Arrhythmias and Dysrhythmias: A Shocking Diagnosis

Brian Shahan, MD

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Dr. Shahan earned his medical degree from the University of Nebraska Medical Center, Omaha, and completed his family medicine residency at Tripler Army Medical Center in Honolulu, Hawaii. After his residency, he spent four years in Alaska, providing full-scope primary care in remote and austere locations. He returned to academic medicine to pursue specialty training in hospital medicine. Currently serving as the program director for a family medicine hospitalist fellowship, he plans to continue to train family medicine hospitalists and to improve inpatient residency training for family medicine residents.
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. Be familiar with the roles of various pharmacologic and device therapies for common cardiac arrhythmias, including their indications and how to monitor for control and adverse effects.

4. Recognize the indications and relative benefits and risks of novel oral anticoagulants, and select appropriate anticoagulant therapy for patients.

Associated Sessions

• (PBL) Arrhythmias and Dysrhythmias: A Shocking Diagnosis
Audience Engagement System

Step 1

Step 2

Arrhythmia

Abnormal rhythm
AES Question 1

Which of the following is NOT in the definition of Normal Sinus Rhythm (NSR)?

A. Must have 1:1 conduction of p wave to QRS complex
B. P wave must be upright in lead II
C. P wave must be downward in aVR
D. P wave must have constant morphology
E. HR between 60 and 100 beats/min

NSR

• Sinus node initiates all atrial activity
  • Located in Superior and Anterior atria
    • Positive lead II
    • Negative aVR
• No atrial ectopy
  • All p waves constant
NSR

ECG courtesy of David Kassop, MD

NSR

ECG courtesy of David Kassop, MD
AV Block with NSR

• Sinus rhythm occurs
• Ventricles don't get signal
• No 1:1 conduction

ECG courtesy of Ryan Flannigan, MD FAAP FACC
Case
An 80 year old woman presents with fatigue and global weakness. EKG shows…
AES Question 2

Which of the following is a terrible idea?

A. Rectal exam  
B. Give IV metoprolol  
C. Obtain CBC  
D. CT pulmonary angiogram
Sinus Tachycardia

- Not a heart problem!!!
- Underlying disorder
  - Fever
  - Hypovolemia
  - Bleeding
  - Sepsis
  - PE
  - Pain (usually must be severe)

Review of Sinus Rhythm

- Sinus node initiated
- Sinus arrhythmia is common and physiologic
- Don’t beta block sinus tachycardia!
  - Treat underlying disorder
A 15 year old female presents with palpitations associated with fatigue. Vital signs are normal except a fast heart rate is noted. An EKG shows the following:

ECG courtesy of Ryan Flannigan, MD FAAP FACC
AES Question 3

What is the diagnosis?
A. Sinus tachycardia
B. Atrial flutter with 1:1 conduction
C. Junctional tachycardia
D. Atrio-ventricular re-entry tachycardia

Supraventricular Tachycardia

• Atrial or ventricular rates above 100 bpm
• Involves tissue from the bundle of His or above
PSVT

- Atrioventricular nodal reentrant tachycardia (AVNRT)
  - Narrow complex
  - Most common PSVT
Atrioventricular Reentrant Tachycardia (AVRT)

- Classically narrow complexed
  - Can be wide if antidromic pathway
- Most common in young children
AES Question 4

You have decided to do vagal maneuvers on this patient. Which of the following vagal maneuvers seems to be the most successful?
A. Eyeball pressure
B. Carotid massage
C. Face in ice water
D. Bearing down

Treatment of PSVT

Acute Management

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

Adenosine

- Diagnostic and therapeutic
  - Completely blocks AV node
  - If AT/flutter, will see p-waves
- Extremely short half life
  - Must be pushed fast
  - Likely not to cause harm

Case

Pt now is in sinus rhythm. EKG obtained shows...
AES Question 5

Which of the following medications is the safest if she goes back into stable AVRT or AF knowing she has WPW?

A. Beta blockers
B. Diltiazem/verapamil
C. Amiodarone
D. Digoxin
E. Procainamide

Wolff-Parkinson-White

• Associated mostly with AVRT
• Pre-excitation on EKG (delta wave)
• Avoid all AV nodal blockers!
  • Precipitates V Fib
• Procainamide and ibutilide safe
• Refer for ablation

Long Term Treatment PSVT

- EP study and ablation
- Medical therapy
  - Beta blockers, diltiazem/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)


Review of PSVT

- Adenosine!
- Watch for WPW
- Refer for ablation
AES Question 6

A 60-year old male is admitted for pneumonia. The nurse calls and says the patient has been in V tach now for the last 2 mins and is asymptomatic. What is the next step in management?

A. Emergent electro-cardioversion
B. Load amiodarone
C. Get 12 lead EKG
D. Push adenosine

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

Wide Complex Tachycardia

• Ventricular tachycardia (v-tach)
  • A-V dissociation
  • If unsure...

