Disclosures

♥ Mary Eng Huntsinger
♥ None

♥ Stephanie H. Yoakum
♥ None
Objectives

♥ List the primary etiologies of atrial fibrillation (AF)
♥ Discuss the difference in management between rate and rhythm control
♥ Discuss the different anticoagulation options for CVA prophylaxis related to AF
ABC’s of AF

♥ Who?
♥ What?
♥ Why?
♥ When?
♥ Where?
ABC’s of AF

❤ Definition
❤ Incidence and prevalence
❤ Mechanism
❤ Classification / Types
❤ Evaluation of patient
❤ Recommendations for management
What is AF?

❤ Definition: a supraventricular tachyarrhythmia with uncoordinated atrial activation resulting in deterioration of atrial mechanical function

❤ On ECG, P wave is replaced by irregular fibrillatory waves with varying shape & timing

❤ Irregular ventricular response, depends on AV node, vagal & sympathetic tone, or drugs

❤ May occur with atrial flutter or other atrial tachycardias
Normal Electrocardiogram (ECG)

♥ EKG = ECG
♥ P wave: atrial depolarization
♥ PR interval: AV conduction
♥ QRS complex: ventricular depolarization
♥ T wave: ventricular repolarization
♥ Normal sinus rhythm: things are regular
Atrial Fibrillation
AF: “Irregularly Irregular”

♥ Normal sinus rhythm (NSR)
  • P waves precedes QRS complexes
  • R-R waves are at regular intervals

♥ Atrial Fibrillation (AF)
  • No discernable P waves
  • Irregularly irregular R waves
Incidence & Prevalence

♥ AF is the most common arrhythmia
♥ AF accounts for ~ 1/3 of hospitalizations
♥ Affects ~2.3 million people in North America & 4.5 million in Europe
♥ Past 20 years, hospital admissions increased by 66%
  • Aging population
  • Rising prevalence of chronic heart disease
  • More frequent diagnosing

ACC/AHA/ESC AF Guidelines 2006
Hospitalizations for AF Are Increasing

1985-1999: National Hospital Discharge Survey

AF as principal diagnosis*

Age (y) 85+ 75-84 65-74 55-64 35-54

AF as secondary diagnosis*

Per 10,000 Persons

Year

*Also includes atrial flutter.

AF: Prevalence Increases with Age

2.3 million No America, 4.5 million in EU

Costs of Atrial Fibrillation

♥ Past 20 years, 66% increase in hospital admissions
  • Aging population
  • Rising prevalence of chronic heart disease
  • More frequent diagnosing

♥ Expensive public health problem
  • $3600 per patient annually
  • Total cost burden, estimated $15.7 billion

♥ Distribution of cost
  • Hospitalizations (52%)
  • Drugs (23%)
  • Consults (9%)
  • Further investigations (8%)
  • Loss of work (6%)
  • Paramedical procedures (2%)

AF: EPIDEMIOLOGY

AF population predominantly >65 yrs with many co-morbidities

♥ AF prevalence estimate: 2.44 million and increasing (USA)
♥ Prevalence by age distribution:
  • 45 – 54 (7%)
  • 55 – 64 (10%)
  • 65 – 74 (24%)
  • 75 – 84 (34%)
  • 85+ (25%)

♥ AF is associated with other underlying CV conditions:
  • Hypertension (37%)
  • Heart Failure (22.5%)
  • Coronary Artery Disease (18%)
  • Diabetes (15%)
  • AMI (4%)

♥ Annual hospital admissions for AF in 2001: 384,000
Etiologies & Predisposing Factors

♥ EP abnormalities:
- Focal AF
- AVNRT

♥ Atrial Pressure Elevations:
- Valvular disease
- Myocardial disease leading to systolic or diastolic dysfunction

♥ Atrial Ischemia

♥ Inflammatory Atrial disease

♥ Sleep Apnea

♥ Primary or Metastatic disease

♥ Congenital HD

ACC/AHA/ESC AF Guidelines 2006
Etiologies & Predisposing Factors, p.2

♥ Drugs:
  • Alcohol or/or caffeine

♥ Endocrine Disorders
  • Hyperthyroidism

♥ Neurogenic

♥ Post-operative: \( \uparrow \) in Autonomic tone

♥ Idiopathic (lone AF)

♥ Familial AF

ACC/AHA/ESC AF Guidelines 2006
Causes of AF Among Emergency Admission to Hospital

- Hypertension: 35.9%
- Rheumatic heart disease: 23.5%
- Dysthyroid disease: 13.5%
- Ischaemic heart disease: 10%
- Other: 8.2%
- Angina: 7.1%
- Myocardial infarction: 6%
- Cerebrovascular accident or transient ischaemic attack: 5%
- Heart failure: 4.6%
- Other: 1.8%

Lip, GY, DG Beevers, 1996 UK.
AF Risk Factors

- Age
- Hypertension
- Heart disease
- Sleep apnea
- Other chronic conditions
- Alcohol use
- Drug use
- Family history
- Obesity
Clinical Consequences of AF

- Arrhythmia-associated symptoms: palpitations, dizziness, dyspnea, chest pain, fatigue
- Reduction in LV function, exercise tolerance, and QOL
- Tachycardia-mediated cardiomyopathy and CHF
- 2-fold ↑ in cardiac mortality
- 5-fold ↑ in risk of stroke
- Over 75,000 AF-strokes in US yearly
- Risk: 5 - 8% per year in high-risk patients; accounts for 15% of all strokes
  - Presumably due to LAA clot (95%)
- Significant burden to healthcare system
Clinical Presentation

♥ Asymptomatic
  • Found incidentally on exam

♥ Symptomatic
  • Palpitations
  • Chest pain
  • Dyspnea
  • Fatigue
  • Lightheadedness or syncope
  • CVA presentation
Clinical Evaluation

Basic & Minimum Evaluation

♥ History
♥ Physical Examination
♥ Electrocardiogram (12L ECG)
♥ Echocardiogram (transthoracic)
♥ Blood Tests
  – Thyroid, renal and hepatic functions
  – CBC
Clinical Evaluation

Additional Testing

- Six-minute walk
- Exercise Testing
- Holter Monitoring or Event Monitor
- Transesophageal Echocardiogram (TEE)
- Electrophysiology Study (EPS)
- Sleep Study
- Chest radiograph (CXR)
Management of Patients with AF

