Atrial Fibrillation. Which Patients and When Need Ablation

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What is Atrial Fibrillation?

- Chaotic circular impulses in the atria
  - Several reentrant circuits moving simultaneously
  - Atrial rates 300 to 600 bpm
  - Ventricular rates regulated by the AV node (irregularly irregular due to partial depolarization of AVN)
- Results in loss of AV synchrony (20% to 30% decrease in cardiac output)
Incidence and Prevalence

- 33 million people have AF worldwide
- 3–5 million people in the US by 2050, app. 8 million people
- AF increases risk of stroke on average 5-fold
- AF increases heart failure, dementia, and total mortality
- 450,000 hospitalizations and 90,000 deaths in the US
### AF episode
An AF episode is defined as AF that is documented by ECG monitoring or intracardiac electrogram monitoring and has a duration of at least 30 seconds, or if less than 30 seconds, is present throughout the ECG monitoring tracing. The presence of subsequent episodes of AF requires that sinus rhythm be documented by ECG monitoring between AF episodes.

### Chronic AF
Chronic AF has variable definitions and should not be used to describe populations of AF patients undergoing AF ablation.

### Early persistent AF
Early persistent AF is defined as AF that is sustained beyond 7 days but is less than 3 months in duration.

### Lone AF
Lone AF is a historical descriptor that is potentially confusing and should not be used to describe populations of patients with AF undergoing AF ablation.

### Long-standing persistent AF
Long-standing persistent AF is defined as continuous AF of greater than 12 months duration.

### Paroxysmal AF
Paroxysmal AF is defined as AF that terminates spontaneously or with intervention within 7 days of onset.

### Permanent AF
Permanent AF is defined as the presence of AF that is accepted by the patient and physician, and for which no further attempts to restore or maintain sinus rhythm will be undertaken. The term “permanent AF” represents a therapeutic attitude on the part of the patient and physician rather than an inherent pathophysiological attribute of AF. The term “permanent AF” should not be used within the context of a rhythm control strategy with antiarrhythmic drug therapy or AF ablation.

### Persistent AF
Persistent AF is defined as continuous AF that is sustained beyond 7 days.

### Silent AF
Silent AF is defined as asymptomatic AF diagnosed with an opportune ECG or rhythm strip.

**AF** = atrial fibrillation; **ECG** = electrocardiogram
Atrial Fibrillation: Clinical Problems

- Embolism and stroke (due to LA clot)
- Acute hospitalization with onset of symptoms
- Anticoagulation, especially in older patients (> 75 yr.)
- Congestive heart failure
  - Loss of AV synchrony
  - Loss of atrial “kick”
  - Rate-related cardiomyopathy due to rapid and irregular ventricular response
- Rate-related atrial myopathy and dilatation
- Chronic symptoms and reduced sense of well-being
Therapeutic Approaches to Atrial Fibrillation

- Anticoagulation
- Antiarrhythmic suppression
- Control of ventricular response
  - Pharmacologic
  - Catheter modification/ablation of AV node
- **Catheter (or Surgical) ablation**
AF Mechanisms and Ablation Concepts

Figure 4  Structure and mechanisms of atrial fibrillation. A: Schematic drawing of the left and right atria as viewed from the posterior perspective. The extension of muscular fibers onto the PVs can be appreciated. Shown in yellow are the five major left atrial autonomic ganglionic plexi (GP) and axons (superior left GP, inferior left GP, anterior right GP, inferior right GP, and ligament of Marshall). Shown in blue is the coronary sinus, which is enveloped by muscular fibers that have connections to the atria. Also shown in blue is the vein and ligament of Marshall, which travels from the coronary sinus to the region between the left superior PV and the left atrial appendage. B: The large and small reentrant wavelets that play a role in initiating and sustaining AF. C: The common locations of PV (red) and also the common sites of origin of non-PV triggers (shown in green). D: Composite of the anatomic and arrhythmic mechanisms of AF. Adapted with permission from Calkins et al. Heart Rhythm 2012; 9:632–696.e21.
Technology and Tools

