Learning Objectives

1. Identify the causes of ventricular arrhythmias and differentiate the types of ventricular arrhythmias and identify the causes of atrial arrhythmias and differentiate the types of atrial arrhythmias.
2. Manage life-threatening ventricular arrhythmias, and assess, diagnose and stratify for risk patients who have, or are at risk for, ventricular arrhythmias.
3. Develop collaborative care plans with patients, emphasizing medication adherence and follow-up.
4. Establish quality improvement plans to maximize care coordination and minimize hospital readmission.

Associated Session(s)

• Arrhythmias and Dysrhythmias: PBL
Audience Engagement System

Arrhythmias and Dysrhythmias
Tachyarrhythmia
- Atrial fibrillation
- Supraventricular tachycardia
- Ventricular tachycardia
Bradyarrhythmia

Tachyarrhythmias

Case 1
Evelyn is a 65-year old woman who presents for a routine office visit. On physical exam, she is noted to have an irregular heart rate.

AES POLL QUESTION
What is the most common arrhythmia worldwide?
A. Atrioventricular block
B. Wolf Parkinson White syndrome
C. Atrial fibrillation
D. Atrial flutter
Atrial Fibrillation

- Most common cardiac arrhythmia worldwide
- Disease of aging
  - 1% patients < 60
  - 8-12% patients > 80
- 450,000 admission per year in the US
- Significant cause of stroke
  - Increased mortality and morbidity from stroke from AF


Atrial Fibrillation

- Paroxysmal AF
- Persistent AF
- Long-standing AF
- Permanent AF
- Nonvalvular AF

Treatment of Atrial Fibrillation

Acute Management
If hemodynamically unstable
- Electrical cardioversion
If hemodynamically stable but symptomatic
(with no pre-excitation)
- Metoprolol 2.5-5.0 mg IV bolus every 3 min; up to 3 doses
- Verapamil 0.075-0.15 mg/kg IV bolus over 2 min; may give an additional 10.0 mg after 30 min in no response, then 0.005 mg/kg/min infusion
- Diltiazem 0.25 mg/kg IV bolus over 2 min; then 5-15 mg/hr


Treatment of Atrial Fibrillation

Rate vs. Rhythm Control
- AFFIRM and RACE trials
- Rate control equivalent to rhythm control
- Rhythm control
  - Proarrhythmic
  - Requires monitoring
  - Reoccurs in 20-60% at one year
  - Increased hospitalization rate

Rate Control

- Beta blockers
  - esmolol
  - propranolol
  - metoprolol
- Nondihydropyridine calcium channel blockers
  - diltiazem
  - verapamil
- Digoxin
- Amiodarone

Rhythm Control

- Cardioversion
- Antiarrhythmic drugs
- Catheter ablation
Cardioversion

- Electrical
- Pharmacological
  - Flecainide
  - Dofetilide
  - Propafenone
  - Ibutilide
  - Amiodarone

Catheter Ablation

- Symptomatic paroxysmal AF refractory to medication when rhythm control is desired (Class 1: LOE A)
- Recurrent symptomatic paroxysmal AF in some patients (Class 2a: LOE A)
- Reasonable for persistent AF refractory to medication (Class 2a: LOE A)

Anticoagulation

- In patients with AF, antithrombotic therapy should be individualized based on absolute and relative risks of stroke and bleeding (Class I; LOE C)
- Selection of antithrombotic therapy should be based on the risk of thromboembolism irrespective of whether the AF pattern is paroxysmal, persistent, or permanent (Class 1; LOE C)
- In patients with nonvalvular AF, the CHA₂DS₂-VASc score is recommended for assessment of stroke risk. (Class 1: LOE B)

CHA₂DS₂-VASc

- Congestive heart failure
- Hypertension
- Age > 75 (2 points)
- Diabetes mellitus
- Prior stroke or TIA or thromboembolism (2 points)
- Vascular disease
- Age 65-74 years
- Sex category (female sex)

HAS-BLED Score

- Hypertension (Uncontrolled > 160 mm Hg)
- Abnormal liver/renal function
- Stroke
- Bleeding history
- Labile INR (<60% time in therapeutic range)
- Elderly (Age >65)
- Drug/alcohol use

Anticoagulation

- Warfarin
- Novel oral anticoagulants
  - dabigatran
  - rivaroxaban
  - apixaban
  - edoxaban
AES POLL QUESTION
For patients with atrial fibrillation, aspirin provides an absolute risk reduction of…
A. 8%
B. 80%
C. 4%
D. 0.8%

Case 2
A 76-year old male presents to your office complaining of palpitations. He has a history of atrial fibrillation. An ECG reveals the following:

