Atrial Fibrillation: Pearls and Pitfalls

Christopher R. Cole, M.D., FHRS

Colorado Springs Cardiologists
Director of Electrophysiology Lab
Penrose-St. Francis Hospital
Colorado Springs, Colorado
Disclosures

- Speakers Panel: Medtronic, Boston Scientific, St. Jude Medical, Pfizer, BMS
- Research Support: St. Jude Medical, Boston Scientific, Medtronic, Atricure
Atrial Fibrillation – The Problem

• Over 5 million people worldwide are affected by atrial fibrillation.
• Over 3 million in the US alone.
• Prevalence increases with age:
  – 4.8 % in the 70-79 age group
  – 8.8% in the 80-89 age group
• Lifetime Risk for Any Afib 1:4 M, 1:5 F
Atrial Fibrillation – The Problem

1. Increased Stroke Risk
2. Rapid, Irregular Heart Beat
   May lead to congestive heart failure (CHF)
3. Symptoms – variable
4. Potential long term risks including increased mortality
Atrial Fibrillation – Definitions

1. Paroxysmal – Episode terminates spontaneously
2. Persistent – Lasting greater than 7 days or requires chemical or electrical cardioversion
3. Long-Standing Persistent – Continuous AF greater than one year
4. Permanent – A decision has been made not to pursue a rhythm control strategy
Clinical Pearl # 1

Not All That Palpitates is Fibrillation

First Step - Order a Monitor
All Paroxysmal Atrial Fibrillation eventually becomes Permanent Atrial Fibrillation.

A) True
B) False
Atrial Fibrillation - Treatments

Drugs

Adjunctive Therapies

Ablations

Surgery

Devices
Drugs
Drug Treatment Goals

• Reduce Stroke Risk
• Control Ventricular Rate
• Restore Sinus Rhythm
Drug Treatment Goals

• Reduce Stroke Risk
  – Warfarin
  – Aspirin/clopidogrel – Not as effective
  – NOACs

• Control Ventricular Rate

• Restore Sinus Rhythm
Stroke Risk Increases With CHADS\textsubscript{2} Score\textsuperscript{1,2}

- CHADS\textsubscript{2} is an index that may be used to quantify the risk of stroke for patients with NVAF
  - Patients with NVAF are at increased risk of stroke vs patients without NVAF
  - As CHADS\textsubscript{2} score increases, so does the risk of stroke

### Risk Expressed as a Point-Based Scoring System

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>CHADS\textsubscript{2} Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Age $\geq$75 years</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Prior stroke or TIA</td>
<td>2</td>
</tr>
</tbody>
</table>

### Risk of Stroke in National Registry of Atrial Fibrillation Participants, Stratified by CHADS\textsubscript{2} Score (N=1733)

<table>
<thead>
<tr>
<th>CHADS\textsubscript{2} Score</th>
<th>Adjusted Stroke Rate, %/year* (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.9 (1.2–3.0)</td>
</tr>
<tr>
<td>1</td>
<td>2.8 (2.0–3.8)</td>
</tr>
<tr>
<td>2</td>
<td>4.0 (3.1–5.1)</td>
</tr>
<tr>
<td>3</td>
<td>5.9 (4.6–7.3)</td>
</tr>
<tr>
<td>4</td>
<td>8.5 (6.3–11.1)</td>
</tr>
<tr>
<td>5</td>
<td>12.5 (8.2–17.5)</td>
</tr>
<tr>
<td>6</td>
<td>18.2 (10.5–27.4)</td>
</tr>
</tbody>
</table>

* The adjusted stroke rate is the expected stroke rate per 100 patient-years from the exponential survival model, assuming that aspirin was not taken.

CI = confidence interval; TIA = transient ischemic attack.

CHADS-VASc

For all CHADS2 scores of 0 or 1 add:

- 1 point for Vascular Disease (CAD, PVD)
- 1 point for Age 65-75
- 1 point for Sex - female gender

If the score is still 0 then the patient is truly low risk
Novel Oral Anticoagulants (NOACs)

Pradaxa (dabigatran) – Direct Thrombin Inhibitor
Xarelto (rivaroxiban) – Factor Xa inhibitor
Eliquis (apixaban) – Factor Xa inhibitor
Savaysa (edoxaban) – Factor Xa inhibitor
Drug Treatment Goals

• Reduce Stroke Risk
• Control Ventricular Rate
• Restore Sinus Rhythm
Drug Treatment Goals

