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[1]
    - Incidence increases with age[1]
        - 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

Diagnostics

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)[9]
- 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[6]

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[2,3]
   - 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)[3]
   - 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 ≤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

o Beta Blockers (Class I)2
▪ 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 µg/kg per min.
- If, after 4 minutes, response inadequate, give another bolus followed by infusion of 100 µg/kg per min.
- If, after another 4 minutes, response still inadequate, give third and final bolus followed by infusion of 150 µg/kg per min.
- If necessary, infusion can be increased to maximum of 200 µg/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

o Digoxin (Class 1)2
▪ 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

o Amiodarone (Class IIa)2

        - Second line therapy for rate control
        - Consider when beta blockers, calcium channel blockers and digoxin ineffective alone or in combination (Level of evidence C)[2]
        - 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[2]
    - 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 that 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.9
        - 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)3
        - 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 4,5
            - 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) [3]

Follow-Up

1. Antithrombotic therapy recommended to prevent thromboembolism for all patients with Afib, except those with lone AF or contraindications. (LOE: A)[2,8]
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)[2]
    - If 3 or more, then Warfarin[2]
3. Continue follow up as outpatient with primary care physician and cardiology
    - Maintain INR 2-3
    - Continue rate control

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