ACC/AHA/ESC Practice Guidelines

ACC/AHA/ESC 2006 Guidelines for the Management of Patients With Atrial Fibrillation—Executive Summary

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Revise the 2001 Guidelines for the Management of Patients With Atrial Fibrillation)

Developed in Collaboration With the European Heart Rhythm Association and the Heart Rhythm Society

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Classification of AF: 2006 ACC/AHA/ESC Guidelines

First Detected

Paroxysmal (Self-terminating)

Persistent (Not self-terminating)

Permanent

Classification

♥ Paroxysmal Atrial Fibrillation (23%)
  • Self terminating
  • Episodes lasts < 24-48 hours (most), & ≤ 7 days
  • May be recurrent episodes

♥ Persistent Atrial Fibrillation (38%)
  • Episodes lasts > 7 days, < 6 months
  • Does not self terminate

♥ Permanent Atrial Fibrillation (37%)
  • Cardioversion failed or not attempted
  • Usually > 30 days without reversible cause

♥ “Lone” Atrial Fibrillation (< 12%)
  • No identifiable cardiopulmonary abnormality
  • No RF of >75, Htn, HF, structural heart disease
Classification of recommendations:

- **Class I:** Favorable evidence of benefit of treatment
- **Class II:** Conflicting evidence/opinion
  - **Class IIa:** More likely to be of benefit/effective
  - **Class IIb:** Efficacy is less well established
- **Class III:** Not useful, treatment may even be harmful

Weight or level of evidence:

- **Level A:** Data is derived from multiple clinical trials
- **Level B:** Data derived from a limited # of trials
- **Level C:** Expert consensus was the basis of recommendation
Treatment of AF

❤️ Strategic objectives to management:

• Rate control
  - Control ventricular rate before you try to change the rhythm

• Correction of rhythm disturbance
  - Rhythm control is strategy attempts restoration or maintenance of sinus rhythm

• Prevention of thromboembolism
  - Antithrombotic therapy

❤️ Pharmacological & non-pharmacological treatment options
Therapeutic Approaches

♥ Pharmacologic
  • Rate Control: control ventricular rate
  • Rhythm control: pharmacologic cardioversion
  • Thromboembolic prevention: anticoagulation

♥ Nonpharmacologic
  • Direct current cardioversion
  • Surgical ablation ("MAZE")
  • Catheter ablation
    - Pulmonary vein isolation and rotors
    - AV node ablation & pacemaker implantation
  • Pacemakers & Implantable Cardioverter-Defibrillators
    - Suppression of AF through pacing
    - Internal cardioversions for AF through ICDs
Rate vs Rhythm Control

♥ Rate control is to control ventricular response rate & anticoagulate
♥ Rhythm control is to restore sinus rhythm
♥ Which is better?
Rhythm control no better than rate control: mortality, stroke, quality of life

Rate control should be the first approach to Rx

Anticoagulation is warranted in ALL patients with Afib (and Aflutter) and CVA risks
Cumulative Mortality in Rhythm-Control vs Rate-Control

<table>
<thead>
<tr>
<th>Years</th>
<th>Cumulative Mortality (%)</th>
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<tr>
<td>0</td>
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<tr>
<td>1</td>
<td>5</td>
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<td>2</td>
<td>10</td>
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<td>3</td>
<td>15</td>
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<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
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</table>

No. of Deaths

<table>
<thead>
<tr>
<th>Years</th>
<th>Rhythm control</th>
<th>Rate control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number (%)</td>
<td>number (%)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>80 (4)</td>
<td>78 (4)</td>
</tr>
<tr>
<td>2</td>
<td>175 (9)</td>
<td>148 (7)</td>
</tr>
<tr>
<td>3</td>
<td>257 (13)</td>
<td>210 (11)</td>
</tr>
<tr>
<td>4</td>
<td>314 (18)</td>
<td>275 (16)</td>
</tr>
<tr>
<td>5</td>
<td>352 (24)</td>
<td>306 (21)</td>
</tr>
</tbody>
</table>

P = 0.08

NEJM 2002: 347;23
AF Rx: Rate Control

♥ Class I
- Control HR w/ β-blocker or nondihydropyridine CCB (B)
- In acute setting: slow HR w/ β-blocker or NDH CCB (B)
- IV digoxin or amiodarone if no accessory pathways (B)
- If symptomatic w/ activity, check HR control with exercise and adjust therapy (C)

♥ Class IIa
- Digoxin + β-blocker or Digoxin + NDH CCB for rate control (B)
- Ablate AV node or accessory pathway if cannot control or tolerate w/ drugs (B)
- IV amio if other measures fail or is contraindicated (C)
- If DCCV is not necessary in pts w/ accessory pathway, can give IV procainamide or ibutilide as alternative (C)
AF Rx: Rate Control, cont.

♥ **Class IIb**

- Oral amio if inadequate rate control w/ β-blocker, NDH CCB, dig alone or in combo @ rest & exercise (C)
- Hemodynamically stable & w/ accessory pathway: can give IV procainamide, disopyramide, ibutilide or amio (B)
- If cannot control w/ drugs or suspect tachycardia induced CM, can ablate AV node (C)

♥ **Class III**

- Dig should not be used alone as sole agent (B)
- AV node ablation should not be done prior to trial of medications (C)
- Decompensated HF & AF, IV CCB can worsen hemodynamic compromise (C)
- Pts w/ pre-excitation syndrome & AF may have accelerated ventricular response w/ IV dig or NDH CCB, so do not give. (C)
# Agents for Rate Control of AF

## Acute Setting

<table>
<thead>
<tr>
<th>AGENTS</th>
<th>MAJOR SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients Without Accessory Pathway</strong></td>
<td></td>
</tr>
<tr>
<td>Esmolol</td>
<td>↓ BP, Heart Block, ↓ HR, asthma, HF</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>↓ BP, Heart Block, ↓ HR, asthma, HF</td>
</tr>
<tr>
<td>Propranolol</td>
<td>↓ BP, Heart Block, ↓ HR, asthma, HF</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>↓ BP, Heart Block, Heart Failure</td>
</tr>
<tr>
<td>Verapamil</td>
<td>↓ BP, Heart Block, Heart Failure</td>
</tr>
<tr>
<td><strong>Patients With Accessory Pathway</strong></td>
<td></td>
</tr>
<tr>
<td>Amiodarone</td>
<td>↓ HR, ↓ BP, hypothyroidism, pulmonary toxicity, corneal deposits &amp; optic neuropathy</td>
</tr>
<tr>
<td><strong>Patients With Heart Failure &amp; Without Accessory Pathway</strong></td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>Digitalis toxicity, Heart Block, ↓ HR</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>↓ HR, ↓ BP, hypothyroidism, pulmonary toxicity, corneal deposits &amp; optic neuropathy</td>
</tr>
</tbody>
</table>
## Agents for Rate Control of AF