● Ablation
  1. Radiofrequency energy (RF)
  2. Cryoablation
  3. Laser balloon technology
  4. Other balloon technologies
  5. Multielectrode circumferential ablation catheters (PVAC)
  6. Contact force catheters

● Mapping
  1. Electroanatomic CARTO, NavX, Rhythmia
  2. Robotic and magnetic navigation system
  3. Intracardiac Ultrasound (ICE)
  4. PV venography
  5. CT and/or MRI scans and rotational angiography
  6. MRI of atrial fibrosis and RF lesions and MRI-guided ablation
Why Ablation?

- Efficacy of Radiofrequency Catheter Ablation (RFCA) versus antiarrhythmic drug (AAD) therapy for AF (1)
- Efficacy of RFCA for maintaining sinus rhythm (SR) to be superior to current AAD therapy for providing freedom from symptomatic AF and improving quality of life in selected patient populations (2-3)
- Reduction of AF-related symptoms (4)

2. Wazni O. JAMA. 2005
3. Morillo C. JAMA 2014
4. Wokhlu A. JACC 2010
Why Ablation?

- However, evidence is insufficient to determine whether RFCA reduces all-cause mortality, stroke, or heart failure.
- Evidence supporting the efficacy of RFCA is strongest for paroxysmal AF in younger patients with little or no structural heart disease.
Prior to Ablation

- Investigate **reversible causes of AF** prior to ablation
  1. Hyperthyroidism
  2. Pulmonary embolism
  3. Myocardial ischemia/infarction
  4. Heavy alcohol consumption
  5. Recent cardiac surgery and other acute inflammatory/infectious conditions

- AVNRT, AVRT, AT may also serve as triggers for AF
Appropriate Candidate for Catheter Ablation?

1. Type of AF (paroxysmal, persistent, or long-standing persistent)
2. Severity of symptoms
3. Presence of structural heart disease
4. Candidacy for alternative options such as rate control or antiarrhythmic drug therapy
5. Likelihood of complications
6. Patient preference

- When patient preference is excluded, the primary selection criterion: presence of symptomatic AF
Risk Factors and Interaction with AF

- Obesity
- Sleep apnea
- Hypertension
- Diabetes
- Alcohol
- Exercise

Control of risk factors has a significant impact on AF burden
Indications for Catheter Ablation of Symptomatic Atrial Fibrillation

- Symptomatic AF
  - Paroxysmal AF (IIa)
    - AA Drugs
    - Catheter Ablation
  - Persistent AF (IIa)
    - AA Drugs
    - Catheter Ablation
  - Long-standing Persistent AF (IIb)
    - AA Drugs
    - Catheter Ablation
<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Indications for catheter ablation of atrial fibrillation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptomatic AF refractory or intolerant to at least one Class I or III antiarrhythmic medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paroxysmal: Catheter ablation is recommended.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Persistent: Catheter ablation is reasonable.</td>
<td>IIa</td>
<td>B-NR</td>
</tr>
<tr>
<td>Long-standing persistent: Catheter ablation may be considered.</td>
<td>IIb</td>
<td>C-LD</td>
</tr>
<tr>
<td>Symptomatic AF prior to initiation of antiarrhythmic therapy with a Class I or III antiarrhythmic medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paroxysmal: Catheter ablation is reasonable.</td>
<td>IIa</td>
<td>B-R</td>
</tr>
<tr>
<td>Persistent: Catheter ablation is reasonable.</td>
<td>IIa</td>
<td>C-E0</td>
</tr>
<tr>
<td>Long-standing persistent: Catheter ablation may be considered.</td>
<td>IIb</td>
<td>C-E0</td>
</tr>
</tbody>
</table>
Ablation Outcome: “Early” and “Late” Procedural Success