V-Tach!
Ventricular Tachycardia

• ≥ 3 consecutive ventricular beats
  • Sustained (more than 30 second)
  • Non-sustained
• Monomorphic VT
• Polymorphic VT
  • Torsades de Pointes
• VT/VF storm

Case

When you arrive to the patient’s room he is asymptomatic and in normal sinus rhythm. Rhythm strip on telemetry shows...
AES Question 7

Telemetry confirms the rhythm was present for 3 minutes. What is the most likely cause of his sustained VT?

A. Structural heart disease  
B. Hypoxemia  
C. Electrolyte abnormality  
D. Acidemia
Ventricular Arrhythmias

- Monomorphic ventricular tachycardia
  - Caused by a single focus (scar)
  - Catheter ablation may be curative

- Polymorphic ventricular tachycardia
  - Usually ischemia
    - 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

AES Question 8

Which of the following classes of anti-arrhythmics is the only one that improves mortality in patients with ventricular arrhythmias?

A. Class I
B. Class II
C. Class III
D. Class IV
Antiarrhythmic classes

I - Sodium
II - Blocks
III - Potassium
IV - Channels

AES Question 9

The patient again goes into monomorphic VT with normal blood pressure. It has now been 3 minutes, which of the following medications is NOT recommended for acute management of sustained VT?

A. Procainamide (class I)
B. Metoprolol (class II)
C. Amiodarone (class III)
D. Verapamil (class IV)
Sustained VT

- **Procainamide** - In patients with hemodynamically stable VT, administration of intravenous procainamide can be useful to attempt to terminate VT (Class 2a)
- **Beta blockers** - In patients with polymorphic VT due to myocardial ischemia, intravenous beta blockers can be useful (Class 2a)
- **Amiodarone** - In patients with hemodynamically stable VT, administration of intravenous amiodarone or sotalol may be considered to attempt to terminate VT (Class 2a)
- **Verapamil** - In patients with a wide QRS complex tachycardia of unknown origin, calcium channel blockers (e.g., verapamil and diltiazem) are potentially harmful (Class 3 – Harm)


Case

The next day the patient has nausea and receives ondansetron. Shortly after the patient has altered mental status and now the monitor shows this...
AES Question 10

What is the treatment?
A. Procainamide (class I)
B. Metoprolol (class II)
C. Amiodarone (class III)
D. Magnesium Sulfate (class V)
Management of Wide Complex Tachycardia

- If patient is unstable
  - Synchronized cardioversion (defibrillate if polymorphic VT or pulseless)
- If patient is stable
  - Regular and monomorphic
    - Consider adenosine (Rules out SVT – however always assume VT if unsure)
    - Antiarrhythmic therapy – Almost anything except Non-DHP Ca Blockers (Most use Amio)
    - Beta blocker if ischemia likely
  - Polymorphic
    - If prolonged QT then it’s Torsades -> Magnesium, potassium, lidocaine, chronotropy
    - If no prolonged QT -> beta blocker or amiodarone
- Cardioversion if refractory to medical therapy
- If irregularly irregular
  - Consider atrial fibrillation or flutter


Management of Ventricular Tachycardia

- Treat underlying disease
- Ready to shock
- Only beta blockers improve mortality in the long term
- ICD placement in appropriate patients
Who gets ICD?

- Survivors of SCA
- VT with structural heart disease
  - i.e. HCM, Brugada, Valvular dx, NICM, ICM, many more...
- EF < 35 with class II or III HF
- EF < 30
- Life-expectancy of 1 year


Cardiomyopathies

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<thead>
<tr>
<th>Primary Cardiomyopathies</th>
<th>Secondary Cardiomyopathies</th>
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<tbody>
<tr>
<td>Genetic</td>
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<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>Dilated cardiomyopathy</td>
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<tr>
<td>Arrhythmogenic right ventricular dysplasia</td>
<td>Restrictive</td>
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<td>LV Noncompaction</td>
<td>Peripartum</td>
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<tr>
<td>Glycogen storage diseases</td>
<td>Tachycardia induced</td>
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<tr>
<td>Conduction defects</td>
<td></td>
</tr>
<tr>
<td>Mitochondrial myopathies</td>
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<tr>
<td>Ion channel disorders</td>
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</table>

<table>
<thead>
<tr>
<th>Acquired</th>
<th>Infiltrative/Storage</th>
<th>Endocrine</th>
<th>Other</th>
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<tbody>
<tr>
<td>Myocarditis</td>
<td>Amyloidosis</td>
<td>Diabetes mellitus</td>
<td>Sarcoidosis</td>
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<tr>
<td>Takotsubo</td>
<td>Gaucher disease</td>
<td>Hyperthyroidism</td>
<td>Neurological</td>
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<td>Peripartum</td>
<td>Hurler's disease</td>
<td>Hyperparathyroidism</td>
<td>Nutritional deficiencies</td>
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<tr>
<td>Tachycardia induced</td>
<td>Hunter's disease</td>
<td>Hyperparathyroidism</td>
<td>Neurological</td>
</tr>
<tr>
<td>Hemochromatosis</td>
<td>Pheochromocytoma</td>
<td>Dermatomyositis</td>
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<td>Fabry's disease</td>
<td>Acromegaly</td>
<td>Scleroderma</td>
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<td>Glycogen storage disease</td>
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<td>Electrolyte imbalance</td>
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<tr>
<td>Niemann-Pick disease</td>
<td></td>
<td>Cancer therapy</td>
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</tbody>
</table>

