Perioperative Atrial Fibrillation Update

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February 4, 2019
Puerto Vallarta, Mexico
Peri/Post-Operative Atrial Fibrillation (POAF)

• Outpatient atrial fibrillation (AF) management
• POAF prophylaxis
• Management of POAF
• Electrical cardioversion
• Anesthesia considerations for catheter based AF procedures
Disclosures
AFib Costs and Consequences

More than 750,000 hospitalizations occur each year because of AFib. The condition contributes to an estimated 130,000 deaths each year. The death rate from AFib as the primary or a contributing cause of death has been rising for more than two decades. AFib costs the United States about $6 billion each year. Medical costs for people who have AFib are about $8,705 higher per year than for people who do not have AFib.

AFib Facts

- An estimated 2.7–6.1 million people in the United States have AFib. With the aging of the U.S. population, this number is expected to increase.
- Approximately 2% of people younger than age 65 have AFib, while about 9% of people aged 65 years or older have AFib.
- African Americans are less likely than those of European descent to have AFib.
- Because AFib cases increase with age and women generally live longer than men, more women than men experience AFib.
What’s wrong with chronic atrial fibrillation?

• Compromised hemodynamics
  • Spectrum from mild impaired LV filling to cardiogenic shock
  • Patients are differentially affected (cardiomyopathy vs AS)

• Disorganized contraction in LA →stasis→ thrombus→embolism
  • Stroke
  • Peripheral obstruction
Thrombus formation in left atrium

• @48 hours 1.4% of patients have thrombus

• @12 months 14.7% of patients have thrombus
Classification

• Paroxysmal AF (spontaneously terminates within 7 days)

• Persistent AF (fails to self-terminate within 7 days)

• Long-standing persistent AF (duration >12 months)

• “Permanent AF”: denotes a physician/patient decision to pursue a rate control strategy only
Outpatient: new onset evaluation and associated conditions

- History and Physical exam
- Electrocardiogram
- Transthoracic echocardiogram
- Search for underlying conditions
- Search for common comorbidities
- Laboratory testing
  - Comprehensive metabolic panel
  - TSH and free T4

- Hypertension (60-80%)
- Cardiovascular disease (25-30%)
  - Coronary artery disease
  - Valvular heart disease
  - Hypertrophic cardiomyopathy
  - Congenital heart disease
  - Myocarditis syndromes
- Heart failure: HFP EF/HFr EF (30%)
- Diabetes (20%)
- Venous thromboembolic disease
- COPD
- Diabetes
- Chronic kidney disease
- Substance use: EtOH and others
- Inflammation
Outpatient management decisions

• Search for underlying conditions

• Rate control vs Rhythm Control

• Stroke prevention strategy
Summary of rate vs rhythm control

• First priority is controlling heart rate (target <80)
• Cardioversion is generally attempted if no exclusion criteria identified
• Dilemma:
  • ~2/3 of patients with NOAF spontaneously revert within 72 hours
  • ~2/3 of patients which spontaneously revert will do so in first 24 hours
  • Anticoagulation (3 weeks) or TEE evaluation is required prior to cardioversion after 48 hours
• Second priority is anticoagulation
  • Most patient anticoagulated for at least 4 weeks even after sinus rhythm restored (still at risk due to poor left atrial contraction)
• Recurrent episode: further discussion of long term strategy

**Figure 1**

**CHADS<sub>2</sub> Score**

This figure illustrates the prevalence of transesophageal echocardiogram characteristics relative to CHADS<sub>2</sub> scores.
<table>
<thead>
<tr>
<th>CHA&lt;sub&gt;2&lt;/sub&gt;DS&lt;sub&gt;2&lt;/sub&gt;-VASc</th>
<th>Score</th>
<th>HAS-BLED</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure/LV dysfunction</td>
<td>1</td>
<td>Hypertension i.e. uncontrolled BP</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
<td>Abnormal renal/liver function</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Aged ≥75 years</td>
<td>2</td>
<td>Stroke</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
<td>Bleeding tendency or predisposition</td>
<td>1</td>
</tr>
<tr>
<td>Stroke/TIA/TE</td>
<td>2</td>
<td>Labile INR</td>
<td>1</td>
</tr>
<tr>
<td>Vascular disease [prior MI, PAD, or aortic plaque]</td>
<td>1</td>
<td>Age (e.g. &gt;65)</td>
<td>1</td>
</tr>
<tr>
<td>Aged 65-74 years</td>
<td>1</td>
<td>Drugs (e.g. concomitant aspirin or NSAIDss) or alcohol</td>
<td>1</td>
</tr>
<tr>
<td>Sex category [i.e. female gender]</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum score</strong></td>
<td><strong>9</strong></td>
<td><strong>Score</strong></td>
<td><strong>9</strong></td>
</tr>
<tr>
<td>CHADS2 Score</td>
<td>Adjusted Stroke Risk(%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>18.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Low risk for stroke is ≤ 1 risk factor
• Recommend prophylaxis for all others after considering individual bleeding risk