### Non-acute setting

### AGENTS MAJOR SIDE EFFECTS

<table>
<thead>
<tr>
<th>AGENTS</th>
<th>MAJOR SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heart rate control</strong></td>
<td></td>
</tr>
<tr>
<td>Metoprolol</td>
<td>↓ BP, Heart Block, ↓ HR, asthma, HF</td>
</tr>
<tr>
<td>Propranolol</td>
<td>↓ BP, Heart Block, ↓ HR, asthma, HF</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>↓ BP, Heart Block, Heart Failure</td>
</tr>
<tr>
<td>Verapamil</td>
<td>↓ BP, Heart Block, Heart Failure</td>
</tr>
<tr>
<td><strong>HR control, pts with HF &amp; without accessory pathway</strong></td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>Digitalis toxicity, Heart Block, ↓ HR</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>↓ HR, ↓ BP, hypothyroidism, pulmonary toxicity, corneal deposits &amp; optic neuropathy</td>
</tr>
</tbody>
</table>
Classification of Antiarrhythmic Drugs

♥ Type I: Sodium Channel Blockers
  • Type IA
    - Disopyramide (*Norpace®*)
    - Procainamide (*Pronestyl®*)
    - Quinidine (*generic*)
  • Type IB
    - Lidocaine (*generic*)
    - Mexiletine (*Mexitil®*)
  • Type IC
    - Flecainide (*Tambocor®*)
    - Propafenone (*Rythmol®*)

♥ Type II: Beta Blockers
Antiarrhythmic Classification

♥ Type III
• Amiodarone (Cordarone®)
• Bretylium (generic)
• Dofetilide (Tikosyn®)
• Ibutilide (Corvert®)
• Sotalol (Betapace®)

♥ Type IV: Ca+ Channel Blockers
• Nondihydropyridine CCB (NDH CCB)
  - Verapamil
  - Diltiazem

♥ Type V
• Adenosine, digoxin, mg sulfate
Cardioversion (Rhythm Control)

**PHARMACOLOGIC**
- Efficacy for some at least initially < 50%
- Low initial cost, Noninvasive
- Drug toxicity, potential proarrhythmia, interaction
- Thromboembolism prophylaxis recommended

**DC CARDIOVERSION**
- More effective: ~75%
- High cost, require anesthesia, sedation
- Thromboembolism risk: 1-7%
- Defibrillation threshold, biphasic energy better
- Complications: arrhythmia, cutaneous

Thromboembolism prophylaxis recommended.
Guideline Recommendations: Pharmacological Cardioversion

♥ Class I
• Flecainide, dofetilide, propafenone, or ibutilide (A)

♥ Class Ila
• Amiodarone (A)
• Single oral dose of propafenone or flecinide. Use β-blocker or CCB first (C)
• Outpatient amio for PAF or persistent AF (C)

♥ Class IIb
• Quinididine or procainamide (C)

♥ Class III
• Dig and/or sotalol (A)
• Quinidine, procainamide, disopyramide and dofetilide should NOT be started outside of the hospital (B)
Guideline Recommendations: Direct Current Cardioversion

Class I
- When RVR does not respond promptly to medications in pts w/ ongoing MI, symptomatic hypotension, angina or HF (C)
- AF w/pre-excitation & very rapid techy or hemodynamic instability (B)
- Symptoms of AF are unacceptable to pt., can repeat DCCV after giving meds should AF return (C)

Class IIa
- Restore SR as along term management strategy (B)
- Infrequent repeat DCCV if pts wants for symptomatic or recurrent AF (B)

Class III
- Frequent repeat DCCV for pts w/ short periods of sinus between relapses despite medication enhancements (C)
- Dig toxicity or hyopkalemia, DCCV is contraindicated (C)
Guideline Recommendations: Pharmacological Enhancement of Cardioversion

♥ Class Ila
- Pretreat w/ amio, flecainide, ibutilide, propafenone or sotalol (B)
- In pt who relapse after successful DCCV, repeat w/ medications (B)

♥ Class IIB
- β-blocker, disopyramide, diltiazem, dofetilide, procainamide or verapamil (C)
- Can start meds as an outpatient if no heart disease (C)
- Can start meds as outpatient if pt has heart disease, once drug safety has been established (C)
## Agents for Pharmacologic CV of AF

### Potential Adverse Effects

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ADVERSE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amiodarone</td>
<td>↓ HR, ↓ BP, QT prolongation, Toxicities: thyroid, pulmonary, hepatic; GI, eye complications, torsades</td>
</tr>
<tr>
<td>(Pacerone®)</td>
<td></td>
</tr>
<tr>
<td>Dofetilide</td>
<td>QT prolongation, torsades de pointes, dose adjusted for renal function, body size &amp; age</td>
</tr>
<tr>
<td>(Tikosyn®)</td>
<td></td>
</tr>
<tr>
<td>Flecainide</td>
<td>Ventricular tachycardia, heart failure, conversion to Atrial flutter with rapid conduction</td>
</tr>
<tr>
<td>(Tambacor®)</td>
<td></td>
</tr>
<tr>
<td>Ibutilide</td>
<td>QT prolongation, Torsades de pointes</td>
</tr>
<tr>
<td>(Corvert®)</td>
<td></td>
</tr>
<tr>
<td>Propafenone</td>
<td>Ventricular tachycardia, heart failure, conversion to Atrial flutter with rapid conduction</td>
</tr>
<tr>
<td>(Rythmol®)</td>
<td></td>
</tr>
<tr>
<td>Sotalol</td>
<td>Torsades de pointes, Heart Failure, Bradycardia, COPD exacerbation</td>
</tr>
<tr>
<td>(Betapace®)</td>
<td></td>
</tr>
</tbody>
</table>

