

# ATRIAL FIBRILLATION

## **Pathophysiology**

1. Mechanisms:
  - Multiple supraventricular foci wavelets rather than single wavefront seen in atrial flutter
  - Re-entrant pathways and abnormal conduction
  - Refractory period of atrial muscle shortens in AF which predisposes to further AF
2. Effects:
  - Causes decreased cardiac output which leads to symptoms
    - Rapid ventricular response leads to decreased filling time
    - Lack of atrial “kick” removes 5% of ventricular filling volume
  - Left atrial thrombus can occur secondary to stasis
3. Classified into 4 Categories:
  - Paroxysmal AF - episodes terminate spontaneously in < 7 days, usually < 24 hours
  - Persistent AF - episodes do not self-terminate within 7 days. May eventually terminate spontaneously or by cardioversion
  - Permanent AF - arrhythmia lasts > 1 year, and cardioversion either not attempted or failed
  - Lone AF - paroxysmal, persistent, or permanent AF in people without structural heart disease. Usually under 65 years old
4. Epidemiology:
  - Prevalence - 1% and increasing<sup>1</sup>
  - Incidence increases with age<sup>1</sup>
    - Affects Males > Females
5. Etiology:
  - Hypertension
  - Myocardial Infarction
  - Valvular heart disease
  - Rheumatic Heart Disease
  - Heart Failure
  - Hypertrophic cardiomyopathy
  - Pulmonary Embolism
  - COPD
  - Hyperthyroidism
  - Peri-partum cardiomyopathy
  - Pericarditis
  - Surgery, especially cardiac surgery such as CABG
  - Obstructive Sleep Apnea
  - Alcohol consumption (“holiday heart”)
  - Other substances:
    - Stimulants: amphetamines, cocaine, ephedra, caffeine
    - Tobacco
    - Theophylline

- Digitalis
  - Idiopathic (Lone AF)
- 6. Morbidity / Mortality
  - Increased risk of CVA, CHF, Hospitalization, Death

## Diagnosics

1. History
  - Goals are to define associated symptoms, onset or date of discovery, frequency and duration of episodes, precipitating causes, response to medication, presence of heart disease or reversible causes
  - Symptoms:
    - May vary greatly
    - May be asymptomatic or may present with CVA
    - Palpitations, weakness, fatigue, lightheadedness, syncope, dyspnea
2. Physical Examination
  - Vital Signs (especially pulse and BP)
  - Irregularly irregular rhythm
  - Pulse deficit sign (discrepancy between the heart beat and the radial pulse)
  - Assess for Murmurs
  - Assess for signs of CHF
    - JVD, pedal edema, rales, S3 on auscultation
  - Assess for any signs of CVA or systemic emboli findings
3. Diagnostic Testing
  - Laboratory evaluation
    - CBC, Electrolytes, BUN, Cr
    - Digitalis level (if known or suspected to be on digitalis)
    - TSH
    - Drug Toxicology Screen
    - Consider Troponin, BNP, d-dimer depending on presentation (d-dimer useful to rule out pulmonary embolism)
  - CXR - To assess lungs, vasculature and cardiac outline
  - ECG
    - Compare to previous ECG if possible
    - Things to look for:
      - Absent P waves
      - Irregularly irregular R-R intervals
      - Fibrillatory waves generally between 350-600 bpm
      - Variable, irregular ventricular response, usually between 90-170 bpm
      - QRS complexes narrow unless AV conduction is abnormal due to rate-related aberration, preexisting bundle branch block or fascicular block
      - Need to rule out pre-excitation with ventricular activation via accessory pathway (WPW) as treatment with AV nodal blocking agents in these patients can induce V-fib and/or sudden cardiac death

- Echocardiogram
  - Assess for any underlying etiology: evaluate chamber sizes, assess function of ventricles, assess valvular anatomy and function, assess for pericardial disease
  - Evaluate for left atrial thrombus (Trans-thoracic less sensitive than trans-esophageal echo)<sup>9</sup>
- 24-hour Holter Monitor
  - Used to identify arrhythmia if intermittent and not seen on routine ECG
  - Also, to identify triggering events and evaluate rate control with activity
  - Use event monitor if suspect paroxysmal dysrhythmia occurring less often than every 12-24 hours