Extrapolating* Risk of Death from Travel

- Flying from DTW to PVR
- Driving from DTW to PVR
- Bicycle from DTW to PVR
- Motorcycle from DTW to PVR
- Space shuttle from DTW to PVR
- How many trips from DTW to PVR equals the risk from 1 skydive?

Megamillions 1/300M
Reserve chute 1/548
AF medication overview

• Anticoagulants: eg warfarin, NOAC, heparin derivatives

• Rhythm control agents: eg procainamide, propafenone, ibutilide, amiodarone (Singh and Williams class I,II, III agents)

• Rate control agents: eg metoprolol, propranolol, diltiazem, verapamil, amiodarone

• Comorbidity agents: eg COPD, DM, thyroid, CKD
What to do about a new diagnosis in preop?
Pathophysiology of Perioperative Atrial Tachyarrhythmias

Preexisting Atrial Pathology $^{5,9,18-20}$
- Aging (fibrosis, inflammation)
- Atrial distension (heart failure, valvular disease)

Atrial Electrical Substrate

Aggravating Factors
- Surgically induced trauma
  - Autonomic denervation
  - Cannulation of atria
- High Adrenergic tone
  - Elevated heart rate before surgery $^{8,16,17}$
  - After surgery $^{5,7,9}$
- Inflammatory response $^{14,15,20}$
  - Postoperative state (CRP, IL-6)
  - Pericardial/myocardial
- Tachycardia induced $^{9,18}$
  - Remodeling of the atria
  - Ionic channel changes

Triggers $^{5,7,9,18}$
- Atrial premature beats
- Intense sympathetic and/or vagal stimulation
- Acute atrial stretch
Overview of Postoperative AF

• Impact of POAF

• Natural history of POAF

• Prevention

• Treatment
Consequences of POAF in non-cardiac surgery

<table>
<thead>
<tr>
<th>Complication</th>
<th>OR(CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>2.0(1.7-2.3)</td>
</tr>
<tr>
<td>CHF</td>
<td>3.9(2.9-5.3)</td>
</tr>
<tr>
<td>MI</td>
<td>4.2(2.7-6.6)</td>
</tr>
<tr>
<td>CPR</td>
<td>8.0(3.9-16)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>7.4(5.5-9.9)</td>
</tr>
<tr>
<td>LOS</td>
<td>2.5days (1.9-3.1)</td>
</tr>
</tbody>
</table>

1.6 million patients non-cardiac surgery

Incidence by Type of Surgery

• Unselected adults >45yr 3%

• Joint replacement 4.8%

• Abdominal surgery 12-19%

• **Thoracic surgery 30% (anatomic lung resections & esophagectomy)

• **Cardiac surgery 40% (20-80%)
Predictors of POAF for non-cardiac surgery

Typical onset is by POD #2-4

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>OR (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop HR ≥ 72 bpm</td>
<td>1.89(1.15-3.13)</td>
</tr>
<tr>
<td>Male gender</td>
<td>1.95(1.16-3.30)</td>
</tr>
<tr>
<td>Elevated BNP</td>
<td>3.13(1.38-7.12)</td>
</tr>
<tr>
<td>Age 55-74 years</td>
<td>4.88(1.69-14.13)</td>
</tr>
<tr>
<td>Age ≥ 75 years</td>
<td>9.31(2.01-29.50)</td>
</tr>
</tbody>
</table>

Passman et al
## Prevention of postoperative atrial fibrillation

<table>
<thead>
<tr>
<th>β-blockers</th>
<th>Amiodarone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statins</td>
<td>Corticosteroids</td>
</tr>
<tr>
<td>Non-steroidal anti-inflammatory drugs</td>
<td>Colchicine</td>
</tr>
<tr>
<td>Angiotensin converting enzyme inhibitors</td>
<td>Vitamin C</td>
</tr>
<tr>
<td>N-Acetylcysteine</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Off-pump coronary artery bypass grafting</td>
<td>Atrial pacing</td>
</tr>
<tr>
<td>Transcatheter aortic valve replacement</td>
<td>Posterior pericardiotomy</td>
</tr>
</tbody>
</table>
Prophylaxis Against Atrial Fibrillation After General Thoracic Surgery
Trial Sequential Analysis and Network Meta-Analysis

