



ARRHYTHMIAS OF THE HEART

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DISCLOSURES

No relevant
commercial
relationships to
disclose

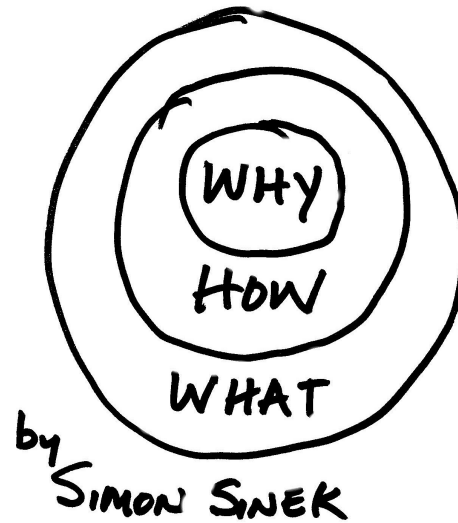


Recognize	Recognize clinical presentations of common cardiac arrhythmias
Identify	Identify electrocardiogram patterns that suggest cardiac arrhythmias
Apply	Apply current guidelines to manage patients with common cardiac arrhythmias

Learning Objectives



THE GOLDEN CIRCLE



Why

- ❖ 2.3 million people in the United States are affected by Atrial Fibrillation
- ❖ 90,000 cases of supraventricular tachycardia are detected annually in the United States
- ❖ 25% of all ED visits for supraventricular tachycardia result in hospitalization
- ❖ 75% to 80% of cases of sudden cardiac death are due to ventricular arrhythmias
- ❖ 184,000 to 450,000 lives lost in the United States per year



How

Case Studies

Focus on:

- ❖ Clinical Presentation
- ❖ Electrocardiogram Manifestations
- ❖ Guideline Driven Management



What

Improve Improve preventative measures

Reduce Reduce possible risk

Eliminate Eliminate symptoms

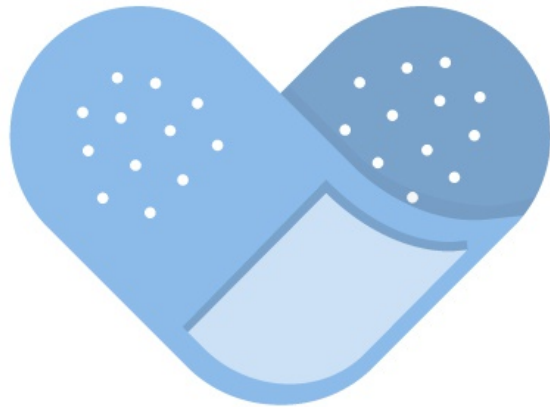
Decrease Decrease morbidity and mortality



Case #1

A 32-year-old woman comes to the clinic with palpitations. The palpitations have been happening sporadically for about six months.





DIFFERENTIAL DIAGNOSIS

- ❖ Sinus Arrhythmia
- ❖ Premature Atrial Contractions
- ❖ Premature Ventricular Contractions
- ❖ Atrial Fibrillation
- ❖ Anxiety disorder/Panic attacks
- ❖ Toxins/Medications

The list could go on and on...



What we know

- ❖ **Palpitations affect both the young and older populations**
- ❖ **Those with or without structural heart disease**
- ❖ **Workup is important:**
- ❖ Premature atrial contractions (PACs) and premature ventricular contractions (PVCs) have an increased risk of adverse cardiovascular outcomes



Image: <https://www.hydra.cloud/en/resources/blog/7-benefits-of-an-effective-knowledge-transfer-plan>

Question #1

Which of the following mechanism results in a PAC?

- A. Early depolarization of atrial tissue
- B. Late repolarization of ventricular tissue
- C. Disturbance of the Purkinje fibers
- D. Early depolarization of the ventricles



Question #1

Which of the following mechanism results in a PAC?