First 3 months

- Paroxysmal: 66.6%
- Non-paroxysmal: 51.9%
- Mixed: 64.2%

3-12 months

- Paroxysmal: 54.1%
- Non-paroxysmal: 41.8%
- Mixed: 53.1%

Ganesan et al. J Am Heart Assoc 2013
## Clinical Trials Performed for FDA Approval

<table>
<thead>
<tr>
<th>Trial</th>
<th>Effectiveness endpoint</th>
<th>Ablation success</th>
<th>Drug/Control success</th>
<th>P value for success</th>
<th>Ablation Cxs</th>
<th>Drug/Control Cxs</th>
<th>FDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAMA 2010; 303; 333-340 (ThermoCool AF)</td>
<td>Freedom from symptomatic PAF, acute procedural failure, or changes in specified drug regimen</td>
<td>66%</td>
<td>16%</td>
<td>&lt; 0.001</td>
<td>4.9%</td>
<td>8.8%</td>
<td>Approval (+)</td>
</tr>
<tr>
<td>JACC 2013; 61: 1713-1723 (STOP AF)</td>
<td>Freedom from any detectable AF, use of nonstudy AAD, or non-protocol intervention for AF</td>
<td>70%</td>
<td>7%</td>
<td>&lt; 0.001</td>
<td>3.1%</td>
<td>NA</td>
<td>Approval (+)</td>
</tr>
<tr>
<td>Heart Rhythm 2014; 11: 202-209 (TTOP)</td>
<td>Acute procedural success, ≥90% reduction in AF burden, off AAD nonirrigated circumferential multielectrode ablation catheters with duty cycled phased RF energy</td>
<td>56%</td>
<td>26%</td>
<td>&lt;0.001</td>
<td>12.3%</td>
<td>4 strokes (2.9%)</td>
<td>NA</td>
</tr>
<tr>
<td>JACC 2014; 64: 647-656 (SMART-AF)</td>
<td>Freedom from symptomatic AF, flutter, tachycardia, acute procedural failure, or changes in AAD</td>
<td>72.5%</td>
<td>N/A</td>
<td>&lt;0.0001</td>
<td>7.5%</td>
<td>NA</td>
<td>Approval (+)</td>
</tr>
<tr>
<td>Circulation 2015; 132: 907-915 (TOCCASTAR)</td>
<td>Acute procedural success + freedom from symptomatic AF/flutter/tachycardia off AAD</td>
<td>67.8%</td>
<td>69.4%</td>
<td>0.0073 for noninferiority</td>
<td>7.2%</td>
<td>9.1%</td>
<td>Approval (+)</td>
</tr>
<tr>
<td>JACC 2015; 66: 1350-1360 (HeartLight)</td>
<td>Freedom from symptomatic AF/flutter/tachycardia, acute procedural failure, AAD, or nonprotocol intervention</td>
<td>61.1%</td>
<td>61.7%</td>
<td>0.003 for noninferiority</td>
<td>5.3%</td>
<td>6.4%</td>
<td>Approval (+)</td>
</tr>
</tbody>
</table>
### Other Paroxysmal AF Ablation Trials

<table>
<thead>
<tr>
<th>Trial</th>
<th>Effectiveness endpoint</th>
<th>Ablation success</th>
<th>Drug/Control success</th>
<th>P for success</th>
<th>Ablation Cxs</th>
<th>Drug/Control Cxs</th>
</tr>
</thead>
<tbody>
<tr>
<td>JACC 2006; 48: 2340-2347 (APAF)</td>
<td>Freedom from detectable AF, flutter, tachycardia</td>
<td>86%</td>
<td>22%</td>
<td>&lt;0.001</td>
<td>1%</td>
<td>23%</td>
</tr>
<tr>
<td>Circulation 2008; 118: 2498-2505 (A4)</td>
<td>Freedom from AF</td>
<td>89</td>
<td>23</td>
<td>&lt;0.0001</td>
<td>5.7%</td>
<td>1.7%</td>
</tr>
<tr>
<td>NEJM 2016; 374: 2235-2245 (FIRE AND ICE)</td>
<td>Freedom from detectable AF, flutter, tachycardia</td>
<td>64.1% (RF)</td>
<td>65.4% (cryo)</td>
<td>NS</td>
<td>12.8%</td>
<td>10.2%</td>
</tr>
<tr>
<td>JACC 2016; 68: 2747-2757</td>
<td>Freedom from AF</td>
<td>59%</td>
<td>5%</td>
<td>&lt; 0.001</td>
<td>10.4%</td>
<td>4.7%</td>
</tr>
</tbody>
</table>
## First-Line Therapy Trials

