Atrial Fibrillation: Catheter Ablation
– Who? How? When? Results?

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Atrial Fibrillation

Classification and Ablation Outcome

Classify the patient based on the most frequent AF clinical pattern

- **Paroxysmal**
  - Duration: < 7 days
  - Cardioversion; spontaneous termination

- **Persistent**
  - Duration: > 7 days
  - Cardioversion: pharmacological or electrical
  (Early Persistent < 3 mos – better response to AF ablation)

- **Longstanding Persistent/Permanent**
  - More than 1 year
  - Cardioversion – failed to restore sinus rhythm

**Modifiable Risk Factors**
- Hypertension
- Diabetes
- Sleep apnea
- Obesity
- Alcohol use.
Class I - “Is Indicated”

1. AF catheter ablation is useful for symptomatic paroxysmal AF refractory or intolerant to at least 1 class I or III antiarrhythmics when a rhythm control strategy is desired. (Level of Evidence: A)

2. Prior to consideration of AF catheter ablation, assessment of the procedural risks and outcomes relevant to the individual patient is recommended. (Level of Evidence: C)

Class II A - “Is reasonable”

In patients with recurrent symptomatic paroxysmal AF, catheter ablation is a reasonable initial rhythm control strategy prior to therapeutic trials of antiarrhythmic drug therapy, after weighing risks and outcomes of drug and ablation therapy relevant to the individual patient. (Level of Evidence: B)
Paroxysmal AF - Pulmonary Vein Isolation
Multicenter Randomized Prospective Study
Failed Initial Drug Therapy (159pts)

All Recurrent AT/AF

Safety

- Ablation Group (6.8%, n=103)
  - 1 pericarditis
  - 1 pulmonary edema
  - 1 pericardial effusion (no tx needed)
  - 5 vascular complications
  - No Stroke/Embolism, Tamponade, Atrio-Esophageal fistula, PV stenosis, or Phrenic nerve paralysis

- AAD group (17.9%, n=56)
  - 3 life-threatening ventricular arrhythmias
  - 7 disabling symptoms requiring drug withdrawal

Wilber D et al, JAMA, 2010
FIRST LINE TREATMENT OF PAROXYSMAL AF (RAAFT 2 TRIAL)

- Time to Any AF/AFL/AT
  - 61 pts
- Time to Symptomatic AF/AFL/AT
  - 61 pts

- No deaths, No strokes
- 43% of patients with meds had recurrent AF and AF ablation at 1 yr versus only 9% of patients with ablation had AAA drugs added

Morillo C et al JAMA 2014;311(7):692-699
US National Inpatient Sample: 93,801 AF patients treated with catheter ablation 2000-2010; 20% hospitals sampled

- In hospital complications assessed by ICD 9 codes
- 81% of AF ablations done by low volume operators who perform < 25 /yr
- Acute complications, inversely related to operator/program volume