### **Differential Diagnosis<sup>6</sup>**

1. Atrial flutter
2. Supraventricular tachycardia
3. Wolff-Parkinson White syndrome
4. Sick sinus syndrome

## **THERAPEUTICS**

### **Acute Treatment**

1. ABC's, Cardiac telemetry, IV access, Oxygen
2. Assess hemodynamic stability
  - Synchronized Cardioversion: if hemodynamically unstable or if presents with Afib with rapid ventricular response in setting of MI, symptomatic hypotension, angina or acute heart failure<sup>2,3</sup>
  - Otherwise initially control ventricular rate while determining whether want to treat with rate control vs rhythm control
3. Assess for underlying cause
4. Rate Control:
  - American College of Cardiology/American Heart Association Task Force/European Society of Cardiology (ACC/AHA/ESC) 2011 guidelines update on management of patients with Afib:
    - Treatment to achieve strict rate control of heart rate (<80 bpm at rest or <110 bpm during a 6 – minute walk) not beneficial
    - Achieve resting heart rate <110 bpm in patient with persistent Afib who have stable ventricular function (left ventricular ejection fraction >0.40) and no or acceptable symptoms related to the arrhythmia
    - Uncontrolled tachycardia may over time be associated with reversible decline in ventricular performance. (Level of Evidence: B)<sup>3</sup>
  - RACE II trial recommends target heart rate of < 110 bpm in permanent Afib.
    - This more lenient rate control leads to less medication and thus fewer side effects than more stringent rate control.
    - No increased risk of cardiovascular events. (SOR: B)2,7,9
  - Non-dihydropyridine calcium channel blockers (Class I)2
    - Do not use if: hypotensive, severe heart failure, pre-excitation syndrome
    - Diltiazem

- IV bolus - 0.25 mg/kg over 2 minutes.
      - If first dose tolerated but does not produce desired response (20% decrease in heart rate from the baseline or a heart rate  $\leq 100$  beats/min) after 15 minutes, give second bolus of 0.35 mg/kg;
      - In those who respond to first or second bolus, initiate continuous infusion at rate of 5-15 mg/hr
    - May transition to oral route for maintenance
  - Verapamil
    - IV bolus of 0.075 to 0.15 mg/kg over 2 minutes.
    - May repeat dose every 15 to 30 minutes as needed.
    - Maintenance rate - 0.125 mg/min
    - May transition to oral route for maintenance
- Beta Blockers (Class I)<sup>2</sup>
  - Do not use if: hypotensive, severe heart failure, pre-excitation syndrome, bradycardia, severe asthma or COPD
  - Best if need to reduce sympathetic tone (i.e. post-operative AFib) and ischemia (post MI AFib)
  - Metoprolol
    - IV bolus 2.5 to 5 mg over 2 minutes.
    - May repeat at 5 minute intervals as needed up to 15 mg total.
  - Esmolol
    - IV bolus 0.5 mg/kg infused over 1 minute, followed by 50  $\mu\text{g}/\text{kg}$  per min.
    - If, after 4 minutes, response inadequate, give another bolus followed by infusion of 100  $\mu\text{g}/\text{kg}$  per min.
    - If, after another 4 minutes, response still inadequate, give third and final bolus followed by infusion of 150  $\mu\text{g}/\text{kg}$  per min.
    - If necessary, infusion can be increased to maximum of 200  $\mu\text{g}/\text{kg}$  per min after another four minutes.
  - Propranolol
    - 0.15 mg/kg over 5 minutes, repeat if needed in 10 minutes
  - May use oral route beta blockers for maintenance therapy
- Digoxin (Class I)<sup>2</sup>
  - Should not be used as first line drug unless severe heart failure or hypotension
  - May be beneficial in patients with heart failure and sedentary lifestyle (LOE C)
  - Monitor levels to avoid digitalis toxicity
  - May increase susceptibility to AFib after initial conversion (VERDICT trial)
  - Give initial 0.5 mg IV
  - May give additional 0.25 mg dose every 30 - 60 minutes as needed up to 1 gram total
  - Give 0.125 mg to 0.25 mg daily oral dose for maintenance
- Amiodarone (Class IIa)<sup>2</sup>

- Second line therapy for rate control
- Consider when beta blockers, calcium channel blockers and digoxin ineffective alone or in combination (Level of evidence C)<sup>2</sup>
- Helpful in patients with heart failure or pre-excitation pathway
- IV 150 mg over 10 minutes, then 0.5 to 1 mg /min

