
Francis Marchlinski, MD
Richard T and Angela Clark President’s Distinguished Professor
Director Cardiac Electrophysiology
University of Pennsylvania Health System
Philadelphia, PA
Francis.marchlinski@uphs.upenn.edu
Disclosure of Relationships

Francis E. Marchlinski, MD,

**Consulting Fees/Honoraria:** Abbot/St. Jude Medical, Biotronik, Biosense Webster, Inc., Infobionics, Medtronic, Inc., Boston Scientific Corp.

**Research Grants:** Medtronic, Inc., Abbot/St. Jude Medical, Biosense Webster, Inc.
Atrial Fibrillation

**Patient Selection/Ablation Outcome: AF Classification**

✓ Classify the patient based on the most frequent AF clinical pattern

Excellente response

- **Paroxysmal**
  - Duration: < 7 days
  - Usually spontaneous termination/early cardioversion

- **Persistent** (Early Persistent < 3mos – better response to AF ablation – before remodeling*)
  - Duration: > 7 days – 1 year
  - Cardioversion: pharmacological or electrical

- **Longstanding Persistent/Permanent**
  - More than 1 year
  - Cardioversion – fails to restore sinus rhythm for any meaningful duration

*Calkins et al AF Ablation Consensus Document Heart Rhythm Oct 2017*
Class I - “Is Indicated”

1. For **symptomatic** paroxysmal AF **refractory or intolerant** to at least 1 class I or III antiarrhythmics. *(Level of Evidence: A)*

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

Paroxysmal AF – Catheter Ablation Outcome

Pulmonary Vein Isolation Multicenter Randomized Prospective Study Failed Initial Drug Therapy (159pts)

All Recurrent AT/AF

63%

17%

Ablation Group (6.8% risk, 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% risk, n=56)

- 3 life-threatening ventricular arrhythmias
- 7 disabling symptoms requiring drug withdrawal

PVI - How?

No Stroke/Embolism, Tamponade, Atrio-Esophageal fistula, PV stenosis, or Phrenic nerve paralysis

Wilber D et al, JAMA, 2010
Individual Risk Assessment Before Ablation?
Extreme Obesity, Age >80 – More Groin Complications
Role of Experience on Ablation Complications

U.S. National Inpatient Sample: 93,801 AF patients treated with catheter ablation 2000-2010; 20% U.S. hospitals sampled

- In hospital complications assessed by ICD 9 codes
  1. 81% of AF ablations done by low volume operators - perform < 25/yr
  2. Acute complications, inversely related to operator/program volume

Class I - "Is Indicated"

1. For **symptomatic** paroxysmal AF refractory or intolerant to at least 1 class I or III antiarrhythmics. (Level of Evidence: A)

2. Prior to 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" first line therapy

In patients with recurrent **symptomatic** paroxysmal AF, 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)

FIRST LINE TREATMENT OF PAROXYSMAL AF
(RAAFT 2 TRIAL – 2 YEAR FOLLOW-UP)

Time to Any AF/AFL/AT

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

**FIRE AND ICE AF Clinical Trial**

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

**Class IIa - “Is reasonable”**

1) For 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 IIa “Is reasonable” 1st line therapy—**for **symptomatic persistent AF** before class I or 3 antiarrhythmic drug therapy—(change from IIB to IIA in 2017 update -Level of Evidence: C)*

**Class IIb - “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)*

Clinical Efficacy for **Longstanding Persistent AF (>1yr)**

Antral PV Isolation + Non PV 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 Catheter Ablation - Target Substrate to Further Improve Outcome?

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

PVI plus non PVI triggers

Which Technique?

Which Patients?
STAR AF II Results - Primary Outcome in Persistent AF (Verma et al)

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

48 experienced centers in 12 countries.

No benefit of lines or fractionated electrogram ablation

1:4:4 ratio
Paroxysmal or Persistent AF

Why does ablation fail?

Make PV Isolation More Permanent with First Ablation (Improve stability)
- JET Ventilation
- Sheaths for stability
- Contact Force Sensing

Reconnected PV
Reisolation can prevent AF (80-90%)!
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
Risk Factor Modification (RFM)

The ARREST-AF Cohort Study

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

Impact of RFM on AF Ablation Outcome

- **Modifiable Risk Factors**
  - Hypertension
  - Diabetes (glycemic control)
  - Sleep apnea
  - Obesity
  - Excess alcohol use

**Aggressive Risk Factor Modification in AF Should be Standard of Care**

Adapted from Pathak RJ .... Sanders P Am Coll Cardiol May 26 2015;65:2159-2169.
Reversible Disease States due to AF??

