs
Substrate Modification
Substrate-Guided Ablation

73/121 (60%) patients had CFAEs clustered around pulmonary veins.

105/121 (87%) patients had CFAEs clustered around septum and roof, close to PVs.

Nademanee et al, JACC 2004
• How do we get to the left atrium?
Mapping and Guiding Catheters
For RF ablation of PV Ostium
ICE Imaging - Transseptal

No trigger detected - defaulting to 1 second capture(s)
ICE Imaging - Transseptal
Use of Intracardiac Echo (ICE) Imaging for AF Ablation

• Transseptal puncture
• Pre ablation anatomical orientation
• Confirmation of catheter positioning
• Assessment of lesion formation
• Detection of complications
3D Image Integration

LUPV
LUPV Registration
LLPV
LLPV Registration
RUPV Registration
RLPV Registration
Landmark Registration
Surface Registration
So why isn’t AF ablation more commonly performed?

- **Safety:**
  - PV Stenosis
  - Cardiac Tamponade
  - Thromboembolism
  - Atrial-Esophageal Fistula

- **Technical Considerations:**

- **Efficacy:**
  - Clinical Recurrences

PV stenosis

CT

TEE
Results - Symptoms

- Asymptomatic: 8/21 (38%)
- Dyspnea: 5/21 (24%)
- Cough: 7/21 (33%)
- Pleuritic pain: 9/21 (42%)
- Hemoptysis: 14/21 (67%)

Saad Ann Intern Med 2003
Results - Radiological Abnormalities

- Parenchymal consolidation: 50%
- Pleural effusion + consolidation: 43%
- Pleural effusion: 7%

Saad Ann Intern Med 2003
Results - Misdiagnoses

- Pneumonia: 11 cases
- Pulmonary Embolism: 6 cases
- Lung cancer: 4 cases
- Asthma: 3 cases

Saad Ann Intern Med 2003
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Clot post Brisk Microbubbles Visualization
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- **Technical Considerations:**

- **Efficacy:**
  - Clinical Recurrences
EGD Images during PVI

Baseline esophagus

External pressure from RF catheter
NAVX - Esophagus
There is No Relationship Between Power and Temperature within the Esophagus

Power (Watts)
Location of Temperature Probe within the Esophagus During PVI
Paroxysmal AF: Why does ablation fail?
Paroxysmal AF: Why does ablation fail?
Paroxysmal AF: Why does ablation fail?
What’s new?
Visually-Guided Ablation
Balloon Ablation Catheters

HiFU Balloon

CryoBalloon

Visually-Guided Laser

RF Balloon
Where is the level of isolation?

Baseline

Post-Cryoablation
Visually-Guided Antral Ablation
In Vivo Visualization of Ablation Gaps