ACC/AHA/ESC AF Guidelines 2006
Clinical Aspects of Cardioversion

- Pre-procedure preparation: TEE?, electrolytes
- Safe in patients with pacemakers/ICD
- Indications: (Class 1A-C recommendations)
  - Unresponsive to pharmacologic measures
  - Symptomatic or unstable: angina, CHF, ↓ BP
  - Pre-excitation with rapid tachycardia
  - AF symptoms unacceptable to patient following antiarrhythmic therapy
- Complications: thromboembolism, more lethal arrhythmias, complications of anesthesia
TEE in Atrial Fibrillation

A  Left Atrium

B  Left Atrial Appendage Clot

Specificity - 98%  Sensitive – 92%

# Atrial Thrombi in Patients With New AF

**TEE Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients</th>
<th>No. (%) With Atrial Thrombi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoddard (1995)</td>
<td>206</td>
<td>37 (18%)</td>
</tr>
<tr>
<td>ACUTE Pilot (1997)</td>
<td>56</td>
<td>7 (13%)</td>
</tr>
<tr>
<td>Weigner (2001)</td>
<td>539</td>
<td>70 (13%)</td>
</tr>
<tr>
<td>ACUTE, Klein (2001)</td>
<td>619</td>
<td>76 (12%)</td>
</tr>
<tr>
<td>Corrado (1999)</td>
<td>123</td>
<td>11 (9%)</td>
</tr>
</tbody>
</table>

Increase in Spontaneous Echo Contrast ("Smoke") Following Electrical Cardioversion

Left atrial appendage (LAA) before (A) and after (B) cardioversion

Direct Current Cardioversion

Success rate varies:

- Defibrillation threshold
- Duration of AF, underlying heart disease
- Immediate success 70 – 99%
  - AFib: 70-80%, A flutter: >95% success rates
  - Varies with duration of AF, LA size
- Complete shock failure & immediate recurrence 25%
- Recurrence up to 25% within 2 weeks
- Pre-treatment or Concomitant AAD therapy enhances success & suppresses recurrence
- Repeated CV after 2nd attempt following relapse is of no value
Hypothetical illustration of cardioversion failure.

Fuster V et al. Circulation 2011;123:e269-e367
Newly Discovered AF

Paroxysmal
- No Rx unless Significantly Symptomatic
  - Anticoagulation PRN

Persistent
- Accept Permanent AF
  - Anticoagulation & Rate Control PRN
- Rate Control & Anticoagulation PRN
  - Consider AADrug Rx
    - Cardioversion
      - Long Term AADrug Rx unnecessary

ACC/AHA/ESC AF Guidelines, 2006
Recurrent AF

- Minimal or No Symptoms
  - Anticoagulation & Rate Control as needed

Disabling Symptoms in AF

- Anticoagulation & Rate Control as needed
  - AAD* Drug Rx
    - Cardioversion as needed

Permanent AF

- Anticoagulation & Rate Control as needed

- Continue Anticoagulation & AAD* Therapy to maintain NSR

Consider Ablation for Severely symptomatic recurrent AF after failure of > 1 AAD plus Rate Control

*AAD – Antiarrhythmic Drug

ACC/AHA/ESC AF Guidelines 2006
Maintenance of Sinus Rhythm

No HD
- Flecainide
- Propafenone
- Sotalol
  - Amio
  - Dofetilide

HTN
- Substantial LVH
  - NO
  - Amio
  - Dofetilide
  - Catheter Ablation
  - Flecainide
  - Propafenone
  - Sotalol
  - Amio
  - Dofetilide

CAD
- Dofetilide
- Sotalol
  - Amio
  - Catheter Ablation

HF
- Amio
- Dofetilide
  - Catheter Ablation

ACC/AHA/ESC AF Guidelines 2006
Guideline Recommendations: Maintenance of Sinus Rhythm

♥ **Class I**
- Before treating w/ anti-arrhythmics, treat reversible causes of AF (C)
- Ablation OK over meds to prevent recurrent AF in symptomatic pts with little or no LAE and normal EF (A)

♥ **Class IIa**
- Use meds to maintain SR & prevent tachy-induced CM (C)
- Infrequent, well tolerate recurrence is a reasonable outcome of medical Rx (C)
- Initiate meds as outpatient, if pt has no associated heart disease (C)
- Lone AF + no structural heart dz, can start propafenone or flecainide as outpatient, as long as in SR at time (B)
- Sotalol in outpatients for PAF if QT < 460ms, normal lytes and no contraindication for class III’s (C)
- Dronedarone- decrease recurrent of PAF, can start outpatient (B)

♥ **Class III**
- Antiarrhythmics are not recommended for maintaining SR or pts w/ RF for proarrhythmia with that specific agent (A)
- Meds not recommended for advanced sinus node or AV node dysfunction in absence of pacemaker (C)
Initiation of Antiarrhythmic Agents (AAD)

❤ Main risk – Proarrhythmia, tachy and brady

❤ Screen for proarrhythmia risks – LV dysfunction, prolonged PR, QRS, QT, or repolarization abnormalities, ischemia

❤ Flecainide, Propafenone, Sotalol, Amiodarone, and Dronedarone are safe for outpatient initiation

❤ Quinidine, Procainamide, Disopyramide, and Dofetilide should be started in in-patient setting
<table>
<thead>
<tr>
<th>Class</th>
<th>Agents</th>
<th>Automaticity</th>
<th>Conduction Velocity</th>
<th>Refractory Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia</td>
<td>Quinidine</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>Procainamide</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Disopyramide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ib</td>
<td>Lidocaine</td>
<td>↓</td>
<td>-</td>
<td>-↓</td>
</tr>
<tr>
<td></td>
<td>Tocainide</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Mexiletine</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ic</td>
<td>Propafenone</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Flecainide/Morizicine</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>II</td>
<td>Propranolol</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>Metoprolol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Esmolol</td>
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<td></td>
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</tr>
<tr>
<td>II</td>
<td><strong>(nodal tissue)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Amiodarone/Dronedarone</td>
<td>-</td>
<td>-</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>Sotalol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ibutilide/Dofetilide</td>
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<td></td>
<td>Azimilide</td>
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<tr>
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<td>Vernakalant</td>
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</tr>
<tr>
<td>IV</td>
<td><strong>(nodal tissue)</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Verapamil</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>Diltiazem</td>
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<tr>
<td>Misc</td>
<td>Digoxin</td>
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<tr>
<td></td>
<td>Magnesium</td>
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<tr>
<td></td>
<td>Adenosine</td>
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</tr>
</tbody>
</table>
Electrophysiology: Cardiac Action Potentials