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 with
- Greater ↓↓ LA size
- Greater ↓↓ Annular dimension

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

Post Ablation Echo
Pre Ablation Echo

Post Ablation Rhythm
Pre Ablation Rhythm

Low EF and AF

- 66 y/o man with persistent AF (X 6mos) reasonable rate control (80-90 at rest) on digoxin, metoprolol( 75bid), diltiazem(120qd).
- Some exercise intolerance - shortness of breath, palpitations (Heart rate 110-140)
- Echo – LVEF 38% //LA 4.7
- Failed two CV off /on sotalol

Is the low EF due to AF/Role of ablation?
Atrial Fibrillation Ablation Effect on LV Ejection Fraction

Improvement in All
Normalization in 94%

41% Improvement in All
Normalized in 94%

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

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

Strong consideration for catheter ablation for improvement in symptoms + LV function!!
Atrial Fibrillation with Conversion Pauses (Tachy-Brady Syndrome -TBS). - Role of Ablation?

Historic treatment standard - Antiarrhythmics + Pacemaker

New recommendation - Catheter ablation + No Pacemaker (2A)

Calkins et al Heart Rhythm Oct 2017

Inada, K., et al Europace, 2014. 16(2): 208-13

Functional MR

LV dysfunction

Conversion Pauses after Afib – treat by eliminating Afib

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

(First ablation 2004 - 2008)

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

Time of 1st Recurrence

- Early: 3 – 6 mos
  - 245 pts
- Late: 6 – 12 mos
  - 118 pts
- Very Late: >12 mos
  - 76 pts

From Gaztañaga L et al Heart Rhythm 2013 Jan;10(1):2-9
No or Rare* AF during Long Term Follow-up
Mean 41 ± 19 months

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 18 mos/CV – wants to know prognosis? – Likely rare episodes!

Gaztañaga L et al Heart Rhythm 2013 Jan;10(1):2-9
<table>
<thead>
<tr>
<th>Condition</th>
<th>Recommendation</th>
<th>Class</th>
<th>LOE</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>It is reasonable to use similar indications for AF ablation in selected patients with heart failure as in patients without heart failure.</td>
<td>2A</td>
<td>B-R</td>
<td>233-237, 384, 386-395, 396-398, 401-404, 1042, 1044</td>
</tr>
<tr>
<td>Older patients (&gt;75 years of age)</td>
<td>It is reasonable to use similar indications for AF ablation in selected older patients with AF as in younger patients.</td>
<td>2A</td>
<td>B-NR</td>
<td>385, 1043, 1044</td>
</tr>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>It is reasonable to use similar indications for AF ablation in selected patients with HCM as in patients without HCM.</td>
<td>2A</td>
<td>B-NR</td>
<td>385, 1043, 1044</td>
</tr>
<tr>
<td>Young patients (&lt;45 years of age)</td>
<td>It is reasonable to use similar indications for AF ablation in young patients with AF (&lt;45 years of age) as in older patients.</td>
<td>2A</td>
<td>B-NR</td>
<td>405, 1045</td>
</tr>
<tr>
<td>Tachy-brady syndrome</td>
<td>It is reasonable to offer AF ablation as an alternative to pacemaker implantation in patients with tachy-brady syndrome.</td>
<td>2A</td>
<td>B-NR</td>
<td>381-383</td>
</tr>
<tr>
<td>Athletes with AF</td>
<td>It is reasonable to offer high-level athletes AF as first-line therapy due to the negative effects of medications on athletic performance.</td>
<td>2A</td>
<td>C-LD</td>
<td>370-372</td>
</tr>
<tr>
<td>Asymptomatic AF**</td>
<td>Paroxysmal: Catheter ablation may be considered in select patients.**</td>
<td>2B</td>
<td>C-EO</td>
<td>416, 418</td>
</tr>
<tr>
<td></td>
<td>Persistent: Catheter ablation may be considered in select patients.</td>
<td>2B</td>
<td>C-EO</td>
<td>417</td>
</tr>
</tbody>
</table>

--- Calkins et al. Heart Rhythm 2017;14:e275-444 ---

- 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 persistent Afib is still debated?
  - Reconnection of PVs remains major reason for recurrence.
  - Efforts to stabilize catheter and permanently isolate veins (JET, sheaths, force sensing) produce better outcomes
- AF Risk Factor Modification – Important 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)
- AF ablation should be considered as primary therapy for patients with post conversion pauses - not pacemaker
- Late recurrence (>1yr) after ablation - more benign prognosis