Bing-Cheng Zhao, MD; Tong-Yi Huang, MD; Qi-Wen Deng, MD; Wei-Feng Liu, MD, PhD; Jian Liu, MD; Wen-Tao Deng, MD; Ke-Xuan Liu, MD, PhD; and Cai Li, MD, PhD
### Table: Results of Bayesian Network Meta-analysis for the Incidence of Postoperative Atrial Fibrillation/Flutter

<table>
<thead>
<tr>
<th>Treatments</th>
<th>OR (95% CrI)</th>
<th>ARD, %</th>
<th>NNT</th>
<th>$P_{\text{best}}$, %</th>
<th>Rank (95% CrI)</th>
<th>SUCRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>reference</td>
<td>--</td>
<td>--</td>
<td>0.0</td>
<td>7 (6, 8)</td>
<td>0.120</td>
</tr>
<tr>
<td>Digoxin</td>
<td>1.25 (0.60-2.64)</td>
<td>-3.9</td>
<td>--</td>
<td>0.0</td>
<td>8 (6, 8)</td>
<td>0.054</td>
</tr>
<tr>
<td>CCBs</td>
<td>0.52 (0.29-0.85)</td>
<td>9.2</td>
<td>10.8</td>
<td>0.0</td>
<td>5 (3, 6)</td>
<td>0.379</td>
</tr>
<tr>
<td>Statins</td>
<td>0.43 (0.12-1.48)</td>
<td>10.4</td>
<td>8.3</td>
<td>4.1</td>
<td>5 (1, 8)</td>
<td>0.469</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.35 (0.16-0.74)</td>
<td>13.0</td>
<td>7.7</td>
<td>1.5</td>
<td>4 (2, 6)</td>
<td>0.546</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>0.25 (0.14-0.43)</td>
<td>15.8</td>
<td>6.3</td>
<td>4.8</td>
<td>3 (1, 5)</td>
<td>0.721</td>
</tr>
<tr>
<td>ACEi</td>
<td>0.22 (0.08-0.56)</td>
<td>16.2</td>
<td>6.1</td>
<td>12.0</td>
<td>2 (1, 6)</td>
<td>0.755</td>
</tr>
<tr>
<td>β-Blockers</td>
<td>0.12 (0.05-0.27)</td>
<td>19.2</td>
<td>5.2</td>
<td>77.7</td>
<td>1 (1, 3)</td>
<td>0.957</td>
</tr>
</tbody>
</table>

**Figure 5** - Results of the Bayesian network meta-analysis for the incidence of postoperative atrial fibrillation/flutter. ARD = absolute risk reduction; CrI = credible interval; NNT = number needed to treat; $P_{\text{best}}$ = probability of being best; SUCRA = surface under the cumulating ranking curve. See Figure 2 legend for expansion of other abbreviations.
Is Prophylaxis Effective in Thoracic Surgery?

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Patients, No.</th>
<th>Studies, No.</th>
<th>OR (95% CI)</th>
<th>P Value</th>
<th>Cochran Q P Value</th>
<th>I², %</th>
</tr>
</thead>
<tbody>
<tr>
<td>POAF</td>
<td>2,353</td>
<td>19</td>
<td>0.33 (0.22-0.49)</td>
<td>&lt; .001</td>
<td>.004</td>
<td>53</td>
</tr>
<tr>
<td>30-d in hospital mortality</td>
<td>2,294</td>
<td>18</td>
<td>0.85 (0.41-1.73)</td>
<td>.46</td>
<td>.90</td>
<td>0</td>
</tr>
<tr>
<td>Severe pulmonary complications</td>
<td>1,860</td>
<td>15</td>
<td>1.17 (0.59-2.30)</td>
<td>.66</td>
<td>.60</td>
<td>0</td>
</tr>
<tr>
<td>Major adverse cardiovascular events</td>
<td>1,516</td>
<td>13</td>
<td>0.39 (0.17-0.87)</td>
<td>.02</td>
<td>.75</td>
<td>0</td>
</tr>
<tr>
<td>Hypotension</td>
<td>1,791</td>
<td>12</td>
<td>2.37 (1.14-4.94)</td>
<td>.02</td>
<td>.04</td>
<td>49</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>1,101</td>
<td>10</td>
<td>3.00 (1.17-7.68)</td>
<td>.02</td>
<td>.19</td>
<td>32</td>
</tr>
<tr>
<td>Withdrawal due to adverse events</td>
<td>894</td>
<td>8</td>
<td>1.67 (0.67-4.16)</td>
<td>.27</td>
<td>.35</td>
<td>6</td>
</tr>
</tbody>
</table>