- Depolarization
- Repolarization
- Refractory period
- Conduction velocity
- Automaticity
AAD: Flecainide

❤ Class IC agent, Na channel blocker
❤ Contraindicated in patients with CAD per CAST trial
❤ Must be used in conjunction with AV nodal blocking agent to prevent atrial flutter 1:1 conductions
❤ Can prolong QRS duration
❤ Recommend follow-up ECG after 5 doses; some providers perform ETT due to “use dependence”
❤ Daily dosing, BID
❤ “Pill-in-the-pocket”
  • Self administration of a single oral dose of drug shortly after the onset of symptomatic AF
AAD: Propafenone

- Class IC agent, Na channel blocker
- Contraindicated in patients with CAD per CAST trial
- Must be used in conjunction with AV nodal blocking agent to prevent atrial flutter 1:1 conduction
- Can prolong QRS duration
- Recommend follow-up ECG after 5 doses; some providers perform ETT
- Daily dosing, BID
- Beta blocker side effects
AAD: Sotalol

❤ Class III agent, K channel blocker
❤ Beta blocker properties: slow HR and decrease BP, similar side effects in some people
❤ Contraindicated with LVH, baseline QTc interval > 460 ms
❤ Can prolong QTc interval
  • QTc acceptable up to 500 ms or 550 ms with paced rhythm or bundle branch block
  • If QTc prolongs > 15% need to decrease dose
❤ Renal dosing
❤ ECG monitoring practices
AAD: Dofetilide/Tikosyn®

♥ Class III agent, $K^+$ channel blocker
♥ Contraindicated with LVH, baseline QTc interval > 460 ms
♥ Will not slow HR
♥ Can prolong QTc interval
  • QTc acceptable up to 500 ms or 550 ms with paced rhythm or bundle branch block
  • If QTc prolongs >15% need to decrease dose
♥ FDA mandates inpatient initiation
  • 5 doses with ECG 2 hours after each dose
  • One night in hospital post cardioversion
♥ Renal dosing
♥ Have to be a certified provider to prescribe
AAD: Amiodarone

❤ Class III agent, blocks Na, K, Ca, Beta, Alpha
❤ Properties of all 4 classes
❤ Can prolong QTc interval
  • However QTc prolongation not associated with increase in morbidity and mortality
❤ Can be used for ventricular arrhythmias as well
❤ Should use loading dose prior to cardioversion
  • 6 grams is goal load
❤ Many potential adverse reactions
  • Liver, thyroid, pulmonary fibrosis, corneal deposits, skin discoloration/photosensitivity
❤ Because of toxicities, the LOWEST effective maintenance dose is always targeted for chronic therapy.
AAD: Amiodarone

❤ Monitoring
  • ECG: baseline and every 6 months
  • LFT’s, TFT’s: baseline, 6 months, annually
  • PFT’s with DLCO: baseline, 6 months, annually
  • CXR
  • Eye exam: baseline, annually

❤ Encourage patients to avoid direct sun exposure, use sunscreen

❤ If patients develop hypothyroidism can treat with replacement. Hyperthyroidism requires immediate discontinuation of amiodarone and referral to Endocrine
AAD: Dronedarone/Multaq

♥ Class III agent, blocks Na, K, Ca, Beta, Alpha
♥ Has properties of all 4 classes
♥ Non-iodinated analog of amiodarone; “amiodarone without all the side effects”
♥ Contraindicated in patients with bradycardia HR <50 bpm, moderate to severe heart failure, Permanent AF, Hepatic or pulmonary toxicity previously on amiodarone
♥ 400 mg BID
Patient Education

❤️ Explanation of symptoms
❤️ Self monitoring: HR, BP, symptoms
❤️ Signs and symptoms to report
❤️ Medication compliance
❤️ Anticoagulation
❤️ Food-drug & drug-drug interactions
❤️ Follow-up
❤️ Written handouts helpful
Patient Monitoring

❤ Vital signs
❤ Pt symptoms
❤ Side effects
❤ Risk identification
❤ Labs
  • Serum electrolytes (K+, Mg)
  • Digoxin level
  • Renal and liver function
❤ ECG
❤ Echo
❤ PFT (drug dependent)
Atrial Fibrillation and Stroke

♥ Risk: 5 - 8% per year in high-risk patients; accounts for 15% of all strokes

♥ Presumably due to LAA clot (95%)

♥ Meta-analysis showed that adjusted dose oral anticoagulation is highly efficacious

♥ Data revealed a risk reduction of 61-70% versus placebo

♥ Evaluate patient for risk stratification
Stroke in AF

Paroxysmal vs Permanent

Clot Formation in AF
Antithrombotic Strategies: Prevention of Ischemic CVA & Systemic Embolism

♥ Anticoagulation with Vitamin K Antagonist agents (VKA = warfarin)
♥ Aspirin
♥ Combining anticoagulation and platelet-inhibitor therapy
♥ Novel Antithrombotic Agents
♥ Low-molecular weight heparins
♥ Nonpharmacologic approaches
  • Obliteration or occlusion of the LAA
  • Surgical amputation or truncation of the appendage
Guideline Recommendations: Preventing Thromboembolism

Class I

- Anticoagulate all AF pts except those w/ lone AF or contraindications (A)
- Choose anticoagulate based on absolute risks of stroke vs bleeding (A)
- INR goal 2.0-3.0 w/ warfarin (without mechanical valve) (A)
- Warfarin if > 1 risk factor (A)
- Warfarin: check INR weekly when initiating, then monthly (A)
- ASA 81-325mg daily in low risk pts w/ contraindications to warfarin (A)
- AF w/ mechanical valves, adjust per valve, INR at least 2.5 (B)
- Treat atrial flutter as AF (C)
Guideline Recommendations: Preventing Thromboembolism