<table>
<thead>
<tr>
<th>Trial</th>
<th>Effectiveness endpoint</th>
<th>Ablation success</th>
<th>Drug/Control success</th>
<th>P</th>
<th>Ablation Cxs</th>
<th>Drug/Control Cxs</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAMA 2005; 293: 2634-2640 (RAAFT)</td>
<td>Freedom from detectable AF</td>
<td>84%</td>
<td>37%</td>
<td>&lt;0.01</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>NEJM 2012; 367:1587-1595 (MANTRA-PAF)</td>
<td>Cumulative AF burden</td>
<td>13% AF burden</td>
<td>19% AF burden</td>
<td>NS</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>JAMA 2014; 311: 692-700 (RAAFT-2)</td>
<td>Freedom from detectable AF, flutter, tachycardia</td>
<td>45%</td>
<td>28%</td>
<td>0.02</td>
<td>9%</td>
<td>4.9%</td>
</tr>
</tbody>
</table>

MANTRA-PAF negative result might be explained by the ablation techniques with discretionary circumferential ablation **without confirmation of PVI with a circular mapping catheter** as well as by the choice of **reduction in AF burden on 7-day Holter as a primary endpoint**

RAAFT: Whether such benefits extend to elderly patients with PAF, patients with associated SHD or non-PAF, is still controversial
Long-term efficacy of catheter ablation as first-line therapy for paroxysmal atrial fibrillation: 5-year outcome in a randomised clinical trial

Jens Cosedis Nielsen,1 Arne Johannessen,2 Pekka Raatikainen,3 Gerhard Hindricks,4 Håkan Walfridsson,5,6 Steen Michael Pehrson,7 Anders Englund8 Juha Hartikainen,9 Leif Spange Mortensen,10 Peter Steen Hansen,1 for the MANTRA-PAF Investigators
## Other Persistent AF Ablation Trials

<table>
<thead>
<tr>
<th>Trial</th>
<th>Effectiveness endpoint</th>
<th>Ablation success</th>
<th>Drug/Control success</th>
<th>( P )</th>
<th>Ablation Cxs</th>
<th>Drug/Control Cxs</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEJM 2006; 354: 934-941</td>
<td>No AF or flutter month 12</td>
<td>74%</td>
<td>58%</td>
<td>0.05</td>
<td>1.3%</td>
<td>1.4%</td>
</tr>
<tr>
<td>EHJ 2014; 35: 501-507 (SARA)</td>
<td>Freedom from AF/flutter lasting &gt;24h</td>
<td>70%</td>
<td>44%</td>
<td>0.002</td>
<td>6.1%</td>
<td>4.20%</td>
</tr>
<tr>
<td>NEJM 2015; 372: 1812-1822</td>
<td>Freedom from AF with or without drugs</td>
<td>59% (PVI alone)</td>
<td>49% and 46%</td>
<td>NS</td>
<td>6%</td>
<td>4.3% and 7.6%</td>
</tr>
<tr>
<td>STAR AF II</td>
<td></td>
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</tr>
</tbody>
</table>
Ablation Concepts in Persistent AF

Preferred strategy for ablation of “long-standing persistent AF”

- **PVI only**: 37%
- **PVI plus linear lesions**: 20%
- **PVI plus CFAE ablation**: 3%
- **CFAE ablation only**: 10%
- **PVI plus substrate ablation**: 13%
- **Stepwise approach**: 0%
- **Rotor mapping**: 0%