- Reduce Stroke Risk
- Control Ventricular Rate
  - Beta-Blockers
  - Calcium Channel Blockers
  - Digoxin
  - (amiodarone, dronedarone)
  - (Ablate and Pace)
- Restore Sinus Rhythm
Drug Treatment Goals

• Reduce Stroke Risk
• Control Ventricular Rate
• Restore Sinus Rhythm
Drug Treatment Goals

• Reduce Stroke Risk
• Control Ventricular Rate
• Restore Sinus Rhythm
  – Antiarrhythmic Medications:
    • Flecainide, Propafenone
    • Sotalol
    • Amiodarone, Dronedarone
    • Dofetalide
Rate vs. Rhythm

Mortality in AFFIRM

![Graph showing cumulative mortality over years for rate control and rhythm control, with a significance level of P=0.08.](chart.png)
### On Treatment Analysis

<table>
<thead>
<tr>
<th></th>
<th>P value</th>
<th>Hazard Ratio</th>
<th>Lower Confidence Limit</th>
<th>Upper Confidence Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance of Sinus Rhythm</td>
<td>&lt;0.0001</td>
<td>0.53</td>
<td>0.39</td>
<td>0.72</td>
</tr>
<tr>
<td>Warfarin Use</td>
<td>&lt;0.0001</td>
<td>0.50</td>
<td>0.37</td>
<td>0.69</td>
</tr>
</tbody>
</table>
ATHENA
Reduction in Risk of Stroke

Connolly Circ 2009
Post-Ablation: Stroke

Bunch  J Cardiovasc Electrophysiol, March 15, 2011
Post-Afib Ablation: Mortality

n=37,908

Bunch  J Cardiovasc Electrophysiol, March 15, 2011
Clinical Pearl # 2

Calculate a CHADS-Vasc Score on all your patients with Atrial Fibrillation
A 75 yo woman with Afib, diabetes and a TIA has no history of heart failure, peripheral vascular disease or heart failure. Her CHADS2-Vasc score is:

A) 2
B) 3
C) 4
D) 5
E) 6
Adjunctive Therapies
Adjunctive Therapies

• Obstructive Sleep Apnea (OSA)
• Diet
  – Obesity
  – Coffee
  – Alcohol
  – Fish Oil
• “The rest of the body”
  – Inflammation
  – Smoking
Adjunctive Therapies

• Obstructive Sleep Apnea (OSA)

• Diet
  – Obesity
  – Coffee
  – Alcohol
  – Fish Oil

• “The rest of the body”
  – Inflammation
  – Smoking
Adverse Effects of Untreated Obstructive Sleep Apnea (OSA)

- Ventricular Arrhythmias
- Heart Attack
- Heart Failure
- Stroke
- Sexual Dysfunction
- Diabetes
- Obesity
- Depression
- Death
OSA and Prevalence of Cardiac Arrhythmias in the Sleep Heart Health Study

Mehra et al. AJRCCM 2006
Figure 1. Proportion and 95% CI of patients with OSA. Prevalence of OSA is significantly higher in patients with AF than in patients without past or current AF in general cardiology practice (49% [95% CI 41% to 57%] vs 32% [95% CI 27% to 37%], \( P=0.0004 \)).
Can Treatment of OSA prevent/improve AF outcomes?

Maybe and Yes
Recurrence of AF at 12 months Post-Cardioversion

Kangala et al. Circulation 2003

12 month recurrence of AF, %

Control  Treated  Untreated

OSA       OSA

P=0.006

P=0.013

P=0.48

Kanagala Circulation 2003
Treatment of OSA improves success rates of PVI

- 52 pts with OSA
- 28 (53%) using CPAP
- At 26 months 72% CPAP vs. 63% non-CPAP were free from AF (p=0.005)
- CPAP group outcomes similar to age and sex matched controls
Adjunctive Therapies

- **Obstructive Sleep Apnea**
- **Diet**
  - Obesity
  - Coffee
  - Alcohol
  - Fish Oil
- **“The rest of the body”**
  - Inflammation
  - Kidneys
Obesity

BMI = 4% AF risk increase

- Increased Risk of Sleep Apnea
- Increase in LA volume and pressures
- Increase in Pulmonary Pressures
- Decreases in Atrial ERPs
- Better QoL post-ablation
- Weight loss reduces AF

