Atrial Fibrillation – Interventional Cardiology Approach

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Disclosures

• No potential competing interests to declare

• Off-label uses
  – None

• Objectives:
  – Understand current approach to catheter ablation of atrial fibrillation, results, complications, and patient selection
Atrial fibrillation: Clinical significance

- Most common sustained arrhythmia
- Important cause of stroke
- Significant morbidity from symptoms
  - Palpitations, malaise, loss of exercise tolerance, reduced QOL
- Tachymyopathy may result in CHF
- Associated with increased mortality (1.2-2x)
- Many patients require rhythm control for symptoms
  - Antiarrhythmic drugs only 30-50% effective
Cox Maze Procedure

190 patients: 1987 - 1997
92% freedom from AF, off AA agents

“Catheter Maze” Linear Ablation Approach

- First reported 1994
- Several groups worked in this area
- Poor success rates
- High complication rates

Atrial fibrillation: Mechanisms

- Multiple wavelet hypothesis
- Atrial substrate
- Role of triggers
45 patients with paroxysmal AF
- PAF at least every other day
- >700 APBs/24 hr
- Mean LA size 39 mm
- Mean age 54 yo

Pulmonary venous anatomy

- Sleeves of atrial myocardium invest PVs (and CS and SVC)
- Border zones of myocardium and vein may be arrhythmogenic
- Role of PV in autonomic innervation and sites of reentry


JAMA 2007;298:2768
Atrial Fibrillation – Focal Ablation Strategy
Electrophysiologic Breakthroughs From the Left Atrium to the Pulmonary Veins
Michel Haissaguerre, Pierre Jais, Dipen Shah, et al
Segmental Ostial PV Isolation
Use of Electroanatomical Mapping: Wide-Area Circumferential Ablation (WACA)

Pappone C, et al., Circulation 100:1203, 1999
Catheter Ablation for AF Ablation: Hopkins Protocol

- Combination WACA and segmental ostial PVI
- Pre-procedural CT or MRI
- Pre-procedural TEE in some patients
  - Persistent AF, ? anticoag status, high CHADS$_2$
- General anesthesia
- Usually continue warfarin uninterrupted
- Esophagus marked with radio-opaque temperature probe
- Double transseptal sheaths placed
- Pulmonary vein angiography
Image Acquisition and Segmentation

CT or MRI
Image integration with CT or MRI
Left-Sided PV Isolation
Right-sided PV Isolation
Electrical Isolation of Pulmonary Veins

Marine JE, JAMA 2007; 298:2768
Assess for PV Isolation with circular mapping catheter

- Wide-area circumferential ablation
- Continue ablation until all PV’s isolated for 30-60 minutes

JAMA 2007;298:2768
Additional Targets in Selected Cases

- Connecting roof line and complex fractionated electrogram (CFAE) ablation in re-do cases and in patients with long-standing persistent AF
- SVC in some re-do paroxysmal patients
- Additional atrial triggering sites if observed or induced with isoproterenol
- Cavotricuspid isthmus if clinical or inducible typical atrial flutter
- Atypical flutters if inducible or occur spontaneously during ablation
Ablation for AF: Risks

- Femoral vascular injury (1-2%)
- Pulmonary vein stenosis (0.5-1%)
- Stroke (0.5-1%)
- Pericardial tamponade (1%)
- Right phrenic nerve injury (0.2%)
- LA-esophageal fistula (0.1%)
- Death (0.15%)
  - Usually from CVA or T-E fistula
- Total complications rate: 2-5 %

Cappato R, et al. Circ A+E 2010;3;32
Updated Worldwide Survey on the Methods, Efficacy, and Safety of Catheter Ablation for Human Atrial Fibrillation

<table>
<thead>
<tr>
<th>Major Complications in the Overall Population</th>
<th>(n = 16,309)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Complication</td>
<td>No. of Patients</td>
</tr>
<tr>
<td>Death</td>
<td>25</td>
</tr>
<tr>
<td>Tamponade</td>
<td>213</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>15</td>
</tr>
<tr>
<td>Hemothorax</td>
<td>4</td>
</tr>
<tr>
<td>Sepsis, abscesses, or endocarditis</td>
<td>2</td>
</tr>
<tr>
<td>Permanent diaphragmatic paralysis</td>
<td>28</td>
</tr>
<tr>
<td>Total femoral pseudoaneurysm</td>
<td>152</td>
</tr>
<tr>
<td>Total artero-venous fistulae</td>
<td>88</td>
</tr>
<tr>
<td>Valve damage/requiring surgery</td>
<td>11/7</td>
</tr>
<tr>
<td>Atrium-esophageal fistulae</td>
<td>6</td>
</tr>
<tr>
<td>Stroke</td>
<td>37</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>115</td>
</tr>
<tr>
<td>PV stenoses requiring intervention</td>
<td>48</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>741</strong></td>
</tr>
</tbody>
</table>
Complications arising from catheter ablation of atrial fibrillation: Temporal trends and predictors