*Europace 2015;17:1596-1600*
### Indications for catheter atrial fibrillation ablation in populations of patients not well represented in clinical trials

<table>
<thead>
<tr>
<th>Condition</th>
<th>Summary</th>
<th>Level</th>
<th>Evidence Rating</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>IIa</td>
<td>B-R</td>
</tr>
<tr>
<td>Older patients (≥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>IIa</td>
<td>B-NR</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>IIa</td>
<td>B-NR</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>IIa</td>
<td>B-NR</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>IIa</td>
<td>B-NR</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>IIa</td>
<td>C-LD</td>
</tr>
<tr>
<td>Asymptomatic AF**</td>
<td><strong>Paroxysmal</strong>: Catheter ablation may be considered in select patients. ** Persistent: Catheter ablation may be considered in select patients.</td>
<td>IIb</td>
<td>C-EO</td>
</tr>
</tbody>
</table>
1. Evidence for a Better Prognosis after RFA of AF in HF Patients?

- Patients with atrial fibrillation, heart failure, and highly reduced ejection fraction (EF) have a poor prognosis.
- Non-pharmacological restoration of sinus rhythm with catheter ablation may improve EF.
- Improvement of EF may reduce mortality.
Pulmonary-Vein Isolation for Atrial Fibrillation in Patients with Heart Failure

PABA-CHF Investigators*

**A** Ejection Fraction

![Graph showing ejection fraction over months with PVI and AV-node ablation+BiV](image)

- PVI: Ejection Fraction (%)
- AV-node ablation+BiV: Ejection Fraction (%)
- P=0.03
- P<0.001

**B** 6-Minute Walk

![Graph showing distance walked over months with PVI and AV-node ablation+BiV](image)

- PVI: Distance (m)
- AV-node ablation+BiV: Distance (m)
- P=0.003
- P<0.001

**C** Minnesota Living with Heart Failure Questionnaire

- PVI
- AV-node ablation+BiV
- P<0.001

Adverse effects of AA drugs and AV nodal blocking agents minimized

Rhythm control by PVI is superior to best possible rate-control strategy

Ablation vs. 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, Prashant Mohanty, Sanghamitra Mohanty, Pasquale Santangeli, Chintan Trivedi, Dhanunjaya Lakireddy, Madhu Reddy, Pierre Jais, Sakis Themistoclakis, Antonio Dello Russo, Michela Casella, Gemma Pelargonio, Maria Lucia Narducci, Robert Schweikert, Petr Neuzil, Javier Sanchez, Rodney Horton, Salwa Beheiry, Richard Hong, Steven Hao, Antonio Rossillo, Giovanni Forleo, Claudio Tondo, J. David Burkhardt, Michel Haissaguerre and Andrea Natale

(Circulation. 2016;133:1637-1644.)
LVEF improved 9.6±7.4%, vs. 4.2±6.2% (p<0.001),
6MWD changed 27±38 vs. 8±42 (p<0.001),
MLHFQ score reduced 14±18 vs. 2.9±15 (p<0.001) in recurrence-free versus patients with recurrence

• Over the 2 year follow-up:
  – Hospitalization rate substantially lower in Group 1 (32 [31%] vs. 58 [57%] in group 2, p <0.001)
  – All-cause Mortality in
  – Group 1 (8 [8%]) and 18 [18%] group 2, log-rank p=0.037);
Catheter Ablation versus Standard conventional Treatment in patients with L Ef t ventricular dysfunction and Atrial Fibrillation

The CASTLE-AF trial

Nassir F. Marrouche MD
on behalf the CASTLE AF Investigators

Conclusion-CASTLE AF

• **Catheter ablation** of atrial fibrillation in patients with heart failure is associated with **improved all-cause mortality** and **fewer admissions for worsening heart failure** when compared to conventional standard of care treatment.