Different Tools for Pulmonary Veins Isolation

**FIRE AND ICE AF Clinical Trial**

- **15 Centers**
- **764 Patients**

**Paroxysmal AF Ablation**

- **Number at Risk**
  - RFC: 376, 350, 243, 191, 149, 118, 93, 58, 44, 25, 12

**Modified ITT analysis**
- HR [95% CI] = 0.96 [0.76-1.22]; p = 0.0004
- Non-inferiority hypothesis met

**FIRE - RF**

**ICE - Cryo**

# Key Treatment-Related Serious Adverse Events (“Fire and Ice”)

<table>
<thead>
<tr>
<th>Event (N, %)</th>
<th>RFC (n=376)</th>
<th>Cryoballoon (n=374)</th>
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</thead>
<tbody>
<tr>
<td>Groin Site Complication*</td>
<td>16 (4.3%)</td>
<td>7 (1.9%)</td>
</tr>
<tr>
<td>Atrial Flutter/Atrial Tachycardia**</td>
<td>10 (2.7%)</td>
<td>3 (0.8%)</td>
</tr>
<tr>
<td><strong>Phrenic Nerve Injury unresolved at discharge</strong></td>
<td>0 (0%)</td>
<td>10 (2.7%)***</td>
</tr>
<tr>
<td>Unresolved at 3 months</td>
<td>0 (0%)</td>
<td>2 (0.5%)</td>
</tr>
<tr>
<td>Unresolved at &gt; 12 months</td>
<td>0 (0%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>Cardiac Tamponade/Pericardial Effusion</td>
<td>5 (1.3%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>Stroke/TIA</td>
<td>2 (0.5%)</td>
<td>2 (0.5%)</td>
</tr>
<tr>
<td>Atrial Septal Defect</td>
<td>1 (0.3%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Esophageal Ulcer</td>
<td>0 (0%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>Pericarditis</td>
<td>0 (0%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>Atrioesophageal Fistula</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Pulmonary Vein Stenosis</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
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* Includes vascular pseudoaneurysm, AV fistula, device-related infection, hematoma, puncture site hemorrhage, groin pain

** Serious (e.g. hospitalization) and causally related to the therapeutic intervention (e.g. ablation-induced or drug-induced)

*** 8 resolved by 3 month visit, 1 resolved by 6 months visit, 1 unresolved after 12 month visit

Class IIa - “Is reasonable”
1) AF catheter ablation is reasonable for some patients with symptomatic persistent AF refractory or intolerant to at least 1 class I or III antiarrhythmic medication (157, 161–163). (Level of Evidence: A)

Class IIb - “May be Considered”
1) AF catheter ablation may be considered for symptomatic long-standing (>12 months) persistent AF refractory or intolerant to at least 1 class I or III antiarrhythmic medication when a rhythm-control strategy is desired (154, 167). (Level of Evidence: B)
2. AF catheter ablation may be considered before initiation of antiarrhythmic drug therapy with a class I or III antiarrhythmic medication for symptomatic persistent AF when a rhythm-control strategy is desired. (Level of Evidence: C)
Clinical Efficacy for **Longstanding Persistent AF (>1yr)**

Antral PV Isolation + Trigger RF Ablation

N=130 pts followed for >1 year

- Long term control in ~50% without AADs
- ~72% with AADs
- Repeat ablation required in 28%

Persistent AF/Recurrent Paroxysmal Catheter Ablation - Target Substrate?

Ganglionated Plexi - ? Make lines to divide LA
- ? Target fractionated Egs
- ? Isolate Post LA
- ? Isolate the SVC, CS, LAA
- ? Ganglionated Plexi ablation
- ? Target rotors

Which Patients?

PVI plus non PVI triggers
STAR AF II Results - Primary Outcome in Persistent AF (Verma et al)

Documented AF > 30 seconds after one procedure with or without AAD

No benefit of lines or fractionated electrogram ablation

48 experienced centers in 12 countries

1:4:4 ratio
Persistent AF/Recurrent Paroxysmal Catheter Ablation - Target Substrate?

Ganglionated Plexi

PVI plus non PVI triggers

Which Technique?
- ? Make lines
- ? Target fractionated Egs
- ? Isolate Post LA
- ? Isolate the SVC, CS, LAA
- ? Ganglionated Plexi ablation
- ? Target rotors

Which Patients?
Paroxysmal or Persistent AF

Why does ablation fail?

Reconnected PV
Reisolation can prevent AF (80-90%)!

Make PV Isolation More Permanent with First Ablation
- JET Ventilation
- Contact Force Sensing
- Sheaths for stability
Jet Ventilation and Sheaths to Improve Stability and Improve PVI Outcome

Fewer Recurrences

fewer reconnections

P <0.006

Hutchinson MD et al  Heart Rhythm 2013;10:347–353
Impact of Maintaining Good Catheter Tip Contact with Force-Sensing Catheter

Natale A et al J Am Coll Cardiol 2014;64:647–56)
Risk Factor Modification (RFM)

The ARREST-AF Cohort Study


Impact of RFM on AF Ablation Outcome

Aggressive Risk Factor Modification in AF Should be Standard

Adapted from Pathak R J .... Sanders P Am Coll Cardiol May 26 2015;65:2159-2169.