## 5. Rhythm Control

- First, control ventricular rate
- Rate control vs. rhythm control: no difference in risk of embolic events
- Perform cardioversion in hemodynamically unstable patients as well as patients who have failed rate control strategy.
  - May also consider in new onset AFib<sup>2</sup>
- Only 20-30% of successfully cardioverted patients maintain NSR for more than one year without chronic antiarrhythmic therapy.
- More likely to remain in NSR if:
  - Had AFib for less than 1 year
  - No atrial enlargement
  - Reversible cause of Afib such as hyperthyroidism, pericarditis, pulmonary embolism, or cardiac surgery
- If Afib < 48 hours:
  - May consider conversion to sinus rhythm without prior prolonged anticoagulation or imaging
  - May start IV heparin drip with target aPTT 45-60 seconds
  - Synchronized electrical cardioversion better success rate than pharmacologic cardioversion
- If Afib > 48 hours:
  - Anticoagulation for 3-4 weeks prior to cardioversion; then for 4 weeks afterwards to prevent development of mural thrombus.
  - INR goal of 2-3 if warfarin used for anticoagulation
  - If obtain transesophageal echo which shows no atrial thrombus, may proceed to cardioversion without prior anticoagulation.
    - Should still anticoagulate for 4 weeks afterwards.<sup>9</sup>
  - Adding clopidogrel to aspirin (ASA) to reduce major vascular events, including stroke, might be considered in patients with Afib in whom:
    - Oral anticoagulation with warfarin considered unsuitable due to patient preference, or
    - Physician's assessment of patient's ability to safely sustain anticoagulation makes that option non-viable. (LOE: B) (Class IIb)<sup>3</sup>
  - Synchronized cardioversion
  - Pharmacologic cardioversion
    - American Academy of Family Physicians/American College of Physicians recommend against routine maintenance antiarrhythmic drug therapy after cardioversion in newly detected Afib <sup>4,5</sup>
    - Choice of medication depends upon clinical situation
      - Flecainide and propafenone in patients with no or minimal heart disease

- Amiodarone and dofetilide in patients with heart failure and EF < 35%
  - Propafenone - 450-600 mg PO single dose
  - Flecainide - 300 mg PO single dose
  - Procainamide - IV bolus 10-18 mg/kg given at 50 mg/min rate then 1-4 mg infusion
  - Amiodarone - 5 mg/kg IV over 10-15 min
  - Dofetilide - 500 mcg every 12 hours
- Reduce dose (or avoid) in renal impairment; correct hypokalemia before use
- vii. Catheter ablation reasonable to treat symptomatic persistent Afib. (LOE: A) (Class I)<sup>3</sup>

### Follow-Up

1. Antithrombotic therapy recommended to prevent thromboembolism for all patients with Afib, except those with lone AF or contraindications. (LOE: A)<sup>2,8</sup>
2. Risk factors include: CHF, Hypertension, Age > 75, Diabetes Mellitus, Prior Stroke or TIA
  - If 0 risk factors, then Aspirin 325 mg daily
  - If 1-2 risk factors, then Aspirin or Warfarin (Class IIa) (LOE: A)<sup>2</sup>
  - If 3 or more, then Warfarin<sup>2</sup>
3. Continue follow up as outpatient with primary care physician and cardiology
  - Maintain INR 2-3
  - Continue rate control

### References

1. Krahn AD, Manfreda J, Tate RB, et al. The natural history of atrial fibrillation: incidence, risk factors, and prognosis in the Manitoba Follow-Up Study. *Am J Med* 1995; 98:476.
2. Fuster, V, Ryden, LE, Cannom, DS, et al. ACC/AHA/ESC 2006 Guidelines for the Management of Patients With Atrial Fibrillation 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). *J Am Coll Cardiol* 2006; 48:e149.
3. Wann LS, Curtis AB, January CT, et al. 2011 ACCF/AHA/HRS focused update on the management of patients with atrial fibrillation (Updating the 2006 Guideline): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2011; 57:223.
4. Snow V, Weiss KB, LeFevre M, et al. Management of newly detected atrial fibrillation: a clinical practice guideline from the American Academy of Family Physicians and the American College of Physicians. *Ann Intern Med* 2003; 139:1009.
5. McNamara RL, Tamariz LJ, Segal JB, Bass EB. Management of atrial fibrillation: review of the evidence for the role of pharmacologic therapy, electrical cardioversion, and echocardiography. *Ann Intern Med* 2003; 139:1018.

6. Lip GY, Watson RD. ABC of atrial fibrillation. Differential diagnosis of atrial fibrillation. *BMJ* 1995; 311(7018): 1495-1498.
7. Van Gelder IC, Groenveld HF, Crijns HJ, et al. Lenient versus strict rate control in patients with atrial fibrillation. *N Engl J Med.* 2010;362:1363–1373.
8. Wyse DG, Waldo AL, DiMarco JP, et al. A comparison of rate control and rhythm control in patients with atrial fibrillation. *N Engl J Med.* 2002;347:1825–1833.
9. Klein AL, Murray RD, Grimm RA. Role of transesophageal echocardiography-guided cardioversion of patients with atrial fibrillation. *J Am Coll Cardiol* 2001; 37:691.

**Authors: Abdullah J. Saïdy, MD, & Robert Sallis, MD,**

*Kaiser Permanente Fontana FMRP, CA*

**Editor: Edward Jackson, MD,**

*Saginaw FMRP, MI*