• **Catheter ablation** of atrial fibrillation in patients with heart failure is also associated with **improved cardiovascular mortality** and **hospitalization** when compared to conventional standard of care treatment.
### Table 1: Clinical efficacy and complication rates of AF ablation.

<table>
<thead>
<tr>
<th>Author</th>
<th>Patients (Age range in years)</th>
<th>AF type (Paroxysmal, persistent, chronic)</th>
<th>Mean follow-up (Months)</th>
<th>Clinical efficacy of ablation</th>
<th>Major complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hsieh et al.</td>
<td>37 (72 ± 4)</td>
<td>Paroxysmal</td>
<td>52 ± 6</td>
<td>81%</td>
<td>0%</td>
</tr>
<tr>
<td>Corrado et al.</td>
<td>174 (77 ± 6)</td>
<td>Paroxysmal 55 % Persistent 45%</td>
<td>20 ± 14</td>
<td>73 - 80%</td>
<td>1%</td>
</tr>
<tr>
<td>Zado et al.</td>
<td>948 (&lt;65) 185 (65-75) 32 (≥75)</td>
<td>Paroxysmal 65% Paroxysmal 62% Paroxysmal 53%</td>
<td>27 ± 13</td>
<td>89%</td>
<td>1.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>84%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Leong-Sit et al.</td>
<td>232 (&lt;45) 438 (45-54) 570 (55-64) 308 (≥65)</td>
<td>Paroxysmal 71% Paroxysmal 62% Paroxysmal 66% Paroxysmal 63%</td>
<td>32 ± 20</td>
<td>87%</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>88%</td>
<td>1.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>88%</td>
<td>1.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>82%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Traub et al.</td>
<td>45 (&lt;70) 15 (≥70)</td>
<td>Paroxysmal</td>
<td>19 23</td>
<td>80%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Bunch et al.</td>
<td>717 (&lt;80) 35 (≥80)</td>
<td>Paroxysmal 46% Paroxysmal 54%</td>
<td>12</td>
<td>75%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Santangeli et al.</td>
<td>2651 (&lt;80) 103 (≥80)</td>
<td>Paroxysmal</td>
<td>18 ±6</td>
<td>71%</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>69%</td>
<td>0</td>
</tr>
</tbody>
</table>
3.

Catheter ablation for atrial fibrillation in hypertrophic cardiomyopathy: a systematic review and meta-analysis

Rui Providencia,1 Perry Elliott,1,2 Kiran Patel,2 Jack McCready,3 Girish Babu,1 Neil Srinivasan,1,2 Kostantinos Bronis,1 Nikolaos Papageorgiou,1,2 Anthony Chow,1 Edward Rowland,1 Martin Lowe,1 Oliver R Segal,1 Pier D Lambiase1,2

Freedom from AF/AT relapse after a single procedure  |  Freedom from AF/AT relapse after one or more procedures

Number of catheter ablation procedures  |  Need for AADs in patients with successful ablation

*Heart* 2016;102:1533–1543
4. Catheter ablation of atrial fibrillation in the young: insights from the German Ablation Registry

Chun KR. Clin Res Cardiol 2013
The role of successful catheter ablation in patients with paroxysmal atrial fibrillation and prolonged sinus pauses: outcome during a 5-year follow-up

Keiichi Inada*, Teiichi Yamane, Ken-ichi Tokutake, Ken-ichi Yokoyama,

Paroxysmal AF patients = 260

TBS patients = 37

1st ablation

Sinus rhythm = 19
AF recurrence = 18

2nd ablation = 14

Sinus rhythm = 11
AF recurrence = 3

3rd ablation = 2

Sinus rhythm = 1
Sick sinus = 1

Pacemaker = 1

Catheter ablation can eliminate both AF and prolonged sinus pauses in the majority of TBS patients.
Efficacy of circumferential pulmonary vein ablation of atrial fibrillation in endurance athletes

Naiara Calvo, Lluis Mont, David Tamborero, Antonio Barruezo, Graziana Viola, Eduard Guasch, Mercè Nadal, David Andreu, Barbara Vidal, Marta Sitges, and Josep Brugada

**Figure 1** Kaplan–Meier curves for long-term freedom from recurrent arrhythmias after a single ablation procedure in the lone AF sport group (dashed line) and the control group (solid line).