Atrial Flutter
- Reentrant atrial arrhythmia
- Regular atrial rate
- Constant p-wave morphology
- Similar risk factors for atrial fibrillation
- Atrial flutter and atrial fibrillation can coexist in same patient

Atrial Flutter
- Acute Management
  - Hemodynamically unstable
    - Rhythm control
    - Synchronized cardioversion (Class 1)
  - Rate control
    - IV amiodarone (Class 2a)
- Hemodynamically stable
  - Rhythm control
  - Synchronized cardioversion (Class 1)
  - Rate control
    - IV beta blockers, diltiazem, verapamil (Class 1)
    - IV amiodarone (Class 2a)

Atrial Flutter
- Chronic Management
  1. Rate control
    - Beta blockers, diltiazem, verapamil (Class 1)
  2. Rhythm control
    - Catheter ablation (Class 1)
    - Amiodarone, dofetilide or sotalol (Class 2a)
    - Flecainide or propafenone (Class 2b)
Case 3
A five-week old infant presents for her well baby exam. A fast heart rate is noted on physical examination. An ECG shows the following:

Supraventricular Tachycardia
- Atrial or ventricular rates above 100 bpm
- Involves tissue from the bundle of His or above
- Includes
  - Inappropriate sinus tachycardia
  - Junctional sinus tachycardia
  - Atrial tachycardia
  - Macroreentrant atrial tachycardia
  - AVNRT
  - AVRT

Supraventricular Tachycardia
Atrioventricular nodal reentrant tachycardia (AVNRT)
- Involved two distinct pathways
  - Fast and slow
- Most common SVT
Atrioventricular Reentrant Tachycardia (AVRT)

- Reentrant tachycardia
- Electrical pathway
  - Atrium
  - Atrioventricular node
  - Accessory pathway
- Most common in young children

AVRT

Accessory pathway
- Extranodal AV pathway that connects the atrium to the ventricle
- Manifest pathway
  - Conducts anterograde, causing pre-excitation
- Concealed pathway
  - Conducts only retrograde
- Pre-excitation
  - Manifest pathway leading to short PR interval and slurring of QRS

Treatment of SVT

Acute Management
1. Vagal maneuver or adenosine (Class 1)
2. Hemodynamically stable or unstable?
   - Hemodynamically unstable
     - Synchronized cardioversion
   - Hemodynamically stable
     - IV beta blocker, diltiazem, verapamil
     - Synchronized cardioversion

Ongoing Management
- EP study and ablation
- Medical therapy
  - Beta blockers, diltiazem or verapamil (if no pre-excitation) (Class 1)
  - Flecainide or propafenone (Class 2a)
  - Amiodarone, dofetilide or sotalol (Class 2b)
  - Digoxin (if no pre-excitation) (Class 2b)
Tachycardia-Induced Cardiomyopathy

- Cardiomyopathy secondary to sustained tachycardia
- Dilated cardiomyopathy
- Sustained tachycardia for months to years
- Reversible with control of underlying rhythm

AES POLL QUESTION

Which of the following are relatively contraindicated in AVRT with preexcitation?

A. Adenosine
B. Beta blockers
C. Nondihydropyridine CCB
D. B and C

Wide Complex Tachycardia

Case 4

A 60-year old woman presents to your clinic with palpitations and shortness of breath. She has a history of atrial fibrillation. ECG reveals a wide-complex regular tachycardia.

Wide Complex Tachycardia

- Ventricular tachycardia
- Supraventricular rhythm with abnormal conduction
Wide Complex Tachycardia

SVT with abnormal conduction
- Pre-existing bundle-branch block or intraventricular conduction defect
- Aberrant conduction due to tachycardia (normal QRS in sinus rhythm)
- Electrolyte or metabolic disorder
- Conduction over an accessory pathway
- Paced rhythm

Ventricular Arrhythmias

- PVCs
- Monomorphic SVT
  - Sustained (more than 30 second)
  - Nonsustained
- Polymorphic SVT
  - Torsades de Points

Ventricular Arrhythmias

- Monomorphic ventricular tachycardia
  - May be SVT in origin
  - Result of structural heart disease
- Idiopathic ventricular tachycardia
- Polymorphic ventricular tachycardia
  - Clinically significant structural heart disease
  - Acute myocardial infarction
  - Cardiomyopathies
  - Genetic arrhythmia syndromes
  - ICD may be indicated
- PVCs and non-sustained ventricular tachycardia
  - Low risk in absence of structural heart disease or arrhythmia syndrome

Causes of Sudden Cardiac Death

- Ventricular fibrillation (62.4%)
- Bradyarrhythmias (16.5%)
- Torsades de pointes (12.7%)
- Ventricular tachycardia (8.3%)