♥ Class IIa

• ASA alone or warfarin for AF if just one: age > 75, htn, CHF, EF < 35%, DM (A)
• ASA alone or warfarin for AF IF > 1: age 65-74, female, CAD (B)
• Same recommendations for anticoagulation: PAF, persistent & permanent AF (B)
• If no mechanical valve, can interrupt warfarin for up to one week w/o heparin for surgery/procedures (C)
• Reasonable to re-evaluate as needed for anticoagulation at regular intervals (C)
Guideline Recommendations: Preventing Thromboembolism

♥ Class IIb
- > 75 yo + ↑ risk of bleeding: lower INR goal to target 2.0; range 1.6-2.5 (C)
- LMWH if surg/procedures require interruption of anticoagulation for > 1 week in high risk pts (C)
- After PCI: OK to give ASA 81mg, plavix & warfarin (C)
- Can hold warfarin for PCI, but restart ASAP.
- Lone AF: risk of embolism is low, no need for ASA (C)
- If CVA in AF pt while on warfarin w/ INR 2.0-3.0, can increase to 3.0-3.5 instead of adding anti-platelet (C)

♥ Class III
- Long term warfarin for primary CVA prevention in pts < 60, no CAD, no RF for embolus (C)
## Predictors of Thromboembolic Risk in Atrial Fibrillation

<table>
<thead>
<tr>
<th>Weaker Risk Factors</th>
<th>Moderate Risk Factors</th>
<th>High Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Gender</td>
<td>Age $\geq$ 75 years</td>
<td>Prior CVA, TIA</td>
</tr>
<tr>
<td>Age 65 to 74 years</td>
<td>Hypertension</td>
<td>Mitral Stenosis</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
<td>Heart failure</td>
<td>Prosthetic Heart Valve</td>
</tr>
<tr>
<td>Thyrotoxicosis</td>
<td>LVEF $&lt; 35%$ or Diabetes Mellitus</td>
<td>Prior Embolism</td>
</tr>
</tbody>
</table>

ACC/AHA/ESC AF Guidelines 2006
Use and Adequacy of Anticoagulation on Hospital Admission in AF Patients

- No Warfarin: 64%
- Supratherapeutic INR: 19%
- Therapeutic INR: 37%
- Subtherapeutic INR: 45%
- Warfarin: 35%

n=1085 patients admitted to a tertiary care facility

CHADS2

❤ Conditions
• CHF
• Hypertension
• Age
• Diabetes
• Stroke/TIA

❤ Score, points
• yes- 1
• yes-1
• > 75- 1
• yes- 1
• Yes- 2

Score and recommendations:
Max score: 6
Score 0: aspirin
Score 1: aspirin or oral anticoagulation
Score 2 or more: oral anticoagulation
### Stroke risk factors – CHADS<sub>2</sub>

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Points</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 ≥ 75</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Stroke or TIA history</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Points</th>
<th>% stroke per year</th>
<th>Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.9</td>
<td>No anticoagulation</td>
</tr>
<tr>
<td>1</td>
<td>2.8</td>
<td>Aspirin 75 – 325mg or oral anticoagulant</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Oral anticoagulant</td>
</tr>
<tr>
<td>3</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>18.2</td>
<td></td>
</tr>
</tbody>
</table>

Gage JAMA 2001
EACTS Eur Heart J 2010
Stroke risk factors – CHA$_2$DS$_2$VASc

### Table 8: CHA$_2$DS$_2$VASc score and stroke rate

<table>
<thead>
<tr>
<th>‘Major’ risk factors</th>
<th>‘Clinically relevant non-major’ risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous stroke, TIA, or systemic embolism</td>
<td>Heart failure or moderate to severe LV systolic dysfunction (e.g. LV EF ≤ 40%)</td>
</tr>
<tr>
<td>Age ≥ 75 years</td>
<td>Hypertension - Diabetes mellitus</td>
</tr>
<tr>
<td></td>
<td>Female sex - Age 65–74 years</td>
</tr>
<tr>
<td></td>
<td>Vascular disease$^a$</td>
</tr>
</tbody>
</table>

(b) Risk factor-based approach expressed as a point based scoring system, with the acronym CHA$_2$DS$_2$VASc (Note: maximum score is 9 since age may contribute 0, 1, or 2 points)

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Score</th>
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<tbody>
<tr>
<td>Congestive heart failure/LV dysfunction</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥ 75 years</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Stroke/TIA/thrombo-embolism</td>
<td>2</td>
</tr>
<tr>
<td>Vascular disease$^a$</td>
<td>1</td>
</tr>
<tr>
<td>Age 65–74 years (i.e. female sex)</td>
<td>1</td>
</tr>
<tr>
<td>Sex category (i.e. female sex)</td>
<td>1</td>
</tr>
</tbody>
</table>

Maximum score: 9

(c) Adjusted stroke rate according to CHA$_2$DS$_2$VASc score

<table>
<thead>
<tr>
<th>CHA$_2$DS$_2$VASc score</th>
<th>Patients (n=7329)</th>
<th>Adjusted stroke rate (%/year)$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>1</td>
<td>422</td>
<td>1.3%</td>
</tr>
<tr>
<td>2</td>
<td>1230</td>
<td>2.2%</td>
</tr>
<tr>
<td>3</td>
<td>1730</td>
<td>3.2%</td>
</tr>
<tr>
<td>4</td>
<td>1718</td>
<td>4.0%</td>
</tr>
<tr>
<td>5</td>
<td>1159</td>
<td>6.7%</td>
</tr>
<tr>
<td>6</td>
<td>679</td>
<td>9.8%</td>
</tr>
<tr>
<td>7</td>
<td>294</td>
<td>9.6%</td>
</tr>
<tr>
<td>8</td>
<td>82</td>
<td>6.7%</td>
</tr>
<tr>
<td>9</td>
<td>14</td>
<td>15.2%</td>
</tr>
</tbody>
</table>

FACTS Eur Heart J 2010
Lip Stroke 2010
CHA₂DS₂ -VASc

❤ Conditions
  • CHF
  • Hypertension
  • Age
  • Diabetes
  • Stroke/TIA/Thrombo
  • Vascular disease
  • Age
  • Sex category

❤ Score
  • Yes- 1
  • Yes- 1
  • <65- 0, 65-74-1, >75- 2
  • Yes- 1
  • Yes- 2
  • Yes- 1
  • ≥ 65-74- 1
  • Female- 1, male- 0
Stroke Prophylaxis in AF