Wang JAMA 2004
Munger JACC 2012
Mohanty Heart Rhythm 2011
Coffee and AF

• Popular opinion is to avoid coffee to prevent AF
• However… No evidence to support this perception
• In fact, there may be beneficial effects
• This does not apply to “Energy drinks”

Glatter; Curr Treat Options Cardiovasc Med. 2012
Freedman NEJM 2012
Alcohol and AF

• Moderate use decreases CAD
• Any amount can cause atrial and ventricular arrhythmias
• Classic “Holiday Heart”
• Heavy Use $\rightarrow$ Cardiomyopathy $\rightarrow$ AF
• Increased sympathetic activity and decreased vagal modulation
• Decreased HRV

Koskinen Br Heart J 1987
Ettinger Am Heart J 1978
Thornton Lancet 1984
Alcohol and AF – Meta Analysis

- 14 Studies (130,820 participants and 7,558 cases)
- Significant increase AF with heavy intake (pooled estimate of 1.35-2.24)
- Linear dose response was found even with moderate intake

Kodama JACC 2011
Log OR/RR Regression Model for Daily Alcohol Use

Kodama JACC 2011
The relationship between daily alcohol consumption and the risk of AF was explained by a linear dose-response model, suggesting that not consuming alcohol at all is the most favorable behavior for avoiding AF rather than moderate alcohol consumption.
Fish Oil (PUFAs*)

- Jury is still out
- Animal data demonstrates atrial remodeling and prevention of AF
- Human data showing prolongation of atrial ERP, reduction in inducibility of AF, improvement in atrial function post-cardioversion
- 3 negative and 3 positive RCT

*Prescription-Grade Omega-3 fatty acids

Time to fish or cut bait?
Olshansky Heart Rhythm April 2012
Adjunctive Therapies

- Obstructive Sleep Apnea
- Diet
  - Obesity
  - Coffee
  - Alcohol
  - Fish Oil
- “The rest of the body”
  - Inflammation
  - Smoking
Inflammation and AF

- CRP levels increased in AF
- Higher CRP levels associated with failure of CV and recurrence of AF after CV
- Higher CRP levels maybe associated with increased thromboembolic risk with AF
- Simvastatin attuatuates electrical remodeling in dog model of AF
- Statin Rx shown to reduce risk of AF recurrence after CV
- Colchicine reduces AF post-op
Smoking and AF

Chamberlain Heart Rhythm 2011
Summary
Adjunctive Therapies for AF

• Low Threshold for Sleep Study
• Encourage Weight Loss
• Discuss Alcohol Use
• Hyperlipidemia \(\rightarrow\) Statin
• Smoking cessation
• Consider Fish Oil Supplements
• Have Another Cup of Coffee!
Clinical Pearl # 3

Even Thin people Can have Sleep Apnea

Consider a Sleep Study in all your patients with Afib
When seeing a patient with afib consider recommending all of the following except:

A) Reducing or Stopping Alcohol
B) Avoiding all caffeine, including chocolate
C) Encouraging Weight Loss
D) Screening for Sleep Apnea
E) Checking TSH and electrolytes
Devices

Amplatzer Cardiac Plug (ACP)

Lariat Device

WATCHMAN
Left Atrial Appendage Occlusion

- Majority of blood clots form in the LAA
- Trans-septal placement of device to occlude LAA
- Shown to be as effective as warfarin in preventing strokes
WATCHMAN LAA Closure Device in situ

Device in left atrial appendage
Left atrium
Ablations
Wavelet Hypothesis

- Multiple wavelet hypothesis – Moe and Abildskov 1959
- “…multiple independent reentrant wavelets, to maintain fibrillation must be…changing in position, shape, size and number with each successive excitation”
- Confirmed by detailed mapping in animals and humans

Moe Am Heart J 1959
Maze Procedure

- Based on wavelet hypothesis of atrial fibrillation
- Open heart bypass procedure
- Cut atrium to small segments that cannot maintain fib
- Often done in conjunction with another open-heart procedure such as mitral valve repair
- 50-80% successful

Cox J Thorac Cardiovasc Surgery 1991
Triggers of Atrial Fibrillation

- First proposed by Winterberg in 1906
- Haïssaguerre 1998 mapping during linear lesions
- Isolated areas of rapid focal firing (200-300 bpm) coming primarily from the pulmonary veins