- A. Early depolarization of atrial tissue
- B. Late repolarization of ventricular tissue
- C. Disturbance of the Purkinje fibers
- D. Early depolarization of the ventricles



Premature Atrial Contractions (PACs)

Premature Ventricular Contractions (PVCs)

- ❖ PACs result from early depolarization of atrial tissue
- ❖ Triggers a premature heartbeat from somewhere other than the SA Node
- ❖ PVCs occur when the underlying rhythm is interrupted by an early beat originating from the ventricles
- ❖ Cardiac and/or noncardiac factors

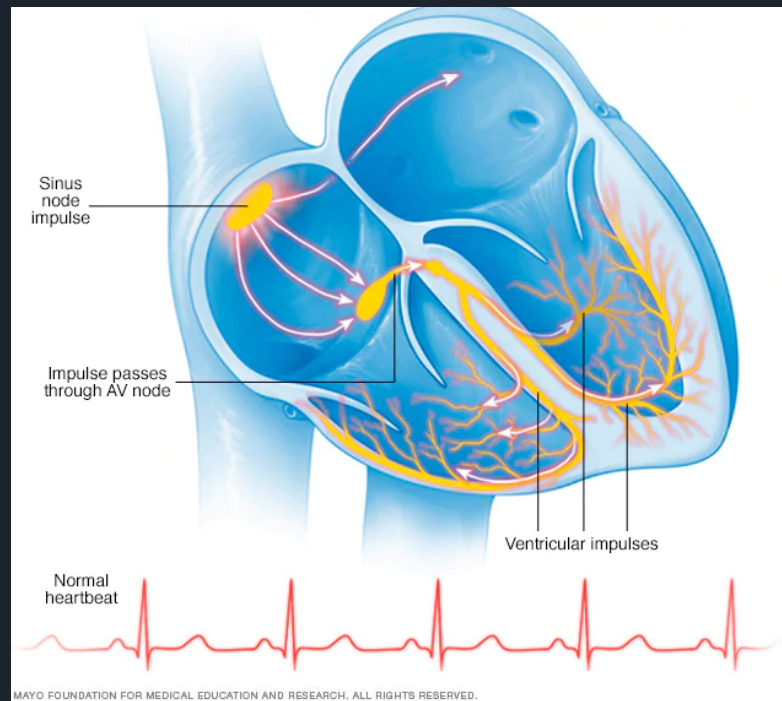


Image: <https://www.mayoclinic.org/diseases-conditions/premature-ventricular-contractions/symptoms-causes/syc-20376757>

Our Patient- Case #1

A 32-year-old woman comes to the clinic with palpitations. The palpitations have been happening **sporadically** for about six months. She cannot think of anything that **makes them better or worse**. She **denies chest pain, shortness of breath, dizziness or syncopal episodes**. Past medical history consists of seasonal allergies only. She does not take any **medications or use any substances**.



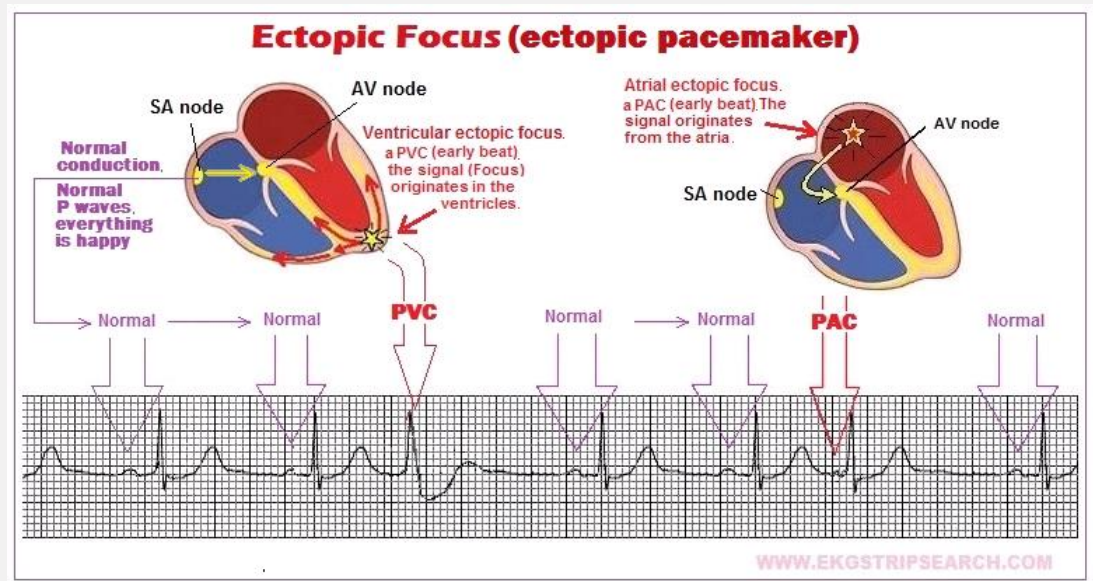
- ❖ Little to no symptoms in many patients
- ❖ Sensation of “skipping” or “flopping” in the chest
- ❖ Dizziness or pre-syncope episodes
- ❖ Palpitations at rest or with exertion (cardiac etiologies)
- ❖ Presence of an irregular pulse
- ❖ Early heart sound on auscultation with PACs
- ❖ Compensatory pause may follow the premature beat in a PVC