♥ CHAD2DS2-VASc score = 0
  • Asa 81 – 325mg daily

♥ CHAD2DS2-VASc score = 1
  • Asa or oral anticoagulant

♥ CHAD2DS2-VASc score = > 2
  • Oral anticoagulant
Current Options

♥ Vitamin K Antagonist → Warfarin
♥ Unfractionated Heparin → Heparin
♥ Low Molecular Weight Heparin (LMWH)
  • Dalteparin, Enoxaparin
♥ Direct Thrombin Inhibitor
  • Dabigatran, Argatroban, Bivalrudan
♥ Factor Xa Inhibitor
  • Rivaroxaban, Apixaban, Endoxaban, Fondaprinux (Arixtra)
Warfarin

♥ Interferes with hepatic synthesis of vitamin K dependent clotting factors II, VII, IX & X as well as proteins C and S

♥ Antidote is Vitamin K K

♥ Therapeutic Range: PT/INR

- Target INR is 2.5 with a range of 2.0 – 3.0 for most indications for warfarin therapy.
- Target INR is 3.0 with a range of 2.5 – 3.5 for the following indications
  - Mechanical heart valves in mitral position
Duration of Warfarin Therapy

♥ AF: based on CHA2DS2 VASc score
♥ Mechanical cardiac valves: indefinitely
♥ Bioprosthetic cardiac valves: varies
♥ Surgery provoked DVT or PE: 3 months
♥ First unprovoked DVT or PE: 3 months
♥ Second unprovoked DVT or PE: extended treatment
♥ LV thrombus: ~3 months, repeat echo
Limitations with warfarin

♥ Narrow therapeutic range
♥ Slow onset of action
♥ Slow offset of action
♥ Multiple drug and dietary interactions
♥ Monitoring required to maintain therapeutic range
♥ PROS: Not a lot of data on procedures to restore sinus rhythm on other anticoagulants
Dabigatran - Pradaxa®

- Direct thrombin (factor IIa) inhibitor
- Approved to prevent stroke and systemic embolism for nonvalvular AF
- Dosage 150 mg BID, one dose fits all
- Half life: 7-17 hours
- Elimination: renal (80%)
  - Consider 75 mg BID with CrCl 30-50 ml/m²
  - Contraindicated in patients with CrCl <30 ml/m²
- Increased risk of GI bleeding in patients >75 years of age
- Trials: RE-LY (AF), RE-NOVATE (THA), RE-MODEL (TKA), RE-COVER (acute VTE)
Dabigatran- Pradaxa®

♥ No drug-food interactions
♥ No antidote
♥ Dialyzable
♥ Unstable if not stored in original bottle (dessicant in lid)
♥ Must be used within 4 months
♥ Main side effect dyspepsia 10%
Rivaroxaban - Xarelto®

♥ Factor Xa inhibitor
♥ Approved to prevent stroke and systemic embolism for nonvalvular AF and postoperative thromboprophylaxis for knee and hip replacement
♥ Dosage 10- 20 mg daily with evening meal
  • AF: CrCl > 50 ml/m2: 20 mg daily, CrCl 15-50 ml/m2: 15 mg daily, CrCl <15 ml/m2 avoid use
  • Post-op VTE: 10 mg daily
♥ Half life: 5-9 hours
♥ Elimination: renal 2/3 fecal 1/3
♥ Trials: ROCKET AF (AF) RECORD 1, 2 (THA), RECORD 3,4 (TKA), EINSTEIN (acute VTE)
Rivaroxaban- Xarelto®

♥ Metabolism: oxidation via CYP3A4 and CYP2J2
♥ Drug Interactions: Ketoconazole, ritonavir, clarithromycin, erythromycin, rifampin
♥ Recommend to be taken with food
♥ Not readily available for AF at VA
Apixaban - Eliquis®

- Factor Xa inhibitor
- Half-life 5-6 hours
- Metabolism: oxidation via CYP3A4
- Dosage: 5 mg BID
  - Decreased to 2.5 mg BID if age ≥ 80 years, ≤ 60 kg, or serum creatinine ≥ 1.5 mg/dl
- Not dialyzable
- Excretion: 25% renal, 75% fecal
- Trials: ARISTOTLE (AF), ADVANCE 3 (THA), ADVANCE1,2 (TKA), AMPLIFY (acute VTE)
Timing of Antithrombotic Rx & Cardioversion for AF

❤ Stable AF of unknown duration or > 48 hours
- Therapeutic warfarin levels for 3 weeks prior → Cardioversion
- Therapeutic warfarin levels for 4 weeks after cardioversion

❤ Unstable AF
- Unfractionated Heparin or LMWH
  - NO CLOT: CV then warfarin
  - TEE-guided
    - CLOT: warfarin X 3 wks repeat TEE → CV
Interruption of Anticoagulation

Elective Procedures

✈ Mechanical Valves and High Risk Patients
  • Self administered LMWH or IV UFH (Class IIb)
  • Held before procedure
  • Resumed when possible with LMWH SQ or Unfractionated Heparin IV
  • Oral anticoagulation restarted and heparin/LMWH discontinued when INR goal is achieved

✈ Non mechanical valves patients
  • May be interrupted for 1 week without heparin substitution
Surgical Consideration

♥ Warfarin
  • Discontinue warfarin ~ 5 days prior to surgery
  • Resume warfarin 12-24 hours after surgery

♥ Dabigatran
  • Discontinue 1-2 days (CrCl ≥ 50 ml/min) or 3-5 days (CrCl < 50 ml/min)
  • Resume as soon as adequate hemostasis is established

♥ Rivaroxaban
  • Discontinue at least 24 hours before surgery
  • Resume as soon as adequate hemostasis is established

♥ Apixaban
  • Stop 24-48 hours before surgery/procedure
## Anticoagulation for AF

### Major Contraindications

- Intracranial hemorrhage
- Unstable gait, fall risk or syncope
- Poor compliance
- Poor memory
- ETOH Abuse
- Psychosis

### Adverse Effects

- Bleeding: ICH (0.1-0.8%)
- Intracranial hemorrhage
- GI Bleeding
- Cutaneous
- Drug-drug interactions
- Food-drug interactions
Non-Pharmacologic Therapies