Haïssaguerre NEJM 1998
Chen, Circulation 1999
New Paradigm for Afib

- Pulmonary Vein Triggers
- Electrical Remodeling
- Multiple Wavelets/Rotors
- Substrate
Circular Mapping Catheters
Transeptal Access of the Left Atrium
Mapping at ostium of PV
Final map
Cryoballoon Catheter

- Two balloons diameters:
  - 23mm & 28mm
- Double balloon safety system
- Bi-directional deflection
- Over-the-wire system

Metzner Circ Arrhythmia Electrophysiology 2013
Occlusion of the PV

Complete LSPV occlusion with no leak of contrast into the atrium (Arctic Front™ 28 mm)

Courtesy of Jurgen Vogt, MD.
Ablation vs. AAD

JACC 48 (11), pp. 2340-2347, 2006
# Success Rates by Type of AF

<table>
<thead>
<tr>
<th>Type of AF</th>
<th>Success w/o AADs</th>
<th>Success with AADs</th>
<th>Overall Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paroxysmal</td>
<td>75 (65-83)</td>
<td>9 (0.2-15)</td>
<td>84 (79.7-88.6)</td>
</tr>
<tr>
<td>Persistent</td>
<td>65 (52-72)</td>
<td>10 (0.8-15)</td>
<td>75 (66-80)</td>
</tr>
<tr>
<td>Long-lasting</td>
<td>63 (53-71)</td>
<td>8 (0.9-16)</td>
<td>71 (67-76)</td>
</tr>
</tbody>
</table>

Cappato, Circ. Arrhythm. Electrophysiol. 2009;2:349
AV Node Ablation
(Ablate & Pace)

- Ablation of AV node controls rapid heart rate
- Still require anticoagulation
- Patient becomes pacemaker dependent
- Option in symptomatic, elderly individuals who have failed medical management
- Consider Biventricular pacemaker in patients with EF <50%
Objective Benefits of Catheter Ablation of AV Nodal Conduction and Permanent Pacemaker Implantation

A  Left ventricular ejection fraction (%)

B  Left ventricular end systolic diameter (mm)

Ablation Summary

- **Pulmonary Vein Isolation (PVI)**
  - Symptomatic individuals who have failed medical therapy or who do not desire to take long-term meds

- **AV Node Ablation (rate control)**
  - Symptomatic elderly or frail patients who have failed rate control (<110 bpm at rest)

- **Hybrid procedure** – Consider in symptomatic patients with permanent afib and enlarged left atrium
An ideal patient for catheter ablation would have all of the following characteristics except:
A) Symptomatic Atrial Fibrillation
B) Left Atrial Volume Index > 50
C) No significant heart valve disease
D) Failure of Medical treatment
E) Treated Sleep Apnea
Clinical Pearl # 4

Patients don’t have to live with Atrial Fibrillation!
THANK YOU!
Additional Slides
A Higher CHADS$_2$ Score in Patients With NVAF Was Associated With a Higher Risk of Major Bleeding*

<table>
<thead>
<tr>
<th>CHADS$_2$ Score</th>
<th>Major Bleed Event Rate, %/year (N)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4.4 (10,953)</td>
</tr>
<tr>
<td>1</td>
<td>8.0 (14,779)</td>
</tr>
<tr>
<td>2</td>
<td>12.1 (13,338)</td>
</tr>
<tr>
<td>≥3</td>
<td>20.2 (9190)</td>
</tr>
</tbody>
</table>

- Regardless of exposure to oral anticoagulant, bleeding incidence increased with increasing CHADS$_2$ score
  - Proportions of patients who received oral anticoagulant during follow-up were similar (ranging from 53% to 54%) across patient subgroups with CHADS$_2$ scores of 1, 2, or ≥3
  - Similar proportion (~30%) of patients across CHADS$_2$ subgroups who had a bleeding episode possessed oral anticoagulant at the time of the event

* A bleeding event was considered major if it was associated with any of the following: inpatient care, blood transfusion, decreased hemoglobin or hematocrit, death, physician-guided medical or surgical treatment, or intracranial bleed.
† %/year is equivalent to event rate per 100 patient-years.