Hana Hoyt, MD, Aditya Bhonsale, MD, Karuna Chilukuri, MD, Fawaz Alhumaid, MD, Matthew Needleman, MD, David Edwards, MD, Ashul Govil, MD, Saman Nazarian, MD, Alan Cheng, MD, FFRS, Charles A. Henrikson, MD, FFRS, Sunil Sinha, MD, Joseph E. Marine, MD, FFRS, Ronald Berger, MD, PhD, FFRS, Hugh Calkins, MD, FFRS, David D. Spragg, MD, FFRS

Heart Rhythm 2011; 8:1869

N=1135
No deaths
No T-E fistula with RF
Past 4 years: 1 CVA, no major PV stenosis
Efficacy of Anti-arrhythmic Drugs and Catheter Ablation in Patients with Atrial Fibrillation

Meta-analysis of 97 studies / 13,400 patients

**Antiarrhythmic Drug Therapy**

<table>
<thead>
<tr>
<th>Treatment success</th>
<th>Recurrent AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAD</td>
<td></td>
</tr>
<tr>
<td>46% (1,813)</td>
<td>18 (800)</td>
</tr>
</tbody>
</table>

**Catheter Ablation**

<table>
<thead>
<tr>
<th>Single Procedure Success Off AAD</th>
<th>Multiple Procedure Success Off AAD</th>
<th>Single Procedure Success on AAD or Uncertain</th>
<th>Multiple Procedure Success on AAD or Uncertain</th>
<th>Patients Requiring Repeat Ablation</th>
</tr>
</thead>
<tbody>
<tr>
<td>57% (31,280)</td>
<td>71% (34,348)</td>
<td>72% (52,4786)</td>
<td>77% (42,3562)</td>
<td>26% (50,4768)</td>
</tr>
</tbody>
</table>

Catheter Ablation of Atrial Fibrillation Meta-Analysis of Four Randomized Clinical Trials

Efficacy: \( \frac{162}{214} = 76\% \) (ABL) vs. \( \frac{41}{218} = 19\% \) (AAD)

167 patients with symptomatic paroxysmal AF despite treatment with ≥ 1 antiarrhythmic drug
- Ablation with open irrigated tip RF catheter
- QoL improved in ablation group

Wilber DJ, et al. JAMA 2010; 303:333
AF Ablation: Controversies

- Definition of “Success”
- Discontinuation of anticoagulation
- Best method of monitoring
- Patient selection
- Ablation technique for patients with longstanding persistent AF, large LA
- Newer technology
Case

Atrial Arrhythmia Trend: 49 days with > 4 hours AT/AF

- Patient with hypertension, diabetes, sinus node dysfunction, s/p pacemaker.
- One year of paroxysmal AF: Amiodarone ineffective
- Catheter ablation on June 22
Balloon Catheter Technology:
Cryoballoon
Other New Technology

- Robotic catheter technology
  - Stereotaxis
  - Hansen

- Force-sensing technology built into open-irrigated catheter

- Laser balloon
Catheter Ablation versus Antiarrhythmic Drug Therapy for Atrial Fibrillation Trial - CABANA Trial -

- Multicenter prospective randomized clinical trial
  - NIH-sponsored
  - 3000 patients randomized to AF ablation or to rate or rhythm control with drugs.
  - Three year enrollment, 2 year minimal follow-up.
    - Trial began 2010, results 2015-6
  - Primary endpoint is total mortality.
  - Secondary outcomes: Cardiac death, stroke, heart failure, freedom from recurrent AF, QoL
Catheter ablation for AF: Summary

- Reasonable (Class IIa) for symptomatic AF refractory to one or more antiarrhythmic drugs
- Electrical isolation of PVs is the most important component
- 60-80% success in control of AF symptoms
- 2-4% major complication rate
- Importance of good patient selection
  - Paroxysmal vs. persistent AF
  - Shorter duration of AF
  - Smaller LA
  - Younger age, fewer comorbidities
- Improved technology and techniques may further reduce procedure time and lower complications rates
Thank you