**Figure 2** Kaplan–Meier curves for long-term freedom from recurrent arrhythmias after a single ablation procedure in the lone AF sport group (dashed line) and patients with lone AF and no history of exercise activity (solid line).
Efficacy of radiofrequency catheter ablation in athletes with atrial fibrillation

Pieter Koopman, Dieter Nuyens, Christophe Garweg, Andre La Gerche, Stijn De Buck, Lieve Van Casteren, Becker Alzand, Rik Willems, and Hein Heidbuchel

Freedom from atrial fibrillation recurrence after first ablation procedure

Final outcome after multiple ablations

Europace (2011) 13, 1386–1393
7. Catheter Ablation of Asymptomatic AF

What is the benefit?

1. Will you live better?
2. You will live longer!
3. You will live longer and better!
Clinical impact of catheter ablation in patients with asymptomatic atrial fibrillation: The IRON-AF

Forleo G. IJC 2013
Catheter Ablation of Asymptomatic Persistent AF

66 pts with asymptomatic persistent AF compared to 132 matched controls with symptomatic persistent AF.

**Conclusion**

Our study revealed that current catheter ablation techniques are associated with a worse outcome in asymptomatic AF patients than in those with symptoms. This is mainly due to post-ablation AT that can cause significant symptoms in previously asymptomatic patients.
1. Non-PAF and particularly long-term persistent AF
2. LV dysfunction
3. Sleep apnea and obesity
4. Increased LA size
5. Increased age
6. Hypertension
7. LA fibrosis (MRI)
Despite an AF recurrence rate of 45.9%, the majority of these pts (72.4%) reported a significant alleviation of clinical symptoms.
<table>
<thead>
<tr>
<th>Complication</th>
<th>Incidence</th>
<th>Selected prevention techniques</th>
<th>Diagnostic testing</th>
<th>Selected treatment options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air embolism</td>
<td>&lt;1%</td>
<td>Sheath management</td>
<td>Nothing or cardiac catheterization</td>
<td>Supportive care with fluid, oxygen, head down tilt, hyperbaric oxygen</td>
</tr>
<tr>
<td>Asymptomatic cerebral emboli (ACE)</td>
<td>2% to 15%</td>
<td>Anticoagulation, catheter and sheath management, TEE</td>
<td>Brain MRI</td>
<td>None</td>
</tr>
<tr>
<td>Atrial esophageal fistula</td>
<td>0.02% to 0.11%</td>
<td>Reduce power, force, and RF on posterior wall, monitor esophageal temp, use proton pump inhibitors; avoid energy delivery over esophagus</td>
<td>CT scan of chest, MRI; avoid endoscopy with air insufflation</td>
<td>Surgical repair</td>
</tr>
<tr>
<td>Cardiac tamponade</td>
<td>0.2% to 5%</td>
<td>Cather manipulation, transseptal technique, reduce power, force, and RF time</td>
<td>Echocardiography</td>
<td>Pericardiocentesis or surgical drainage</td>
</tr>
<tr>
<td>Coronary artery stenosis/occlusion</td>
<td>&lt;0.1%</td>
<td>Avoid high-power energy delivery near coronary arteries</td>
<td>Cardiac catheterization</td>
<td>PTCA</td>
</tr>
<tr>
<td>Death</td>
<td>&lt;0.1% to 0.4%</td>
<td>Meticulous performance of procedure, attentive postprocedure care</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Gastric hypomobility</td>
<td>0% to 17%</td>
<td>Reduce power, force, and RF time on posterior wall</td>
<td>Endoscopy, barium swallow, gastric emptying study</td>
<td>Metoclopramide, possibly intravenous erythromycin</td>
</tr>
<tr>
<td>Mitral valve entrapment</td>
<td>&lt;0.1%</td>
<td>Avoid circular catheter placement near or across mitral valve; clockwise torque on catheter</td>
<td>Echocardiography</td>
<td>Gentle catheter manipulation, surgical extraction</td>
</tr>
<tr>
<td>Pericarditis</td>
<td>0% to 50%</td>
<td>None proven</td>
<td>Clinical history, ECG, sedimentation rate, echocardiogram</td>
<td>NSAID, colchicine, steroids</td>
</tr>
<tr>
<td>Permanent phrenic nerve paralysis</td>
<td>0% to 0.4%</td>
<td>Monitor diaphragm during phrenic pacing, CMAP monitoring, phrenic pacing to identify location and adjust lesion location</td>
<td>CXR, sniff test</td>
<td>Supportive care</td>
</tr>
<tr>
<td>Pulmonary vein stenosis</td>
<td>&lt;1%</td>
<td>Avoid energy delivery within PV</td>
<td>CT or MRI, V/Q wave scan</td>
<td>Angioplasty, stent, surgery</td>
</tr>
<tr>
<td>Radiation injury</td>
<td>&lt;0.1%</td>
<td>Minimize fluoroscopy exposure, especially in obese and repeat ablation patients, X-ray equipment</td>
<td>None</td>
<td>Supportive care, rarely skin graft</td>
</tr>
<tr>
<td>Stiff left atrial syndrome</td>
<td>&lt;1.5%</td>
<td>Limit extent of left atrial ablation</td>
<td>Echocardiography, cardiac catheterization</td>
<td>Diuretics</td>
</tr>
<tr>
<td>Stroke and TIA</td>
<td>0% to 2%</td>
<td>Pre-, post-, and inprocedure anticoagulation, catheter and sheath management, TEE</td>
<td>Head CT or MRI, cerebral angiography</td>
<td>Thrombolytic therapy, angioplasty</td>
</tr>
<tr>
<td>Vascular complications</td>
<td>0.2% to 1.5%</td>
<td>Vascular access techniques, ultrasound-guided access, anticoagulation management</td>
<td>Vascular ultrasound, CT scan</td>
<td>Conservative treatment, surgical repair, transfusion</td>
</tr>
</tbody>
</table>
Selection of patients for AF ablation