Zhou: CHEST 2017; 151(1):149-159
POISE: Metoprolol 100mg non-cardiac surgery

<table>
<thead>
<tr>
<th>Event</th>
<th>Increase/Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>fewer myocardial infarctions</td>
<td>15</td>
</tr>
<tr>
<td>fewer patients undergoing revascularisation</td>
<td>3</td>
</tr>
<tr>
<td>fewer developing new AF</td>
<td>7</td>
</tr>
<tr>
<td>additional deaths</td>
<td>8</td>
</tr>
<tr>
<td>additional strokes</td>
<td>5</td>
</tr>
<tr>
<td>suffering significant hypotension</td>
<td>52</td>
</tr>
<tr>
<td>suffering significant bradycardia</td>
<td>42</td>
</tr>
</tbody>
</table>

Paul Min Thein, MBBS\textsuperscript{a,b,}\textsuperscript{*}, Kyle White, MBBS\textsuperscript{b}, Khyati Banker, BPharm\textsuperscript{b}, Carole Lunny\textsuperscript{c}, Sam Mirzaee, MBBS, MCRM, FRACP\textsuperscript{d}, Arthur Nasis, MD, PhD, FRACP\textsuperscript{d}

Results

Five RCTs (688 subjects, mean age 61 ± 8.9, 69% male) were included. Beta blocker administration prior to elective cardiac surgery significantly reduced the incidence of POAF (OR 0.43, 95%CI [0.30–0.61], I\textsuperscript{2} = 0\%) without significant impact on ischaemic stroke (OR 0.49, 95%CI [0.10–2.44], I\textsuperscript{2} = 0\%), non-fatal myocardial infarction (OR 0.76, 95%CI [0.08–7.44], I\textsuperscript{2} = 0\%), overall mortality (OR 0.83, 95%CI [0.19–3.66], I\textsuperscript{2} = 0\%), or length of stay (mean −0.96 days 95%CI [−1.49 to −0.42], I\textsuperscript{2} = 0\%). An increased rate of bradycardic episodes was observed (OR 3.53, 95%CI [1.22–10.23], I\textsuperscript{2} = 0\%).
Take home for POAF prophylaxis in non-cardiac surgery patients

• Predictors: age and high atrial pressure

• Continue b-blockers (also Ace Inhibitors?)

• Many agents effective on POAF

• Beta blockers effective (pre vs post op) (risk vs benefit)

• Specific patient populations need further study to balance R/B
Acute Intraoperative Management
Electrolyte Goals

- Potassium 4.5-5.5 mmol/L
  - PIV 20meq/hr
  - CIV 40meq/hr
  - Caution renal impairment/massive resuscitation
  - Continuous ecg if >20meq/hr
  - Extravasation/phlebitis concerns

- Magnesium 1-2 mmol/L
  - 2g over ~20min
  - Caution renal impairment
  - Flushing/drowsiness/respiratory depression
  - ECG and calcium monitoring
Acute Intraoperative Management

• Beta blocker: (caution heart failure/asthma)
  • Esmolol 0.5mg/kg then 50-200 mcg/kg/min
  • Metolprolol 1-5 mg

• Calcium channel blocker: (caution heart failure)
  • Diltiazem 0.25mg/kg then 5-15 mg/kg/hr

• Amiadarone 150-300mg over 10 min then infusion
  • (Caution: pregnancy, porphyria, bradycardia after conversion, phlebitis/extravasation)
  • Preferred when EF < 40%
Acute Intraoperative Management
Cardioversion for hemodynamic instability

• Biphasic 120-150J, Monophasic 200J, escalate to 360J
• Contraindications
  • Stable patient with duration >48hr without appropriate precautions for LA thrombus (anticoag vs. TEE)
  • × Digitalis toxicity ×
• Prepare for dysrhythmias after CV
Anaesthesia for cardioversion

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The diagram illustrates a circuit with a switch at point A, a capacitor at point C, and a resistor at point R. The current (I) over time can be described by the formula: 

\[ I = \frac{V}{R} \]
Review the device at your institution
Review the device at your institution
Complications

- Lip/tongue laceration
- Extremity injury
- Local burn
- Fire (enriched oxygen environment)
- Stunned myocardium (especially those with PAH and/or RV/LV systolic dysfunction)
- Bradycardia/asystole post conversion (0.9%)
- Stroke (0.22 – 1.06%)
What about this patient?
POAF treatment considerations

- Hemodynamic stability
- Ventricular rate control
- Anticoagulation if >48hrs
  - Assess thrombosis risk
  - Assess bleeding risk
- POAF is a marker for worse outcomes
Do patients need TEE for outpatient cardioversion or Afib Ablation?