Clinical Presentation



Electrocardiogram

- ❖ All patients should have a physical examination and an electrocardiogram (ECG)
- ❖ QRS complex varies depending on the origination site of the impulse
- ❖ PACs originate in the atria
- ❖ QRS complex may be narrow and similar to a normal QRS complex
- ❖ PVCs originate in the ventricles
- ❖ Widened QRS complex very different from that of a normal sinus beat





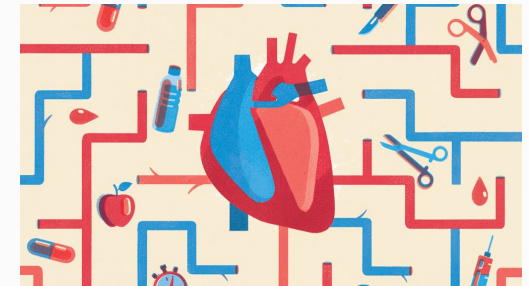
DIAGNOSIS

- ❖ Symptomatic patients benefit from ambulatory monitoring with a 24-48 hour Holter monitor
- ❖ Echocardiogram is recommended to assess for any cardiac structural abnormalities
- ❖ Laboratory testing is warranted
 - ❖ Electrolytes, thyroid stimulating hormone, drug screen



Treatment

- ❖ **Guided by:**
- ❖ Asymptomatic vs. symptomatic
- ❖ Presence or absence of structural heart disease
- ❖ **No therapy is needed in asymptomatic patients in the absence of heart disease**
- ❖ **Symptomatic patients without structural disease reassurance and patient education**
- ❖ Avoiding or minimizing the use of caffeine, alcohol, and nicotine
- ❖ **Ongoing symptomatic PACs**
- ❖ Medical therapy with a beta blocker is recommended
- ❖ **Prognosis depends on the presence of underlying cardiovascular disease**
- ❖ PACs have been linked to a greater risk of atrial fibrillation
- ❖ PVCs have been associated to cardiomyopathy and sudden cardiac death



Case #2

A 71-year-old man presents to the emergency department with palpitations and dyspnea which began approximately 4 hours ago. He denies chest pain, dizziness or any syncopal episodes. He has a history of hypertension and diabetes mellitus type 2. His current medications include an ACE-inhibitor and Metformin.



Differential Diagnosis

- ❖ Premature Atrial Contractions
- ❖ Premature Ventricular Contractions
- ❖ Atrial Fibrillation
- ❖ Atrial Flutter
- ❖ Supraventricular Tachycardia
- ❖ Pulmonary Embolus
- ❖ Acute Coronary Syndrome
- ❖ Anxiety disorder/Panic attacks
- ❖ Toxins/Medications



Image: <https://www.cardiovascularbusiness.com/topics/practice-management/chicago-company-3d-bioprints-mini-human-heart>



Atrial Fibrillation

- ❖ Most common cardiac arrhythmia
- ❖ Prevalence increases with age
- ❖ By 80 years old 10% of people
- ❖ Risk of stroke increases by 5% = overall increase in mortality
- ❖ Risk increases with age and comorbidities