Risk Factors
- hypertension
- Diabetes (glycemic control)
- sleep apnea
- obesity
- excess alcohol use

Single Procedure

Multiple Procedure
Catheter Ablation Outcome

- Functional MR → Reversible Disease States due to AF?
- LV dysfunction → 54 y/o with increase in LA and severity of MR associated with long lived but self terminating AF over the last two years??

Is the worsening MR due to the AF?
**Functional Mitral Regurgitation Due to AF: Reversal with AF Ablation**

(Retrospective Cohort Study – 53 pts in each group)

Only 24% remained mod/severe

Post successful ablation
No/minimal MR ass with

54 y/o with increase in LA and severity of MR associated with long lived but self terminating AF over the last two years??

– **Effort to control AF may reverse the MR**

Case Presentation

• 66 y/o man with persistent AF (X 6mos) reasonable rate control (80-90 at rest)
• Exertion intolerance- shortness of breath, palpitations (Heart rate 110-120)
• Digoxin .125mg/day/Metoprolol succinate 75mg bid/Diltiazem CD 120 mg bid
• Echo – LVEF 38% //LA 4.7
• Failed two CV off/on sotalol

Is the low EF due to AF?
Observational Study – AF and Low LV EF (48 pts)

Atrial Fibrillation Ablation
Effect on LV Ejection Fraction

Improvement in All
Normalization in 94%

41%

(P < 0.001)

Frequent paroxysmal AF (34pts) or “apparent” rate control with persistent (14pts) AF

The CAMTAF Trial (Heart Failure and AF)
Randomized Control Trial – Catheter Ablation (26pts) vs Medical RCTx (24pts)

- EF
  - Persistent AF
    - EF < 50%
    - NYHA II - IV
  - 40±12%
  - 31±13%

- VO2

66 y/o man with persistent AF (X 6mos)
reasonable rate control (80-90 at rest)
EF 38%
with exertional dyspnea

Strong consideration for catheter ablation for improvement in symptoms + LV function!!

Catheter Ablation Outcome

- Functional MR
- LV dysfunction

Late recurrences
- 56 y/o male with symptomatic Persistent AF – 1-2 AF per month for 2 years – undergoes AF ablation. He experiences one AF episode 18mos later requiring CV – wants to know prognosis?

Reversible Disease States?
430 consecutive patients with AF recurrence after ablation + 3mo blanking period

At least 18 mos (mean 41 ± 19 mos) of additional follow-up

(First ablation 2004 - 2008)

Time of 1st Recurrence

245 pts Early

118 pts Late

76 pts Very Late
No or Rare* AF during Long Term Follow-up
Mean 41 ± 19 months

**P < 0.001

N = 245 pts
N = 118 pts
N = 76 pts

56 y/o male with symptomatic Persistent AF – 1 -2 episodes per month for 2 years undergoes AF ablation. He then experiences one AF episode at 18mos/CV – wants to know prognosis? – Likely rare episodes!
AF ablation - integral part of AF management in patients with paroxysmal and persistent AF – good outcome in most.

Pulmonary vein isolation and elimination of non PV triggers remain the cornerstone of the ablation procedure.
- What else to do to modify substrate in more persistent forms of Afib is still debated?
- Reconnection of PVs major reason for recurrence.
- Efforts to stabilize catheter and permanently isolate veins (JET, sheaths, force sensing) produce better outcomes.

AF Risk Factor Modification – Value even in ablation pts

Moderate/severe MR with LA dilatation or LV dysfunction in AF may be functional/ reversed with successful AF ablation (Earlier consideration for ablation even with mild symptoms.)

Late recurrence (>1yr) after ablation - more benign prognosis.