### TABLE 2. Unadjusted ORs and 95% CIs for OSA

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender</td>
<td>1.09</td>
<td>0.90–1.32</td>
<td>0.378</td>
</tr>
<tr>
<td>Age, y</td>
<td>0.99</td>
<td>0.97–1.00</td>
<td>0.085</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>1.12</td>
<td>1.08–1.16</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Neck circumference, cm</td>
<td>1.11</td>
<td>1.06–1.15</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.28</td>
<td>1.04–1.57</td>
<td>0.019</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.33</td>
<td>1.08–1.69</td>
<td>0.008</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>1.03</td>
<td>0.85–1.24</td>
<td>0.754</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>1.06</td>
<td>0.81–1.38</td>
<td>0.669</td>
</tr>
<tr>
<td>AF</td>
<td>1.89</td>
<td>1.28–2.82</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Gami et al. Circulation 2004
Figure 2. Adjusted OR and 95% CI for association between AF and OSA. After adjustment for body mass index, neck circumference (neck circ), hypertension, and diabetes mellitus, AF is significantly associated with OSA (OR 2.19, 95% CI 1.40 to 3.42, P=0.0006).

Gami et al. Circulation 2004
OSA Causes Interatrial Conduction Delay (ICD)

• 250 pts undergoing sleep study
• No history of AF or heart disease
• ICD defined as P wave $\geq 110$ msec
• ICD strongly correlated with AHI (1.54 per 10/hour)
Presence of OSA predicts reconnection of PVs

### Table 2: Predictors of PV reconnection after Multivariable Adjustment

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Relative risk</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN</td>
<td>1.45 (1.21, 2.43)</td>
<td>0.02</td>
</tr>
<tr>
<td>LA size &gt;4.5 cm</td>
<td>1.69 (1.12, 2.5)</td>
<td>0.01</td>
</tr>
<tr>
<td>Age (years)</td>
<td>1.05 (1.03, 1.09)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>OSA</td>
<td>2.16 (1.32, 3.94)</td>
<td>0.01</td>
</tr>
<tr>
<td>Persistent</td>
<td>1.34 (1.09, 1.87)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

†Abbreviations: HTN = Hypertension; LA = Left Atrial; OSA = Obstructive Sleep Apnea.

n=424

Sauer Heart Rhythm 2006
Why is OSA associated with AF?

• (Not all studies show a correlation)
• Swings in Intrathoracic pressure can cause stretch and enlargement of the atria and PVs
• Instability of Autonomic tone; Vagalitic $\rightarrow$ Bradycardia
• Surges in Sympathetic Neural Activity (SNA) $\rightarrow$ Triggers (Including Non-PV triggers)
• Association with Obesity
• Increase in Systemic Inflammation with OSA
Fish Oil (PUFAs*)

- Differences may be dose dependent
- Most trial had doses between 4-8 g/d
- Positive trials used PUFAs in conjunction with antiarrhythmic drugs
- May be more beneficial in persistent AF
- Low-cost, low-risk
- Larger Trials are underway

*Prescription-Grade Omega-3 fatty acids
Coffee and Arrhythmias

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N</th>
<th>&lt;1 cup/day</th>
<th>1–3 cups/day</th>
<th>≥4 cups/day</th>
<th>Per cup per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any arrhythmia</td>
<td>3137</td>
<td>0.97 (0.85–1.11)</td>
<td>0.93 (0.84–1.02)</td>
<td>0.82 (0.73–0.93)</td>
<td>0.97 (0.95–0.99)</td>
</tr>
<tr>
<td>Paroxysmal supraventricular tachycardia</td>
<td>257</td>
<td>0.85 (0.54–1.34)</td>
<td>1.01 (0.72–1.40)</td>
<td>0.63 (0.41–0.98)</td>
<td>0.94 (0.88–1.02)</td>
</tr>
<tr>
<td>Paroxysmal ventricular tachycardia</td>
<td>232</td>
<td>0.99 (0.59–1.63)</td>
<td>1.04 (0.71–1.53)</td>
<td>1.22 (0.79–1.87)</td>
<td>1.05 (0.98–1.12)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>1512</td>
<td>0.82 (0.67–1.00)</td>
<td>0.88 (0.76–1.01)</td>
<td>0.81 (0.69–0.96)</td>
<td>0.97 (0.94–1.00)</td>
</tr>
<tr>
<td>Atrial flutter</td>
<td>273</td>
<td>0.99 (0.65–1.93)</td>
<td>0.86 (0.62–1.20)</td>
<td>0.80 (0.54–1.19)</td>
<td>0.97 (0.91–1.04)</td>
</tr>
<tr>
<td>Ventricular fibrillation/flutter/cardiac arrest</td>
<td>91</td>
<td>0.62 (0.28–1.34)</td>
<td>0.72 (0.42–1.22)</td>
<td>0.47 (0.23–0.96)</td>
<td>0.88 (0.78–1.00)</td>
</tr>
<tr>
<td>Premature beats</td>
<td>91</td>
<td>1.98 (1.02–3.84)</td>
<td>0.98 (0.54–1.79)</td>
<td>0.62 (0.28–1.35)</td>
<td>0.87 (0.77–0.99)</td>
</tr>
<tr>
<td>Other arrhythmia</td>
<td>755</td>
<td>1.02 (0.79–1.32)</td>
<td>0.93 (0.77–1.14)</td>
<td>0.72 (0.56–0.93)</td>
<td>0.94 (0.90–0.98)</td>
</tr>
</tbody>
</table>