Review of V-Tach

- Wide complex is VT or SVT with aberrancy
  - Adenosine can help differentiate
- Don’t use Ca channel blockers
- Beta blockers improve mortality
- Consider ICD

Review V-Tach

- If prolonged QT then it Torsades
  - Lots of mag!
- Amiodarone is most used if not Torsades
  - If in doubt, give mag
AES Question 11

You are awoken in the night by an intern who is concerned that a patient’s HR is 32 while asleep. When awoken, the patient was angry that he was disturbed in his sleep with BP of 140/90. What is the next step in management?

A. Atropine  
B. Epinephrine  
C. Pacing  
D. Intern fails inpatient rotation

Bradyarrhythmias

• Bradycardia heart rate < 60 beats per minute  
• Symptomatic vs. asymptomatic  
• Normal variants  
  • Sleep  
  • Among athletes
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 (can’t increase HR when demand is present)
  • Symptomatic bradycardia from required drug therapy
Question 12

Which of the following rhythms have a high likelihood of requiring a permanent pacer?

A. 1\textsuperscript{st} degree AV block  
B. 2\textsuperscript{nd} degree type 1 (Wenckebach)  
C. 2\textsuperscript{nd} degree type 2 (Mobitz)  
D. 3\textsuperscript{rd} degree AV block  
E. Both C and D
ECG courtesy of Ryan Flannigan, MD FAAP FACC

SA Node

Mobitz I

AV Node

Bundle of His

Left and right bundle branches
SA Node 

AV Node 

Bundle of His 

Left and right bundle branches 

Mobitz I
SA Node

Mobitz I

AV Node

Bundle of His

Left and right bundle branches

SA Node

Mobitz I

AV Node

Bundle of His

Left and right bundle branches
ECG courtesy of Ryan Flannigan, MD FAAP FACC

SA Node

AV Node

Mobitz II

Bundle of His

Left and right bundle branches
SA Node

AV Node

Bundle of His

Complete block

Left and right bundle branches

ECG courtesy of Ryan Flannigan, MD FAAP FACC
Treatment if symptomatic

- Atropine (likely won’t help high degree AV block)
- Transcutaneous pacing
- Dopamine
- Epinephrine
- Reversible causes
- Transvenous pacing
Causes

• Acute bradycardia (sinus bradycardia and AV blocks)
  • Ischemia or infarction
  • Conduction disease
  • Medication effects
    • Beta blockers
    • Calcium channel blockers
    • Tricyclic antidepressants

Question 13

A 77 year old male was admitted for NSTEMI and suddenly develops altered mental status, hypotension and bradycardia. You diagnose 3rd degree AV block and begin external pacing. You dial up the milliamps to 20 and the monitor shows a pacer spike followed by a QRS at a rate of 70 bpm. His blood pressure does not improve and his peripheral pulse is 35 bpm, what is the most likely explanation?

A. Patient has concurrent sepsis  
B. You are pacing the pectoralis muscle  
C. Patient has concurrent decompensated heart failure  
D. This is normal with external pacing
Question 14 (last one)

A 75 year old male has episodes of syncope once every 2 months that occurs suddenly and sometimes when driving. He has had multiple admissions to the hospital with no discovered etiology. Tilt table testing is normal. What is the best next step for him?

A. Continuous external EKG Monitor (Holter)
B. Event Monitor
C. Implanted Cardiac Monitor
D. Pacemaker

Review Bradycardia

• Symptomatic vs asymptomatic
• Pacer if symptomatic and irreversible condition
• Transcutaneous pacing in acute setting of Mobitz II or complete heart block
  • Dial up the electricity!!
Review PSVT

- Adenosine!
- Watch for WPW
- Refer for ablation

Review V-Tach

- Wide complex is VT or SVT with aberrancy
  - Adenosine can help differentiate
- Don’t use Ca channel blockers
- Beta blockers improve mortality
- Consider ICD
Review V-Tach

- If prolonged QT then it Torsades
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Review of Sinus Rhythm

- Sinus node initiated
- Sinus arrhythmia is common and physiologic
- Don’t beta block sinus tachycardia!
  - Treat underlying disorder
Practice Recommendations

• 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 I; 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)


Practice Recommendations

• In patients with HF with New York Heart Association class II–III symptoms and an LVEF of ≤35%, despite guideline-directed management and therapy, an implantable cardioverter-defibrillator (ICD) is recommended if meaningful survival of >1 year is expected (Class I, LOE A).

• In patients with symptomatic, non-life-threatening VA, treatment with a beta blocker is reasonable (Class IIa, LOE C)


Questions
Contact Information

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References


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