- How reliably are patients taking NOACs? (medical and legal risk)

- Risk/benefits of “ordering” at TEE; risks of anticoagulation

- Appropriate anticoagulation or TEE guidance = 0.5% risk of stroke

- Not anticoagulated = 5.2% risk of stroke (unselected patient population)

- Longstanding AF = 14% of thrombus; 1.4% if duration < 48 hours
Other anesthesia considerations for Atrial Fibrillation

• Radiofrequency Catheter Ablation (RFCA)

• Left atrial appendage (LAA) exclusion devices
Indications for Afib ablation

• Curative: a flutter, AVNRT, WPW, Unifocal Atrial tachycardia

• High initial success rate: lone paroxysmal afib
  • 80% success rate at 1 year

• Lower success rate: persistent afib with structural heart disease
  • ~50% success rate at 1 year

• Approximately 25% of AF RFCA patients will require repeat procedure
Fancy afib ablation

• Stereotaxis
• Cryoablation
• Additional RFCA lesion patterns
• High Frequency Jet Ventilation
• Minimally invasive surgical MAZE
Anesthesia for RFCA

257 patients: “General anesthesia is associated with higher cure rate with a single procedure” (69% vs 88%)

650 patients, no conversion to GA-ETT “Deep sedation is feasible and safe”

164 patients: Use of HFJV for PVI using RFCA associated with improved outcomes without increase in adverse procedural events (1 year 69% vs 50% success)
<table>
<thead>
<tr>
<th>RFCA complications</th>
<th>Mitigation strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophageal injury 0.2-12%</td>
<td>Esophageal temp monitoring</td>
</tr>
<tr>
<td>Stroke 0.4-1.0%</td>
<td>Procedural anticoagulation/preop TEE</td>
</tr>
<tr>
<td>Tamponade 1.3%</td>
<td>POCUS, expectant management</td>
</tr>
<tr>
<td>Phrenic nerve injury 4.4-7.5%</td>
<td>Avoid NMB, phrenic pacing via RIJ</td>
</tr>
<tr>
<td>Air embolism</td>
<td>Vigilance with catheters in LA</td>
</tr>
<tr>
<td>Pulmonary vein stenosis</td>
<td>Late complication: PV stenting</td>
</tr>
</tbody>
</table>
Left Atrial Appendage Closure as an Alternative to Warfarin for Stroke Prevention in Atrial Fibrillation
A Patient-Level Meta-Analysis

FIGURE 2 PROTECT AF/PREVAIL Combined: Meta-Analysis Shows Comparable Primary Efficacy Results to Warfarin

<table>
<thead>
<tr>
<th>Event</th>
<th>HR</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All stroke or SE</td>
<td>0.79</td>
<td>0.22</td>
</tr>
<tr>
<td>Ischemic stroke or SE</td>
<td>1.02</td>
<td>0.94</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>1.95</td>
<td>0.05</td>
</tr>
<tr>
<td>Ischemic stroke or SE &gt;7 days</td>
<td>0.22</td>
<td>0.004</td>
</tr>
<tr>
<td>CV/unexplained death</td>
<td>1.56</td>
<td>0.21</td>
</tr>
<tr>
<td>All-cause death</td>
<td>0.48</td>
<td>0.006</td>
</tr>
<tr>
<td>Major bleed, all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major bleeding, non-procedure-related</td>
<td>0.73</td>
<td>0.07</td>
</tr>
<tr>
<td>Favors Watchman</td>
<td>0.01</td>
<td>1</td>
</tr>
<tr>
<td>Favors warfarin</td>
<td>0.1</td>
<td>10</td>
</tr>
<tr>
<td>Hazard Ratio (95% CI)</td>
<td>0.01</td>
<td>10</td>
</tr>
</tbody>
</table>
Anesthetic considerations for LAA device occlusion
Take home points

• Go home and power on your defibrillator machine (seriously, do it)
• Talk with surgical colleagues about prophylaxis for at risk patients
• Have a plan for intraop atrial fibrillation
• Understand principles and performance of cardioversion
• Be appropriately concerned for LA thrombus
• Dive deeper into catheter based therapies if that is in your practice