- Versus nondrinkers as referent, with 8 covariates.
- First admission for each diagnosis used; study participants could be in more than one category.
- Coffee as continuous variable; see text for description.
- Hazard ratio for 4–6 cups/day = 0.82; hazard ratio for ≥6 cups/day = 0.83.
- p < 0.01.
- p < 0.05.
Smoking and AF

- Smoking increases inflammation
- 15,000 pts ARIC study – 15 yrs
- Former/Current smokers OR 1.32 / 2.05
- Risk increases with increasing cigarette years
- Supports the finding of 2 other cohort studies (Framingham and Rotterdam Study)
- Two previous cohort studies did not find a link but did not account for former smokers

Chamberlain Heart Rhythm 2011
Statin Use May reduce AFib

Siu et al, 2003
AF and HTN

• Prevalence of AF and HTN very common
• Prevalence of both increase with age
• ACE inhibitors appear to reduce the risk of developing AF in patients with HTN compared to CCB by approx 15%
• HTN results in LVH and LA enlargement
• Atrial stretch and fibrosis may be substrate for AF mediated by angiotensin II
Rx of HTN and Incidence of AF

L’Allier et al, 2004
Afib Ablation results are worse in lower GFR

Naruse Heart Rhythm 2011
Alcohol and Vagal Tone

• 223 pts presenting for EPS/Ablation
  – (113 PAF 90 SVT)
• ETOH use as trigger
  – OR 4.42 (1.35-14.44) more likely in PAF
• Vagal activity prior to episode
  – OR 2.02 (1.02-4.0) more likely prior to PAF

Mandvam AJC 2012
Balloon Isolation of the PV

- Cryo, Laser, RF, US Energy
- Potential advantages
  - Applying a single lesion
  - Easier?
  - Reduced procedure time
  - Improved Safety?
  - Improved Success?
- Disadvantages
  - One size does not necessarily fit all
  - Does not address the PV antrum or non-PV triggers
  - Phrenic Nerve Injury

Tanaka, JACC 2001
STOP-AF

- 245 patients paroxysmal AF
- Randomized 2:1 cryo vs. medication
- Acute procedural success (≥ 3PVs)
  - 98.2% (160/163)
- Freedom from AF at 1 year
  - 69.9% vs. 7.3%
  - Included 19% Redo procedures in blanking period
  - 60% single procedure success rate

Packer JACC 2013
73% of patients were free from atrial fibrillation at 12 months. 98% acute procedure success rate.
(Arctic Front Data)

One year freedom from AF, 3 month blanking period.

- **Neumann 2008** (n=113) - 72.57% (95% CI 63.37 - 80.54)
- **Van Belle 2008** (n=139) - 74.10% (95% CI 65.99 - 81.15)
- **Kojodjojo 2010** (n=90) - 76.67% (95% CI 66.57 - 84.94)
- **Kuhne 2010** (n=14) - 71.43% (95% CI 41.90 - 91.61)
- **Packer 2010** (n=163) - 69.94% (95% CI 62.27 - 76.86)

**Combined** - 72.83% (95% CI 68.79 - 76.62)

Meta-analysis
STOP-AF

• Complications
  – Phrenic Nerve Palsy 11.2% (1.8% at 1 year)
  – PV Stenosis 3.1% (2/7 required Rx)
  – Both of these complications have come down with experience
  – Case reports of AE fistuale

Packer JACC 2013
Andrade Heart Rhythm 2011
Procedure Duration

Methods:
- 444 procedures were conducted in nine German centers
- Retrospective study used random record collection
- Excluded patients with serious complications

[Graph showing procedure duration time across three categories: Lab Occupancy Time, Primary Physician Time, and Fluoroscopy Time, with reductions indicated by -33% and -24% for different methods.]