♥ Direct Current Cardioversion (DCCV)
  • External synchronized cardioversion

♥ Catheter Ablation
  • Radiofrequency
  • Cryoballoon

♥ Left atrial appendage closure
  • Percutaneous
    - Watchman, Amplatzer Cardiac Plug
    - Lariat
  • Surgical LAA ligation and amputation

♥ Surgical Procedures
  • Maze Procedure
  • Thorascopic surgical maze

♥ AV Node Ablation & Pacemaker
Left Atrial Appendage Exclusion
Catheter Ablation for AF

Appropriate for Patients
(Class IIA -> Class I Recommendation)

♥ With recurrent symptomatic paroxysmal or persistent AF
♥ Who are intolerant or failed AAD therapy
♥ Who have frequent ambient atrial ectopic activity with little or no LA enlargement
♥ Who have tachycardia-mediated cardiomyopathy
AF “Trigger” Sites

Extensions of Cardiac Myocytes Found In:

♥ Pulmonary veins

♥ Superior vena cava

♥ Coronary sinus/ligament of Marshall

♥ Crista terminalis

♥ Left atrial free wall
AF Ablation Burn Sites

Left superior PV

Left inferior PV

CATHETER ABLATION

Success rates vary:

♥ Ablation Techniques
- Early techniques with success rate 40-50%
- New mapping technology and catheters
- Operator technical experience
- RFA techniques wider anatomical targets ↑ 60-90%

♥ Patient variables
- Lower in persistent AF vs PAF
- Lower in presence of concurrent heart disease
- Success rate may be dependent on Pt’s ability to recognize symptoms of AF
- Structural changes: dilated LA
- Sleep apnea
FIRM Catheter Ablation

♥ Focal Impulse and Rotor Modulation
♥ Hypothesis proposes that organized and fast reentrant circuits (rotors) or focal impulses are discrete and disorganize into fibrillatory waves at their periphery
♥ RhythmView™ mapping system using a 64 pole basket catheter
♥ Targeting a focal source
♥ Performed with or without PVI
♥ Less ablation time (average 5 minutes), possible higher success rates
FIRM Catheter Ablation
Catheter Ablation Complications

威尼斯人 Complications
威尼斯人 PV stenosis
威尼斯人 Thromboembolism
威尼斯人 Atrio-esophageal fistula
威尼斯人 LA flutter
威尼斯人 Phrenic nerve or diaphragm paralysis
威尼斯人 Cardiac Tamponade
威尼斯人 Hematoma
威尼斯人 Mild pericarditis symptoms
威尼斯人 Fluid overload
威尼斯人 Radiation burns from fluoroscopy
Post Ablation Care

♥ Anticoagulate
  • Warfarin or novel agent

♥ Antiarrhythmic
  • AAD class Ic or III

♥ GI prophylaxis
  • PPI: pantoprazole bid
  • Sucralfate qid

♥ Monitor rhythm
**AV Node Ablation & Pacemaker Implantation**

### Indications

*(Class IIa Recommendation)*

- Permanent atrial fibrillation with RVR
- Recurrent symptoms; CHF/CM despite medical therapy
- Intolerant of drug therapy for rate control or SR maintenance therapy

### Implications

- Irreversible, lifetime pacemaker dependency & anticoagulation
- Improvement in cardiac symptoms, QOL, clinical status
- Inferior atrial AV node modification optional to avoid PPM
## LVEF Following AV Node Ablation

<table>
<thead>
<tr>
<th>Study</th>
<th>Pts</th>
<th>F/U (m)</th>
<th>Pre</th>
<th>Post</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Kay</td>
<td>156</td>
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A Meta-analysis
AF: Surgical Ablation (MAZE)

❤ Surgical incisions in the atria (geographical “maze”) to create electrical barriers to conduction & prevention of sustained AF
❤ Success rate around 70% - 95% over 15 years
❤ May be combined with LAA obliteration or amputation
❤ Requirements: thoracotomy, general anesthesia & coronary bypass
❤ Risks: death (<1%), may need permanent pacing, bleeding, impaired atrial transport function, delayed atrial arrhythmias
### Implications of Age for Ablation

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age, y</th>
<th>Parox, %</th>
<th>SHD, %</th>
<th>AF free, %*</th>
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<tbody>
<tr>
<td>Ouyang et al., 2004</td>
<td>41</td>
<td>63 ± 9</td>
<td>100</td>
<td>NA</td>
<td>76</td>
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<tr>
<td>Haisaguerre et al., 2004</td>
<td>70</td>
<td>53 ± 8</td>
<td>NA</td>
<td>43</td>
<td>79</td>
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<tr>
<td>Mansour et al., 2004</td>
<td>40</td>
<td>55 ± 10</td>
<td>80</td>
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<td>75</td>
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<tr>
<td>Marrouche et al., 2003</td>
<td>259</td>
<td>54 ± 11</td>
<td>51</td>
<td>21</td>
<td>87</td>
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<tr>
<td>Oral et al., 2003</td>
<td>40</td>
<td>54 ± 11</td>
<td>100</td>
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<td>Pappone et al., 2003</td>
<td>580</td>
<td>65 ± 9</td>
<td>69</td>
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<td><strong>Total</strong></td>
<td>1039</td>
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<td><strong>81.0</strong></td>
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</table>

“Ablation may particularly benefit younger patients with lone AF who are frequently symptomatic and for whom very-long-term antiarrhythmic and anticoagulation pose higher risks and lifestyle costs.”

*Off drugs
Atrial Fibrillation Curative Procedures: Surgical Maze

“cut & sew” procedure with ablation

Efficacy of Surgical Maze Procedure for Atrial Fibrillation

Approach to the AF Patient:

- What is the etiology of the AF? First time? Recurrent? Reversible?
- Is patient symptomatic?
- Has patient had any work-up?
- Has anticoagulation been considered or implemented?
- Will the patient benefit from cardioversion? Or Sinus Rhythm maintenance?
- Has the patient failed drug therapy?
- Has percutaneous or catheter based strategy been considered for pharmacologic failures?
Conclusions

- Diverse invasive therapies becoming more widespread
- Accurate patient assessment is important to guide therapy
- Pharmacologic agents can be effective but require monitoring
- Ultimately, “curing” atrial fibrillation may require a combination of approaches