Holter monitor
Management of Wide Complex Tachycardia

If patient is unstable
- Synchronized cardioversion
- Consider adenosine
- Antiarrhythmic therapy
  - Procainamide
  - Amiodarone
  - Sotalol
- Cardioversion
- If irregular
  - Treat as atrial fibrillation or flutter
- If polymorphic
  - Defibrillation

Management of Ventricular Tachycardia

- Treat underlying disease
- No antiarrhythmic proven to prevent sudden cardiac death
  - Metoprolol
- ICD placement in appropriate patients

Sudden Cardiac Death (SCD)

In patients with heart disease

- Older patients
  - Coronary artery disease
  - Valvular heart disease
  - Heart failure

- Predictors
  - Severity of underlying disease
  - Coronary heart disease
  - Heart failure
  - Ejection fraction strongest predictor (< 30-40%)

In patients without heart disease

- 50% have undiagnosed ischemic heart disease

- Younger patients
  - Channelopathies
  - Cardiomyopathies
  - Myocarditis
  - Substance abuse

Cardiomyopathies

<table>
<thead>
<tr>
<th>Primary Cardiomyopathies</th>
<th>Secondary Cardiomyopathies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetic</td>
<td>Mixed</td>
</tr>
<tr>
<td>Acquired</td>
<td>Infiltrative/Storage</td>
</tr>
</tbody>
</table>

ECG Changes in Cardiomyopathy

- T wave inversion: >1 mm in 2 or more leads, V2-V6, II and AVL and I and AVL
- ST segment depression: >0.5 mm in 2 or more leads
- Pathological Q waves: >3 mm depth or >40ms duration two or more leads
- Complete left bundle branch block: QRS >120 ms, negative QRS complex in V5 and upright monophasic R 1 and V6
- Intraventricular conduction delay: QRS >140 ms
- Left axis deviation: -30° -90°
- Left atrial enlargement
- Right ventricular hypertrophy pattern
- Premature ventricular contractions: ≥3 PVCs per 10 sec tracing
- Ventricular arrhythmias: Couplets, triplets and non-sustained VT

16-year old male with a history of syncope

Bradyarrhythmias
Bradyarrhythmias

- Bradycardia heart rate < 60 beats per minute
- Symptomatic vs. asymptomatic
- Normal variants
  - Sleep
  - Among athletes

CO = HR X SV

MAP = (CO x SVR) + CVP

Presentation

- Syncope
- End organ hypoperfusion
- Chronotropic incompetency

Causes of bradycardia

- Sinus node dysfunction (sick sinus syndrome)
- Atrioventricular block
- Reflex syncope
- Toxins
- Systemic disease
- Electrolytes
- Conduction disturbance
- Medications

Sinus Node Dysfunction

- Problem with the sinus node and surrounding tissue
- Disease of the elderly
- Sinus bradycardia or tachy-brady
- Indications for pacemaker placement
  - Symptomatic bradycardia
  - Chronotropic incompetence
  - Symptomatic bradycardia from required drug therapy

Atrioventricular Blocks

- Delayed conduction through AV conduction system
  - First degree
  - Second degree type 1 (Wenkebach)
  - Second degree type 2
  - Third degree
SA Node

AV Node

Bundle of His

Left and right bundle branches
Treatment

• Atropine
• Reversible causes
• Transcutaneous pacing
• Dopamine
• Epinephrine
• Isoproterenol
• Transvenous pacing

Causes

Acute bradycardia (sinus bradycardia and AV blocks)

1. Ischemia or infarction
2. Conduction disease
3. Medication effects
   – Beta blockers
   – Calcium channel blockers
   – Tricyclic antidepressants

Practice Recommendations

• In patients with AF, antithrombotic therapy should be individualized based on absolute and relative risks of stroke and bleeding (Class I; LOE: C)

• Oral beta blockers, diltiazem, or verapamil is useful for ongoing management in patients with symptomatic SVT who do not have pre-excitation during sinus rhythm. (Class 1; LOE B-R)

Practice Recommendations

• Permanent pacemaker implantation is indicated for Sinus Node Dysfunction with documented symptomatic bradycardia, including frequent sinus pauses that produce symptoms. (Class 1, LOE C)

• Atropine remains the first-line drug for acute symptomatic bradycardia (Class IIa, LOE B)

ICD-10 Codes

I48.- Atrial fibrillation and flutter
   I48.0 Paroxysmal atrial fibrillation
   I48.1 Persistent atrial fibrillation
   I48.2 Chronic atrial fibrillation

I49.- Other cardiac arrhythmias
   I49.01 Ventricular fibrillation
   I49.9 Other specified cardiac arrhythmias

Questions
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