<table>
<thead>
<tr>
<th>Better candidates</th>
<th>Worse candidates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt;70 years</td>
<td>Age ≥70 years</td>
</tr>
<tr>
<td>Highly symptomatic</td>
<td>Oligosymptomatic or asymptomatic</td>
</tr>
<tr>
<td>LA diameter &lt;45 mm</td>
<td>LA diameter ≥45 mm</td>
</tr>
<tr>
<td>Paroxysmal AF (especially &lt;48 h)</td>
<td>Persistent AF</td>
</tr>
<tr>
<td>No other arrhythmia</td>
<td>Associated AT or AFL</td>
</tr>
<tr>
<td>“Lone” AF</td>
<td>Structural heart disease</td>
</tr>
<tr>
<td>Normal cardiac function</td>
<td>Heart failure</td>
</tr>
<tr>
<td>Normal BMI</td>
<td>Obesity</td>
</tr>
<tr>
<td>Normal pulmonary function</td>
<td>COPD</td>
</tr>
<tr>
<td>Normal thyroid function</td>
<td>History of thyrotoxicosis</td>
</tr>
<tr>
<td>Amiodarone not used</td>
<td>History of amiodarone failure</td>
</tr>
</tbody>
</table>

Mujovic A., Potpara T. Adv Ther 2017
Conclusions

- Catheter Ablation is both effective (50–80%) and safe (1–5% risk of life-threatening complications) method of rhythm control strategy.
- Careful selection of patients – modify any risk factors.
- The best candidates are younger patients with symptomatic PAF without structural heart disease and no significant LA remodeling.