1 Medtronic, Inc. data on file.
AF Reduces QOL

**FIGURE 7: AFIB REDUCES PATIENTS’ QUALITY OF LIFE**

Quality of Life Scores for AFib Patients Compared to Patients with Other Cardiovascular Conditions and Control Group


AFib = atrial fibrillation; CHF = congestive heart failure; Post MI = post myocardial infarction
# Improved QOL: RF v. AAD

## Table 4. Quality of Life Assessment

<table>
<thead>
<tr>
<th>Short-Form 36 Subscale</th>
<th>Pulmonary Vein Isolation Group (n = 32)</th>
<th>Antiarrhythmic Drug Group (n = 35)</th>
<th>Corrected Difference in Mean Change at 6 mo (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (Mean ± SD)</td>
<td>Follow-up (Mean ± SD)</td>
<td>Baseline (Mean ± SD)</td>
<td>Follow-up (Mean ± SD)</td>
</tr>
<tr>
<td>General health</td>
<td>57 (2)</td>
<td>9 (1)</td>
<td>57 (2)</td>
<td>68 (2)</td>
</tr>
<tr>
<td>Physical functioning</td>
<td>71 (3)</td>
<td>97 (3)</td>
<td>69 (2)</td>
<td>75 (7.5)</td>
</tr>
<tr>
<td>Role physical</td>
<td>73 (5)</td>
<td>71 (2)</td>
<td>51 (5)</td>
<td>53 (3)</td>
</tr>
<tr>
<td>Bodily pain</td>
<td>71 (3)</td>
<td>97 (1)</td>
<td>70 (3)</td>
<td>90 (3)</td>
</tr>
<tr>
<td>Mental health</td>
<td>65 (4)</td>
<td>65 (2)</td>
<td>64 (2)</td>
<td>68 (3)</td>
</tr>
<tr>
<td>Social functioning</td>
<td>78 (3)</td>
<td>93 (3)</td>
<td>76 (2)</td>
<td>82 (2)</td>
</tr>
<tr>
<td>Role emotional</td>
<td>70 (1)</td>
<td>76 (1)</td>
<td>70 (1)</td>
<td>75 (1)</td>
</tr>
<tr>
<td>Vitality</td>
<td>52 (4)</td>
<td>65 (1)</td>
<td>51 (1)</td>
<td>60 (2)</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

*Quality of life was assessed using the Medical Outcomes Study 36-item Short-Form health survey (Short-Form 36) and was measured at enrollment and 6-month follow-up visit."
Hybrid; Catheter and Surgical Ablation of Recurrent AFib
### What Do We Do Well?

<table>
<thead>
<tr>
<th>Surgeons</th>
<th>Electrophysiologists</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Direct visualization</td>
<td>• Map for focal triggers</td>
</tr>
<tr>
<td>• Create most linear ablations quickly and effectively</td>
<td>• Ablate areas difficult to reach from epicardial approach</td>
</tr>
<tr>
<td>• Map ganglionic plexi</td>
<td>– Tricuspid and mitral valve isthmus</td>
</tr>
<tr>
<td>• Address left atrial appendage</td>
<td>• Rigorously assess for complete block and map/ablate gaps in a linear lesions</td>
</tr>
</tbody>
</table>

**Hybrid AF Ablation**
DEEP AF Epicardial Lesion Set

Hybrid DEEP AF Lesion set

- LAA
- SVC Encircling
- SVC to IVC
- Roof Line
- PVI
- Left Isthmus to Coronary Sinus
- Floor Line

Right Isthmus lesion not shown in illustration

©2008
Good Cosmetic Result
No Rib Spreading
Results

Effectiveness

N=78

Success:
- 100% Long-Standing Persistent
- 82% Persistent (85% on AAD)
- 76% Paroxysmal (97% on AAD)

No deaths; 8% peri-procedure complication rate
Patient Selection

• Long-Standing persistent Afib
• Failed catheter ablation
• Interest in addressing LAA
• Minimally invasive approach
  – No prior cardiac surgery
  – Weight limitations
  – Pectus excavatum
Right Side

• Pulmonary Vein Antrum isolation

Image courtesy of Joseph A. Pangrace © 2009
Procedure Ports Overview – Left Side

- Method of gaining access and PV isolation similar to right side
- Exclusion of LAA
Voltage map of la – pa view
Voltage Map after Roof Line