RISK FACTORS

Age	Male Sex	Hypertension	Heart Disease
Pulmonary Disease	Thyroid Dysfunction	Obstructive Sleep Apnea	Diabetes Mellitus
	Metabolic Syndrome	Kidney Disease	

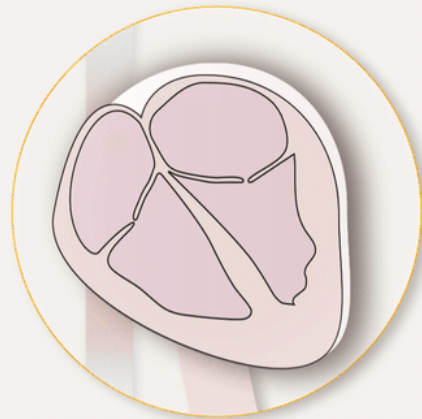
Figure 1: Risk Factors and Underlying Comorbidities to be Addressed in Chronic Comprehensive Atrial Fibrillation Management



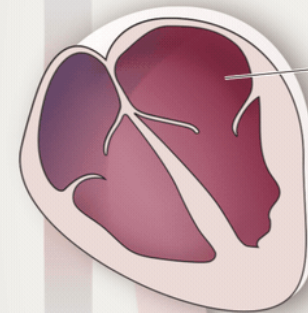
Image: <https://www.aerjournal.com/articles/risk-factor-management-atrial-fibrillation>

- ❖ Chaotic firing of numerous pacemaker cells in the atria
- ❖ No atrial contraction= no P wave
- ❖ Irregular ventricular contraction

Atrial fibrillation (AFib) is the most common type of heart arrhythmia.



Normal heartbeat



AFib occurs when the upper chambers and lower chambers are not coordinated, causing the heart to beat too slowly, too quickly, or irregularly.

Irregular heartbeat



A 71-year-old man presents to the emergency department with palpitations and dyspnea which began approximately 4 hours ago. He denies chest pain, dizziness or any syncopal episodes. He has a history of hypertension and diabetes mellitus type 2. His current medications include an ACE-inhibitor and metformin.

Physical Exam:

- ❖ Heart- 125 bpm, irregular rhythm, no murmurs
- ❖ Lungs- CTA b/l
- ❖ Abdomen- obese, non tender
- ❖ Neck- negative for thyromegaly
- ❖ Electrocardiogram- AF with rapid ventricular response

Our Patient- Case #2



Clinical Presentation

Palpitations

Tachycardia

Fatigue

Weakness

Dizziness/Lightheadedness/Presyncope

Reduced exercise capacity

Dyspnea

Angina

Heart failure/Edema

Irregular rhythm

Murmur if valvular

Electrocardiogram



- ❖ No distinct P waves
- ❖ The RR intervals follow no repetitive pattern (irregularly, irregular)



Diagnosis

- ❖ **Electrocardiogram- necessary to make diagnosis**
- ❖ **Transthoracic echocardiogram:**
 - ❖ Evaluate the size of the atria
 - ❖ Size and function of the ventricles
 - ❖ Valvular heart disease
 - ❖ Pericardial disease
- ❖ **Ischemic evaluation**
- ❖ **Laboratory testing: thyroid panel, electrolytes**





Inpatient Treatment

- ❖ Hemodynamically unstable
- ❖ Management of Heart Failure
- ❖ Treatment with cardioversion if:
 - ❖ Active ongoing ischemia (symptomatic [e.g., angina] or electrocardiographic evidence)
 - ❖ Evidence of organ hypoperfusion (e.g., cold clammy skin, confusion, acute kidney injury)
 - ❖ Inadequate rate control



Outpatient Treatment



Guided By:



Prevention of Systemic Embolism



Rate Control



Rhythm Control



Question #2

A CHA2DS2-VASc score of which of the following would result in a patient being placed on anticoagulation?

- A. Zero
- B. One
- C. Two



Question #2

A CHA2DS2-VASc score of which of the following would result in a patient being placed on anticoagulation?

- A. Zero
- B. One
- C. Two

* A score of one warrants a discussion



CHA2DS2-VASc Risk Score

- ❖ Highest Score= 9
- ❖ Score 1= ASA or Anticoagulation
- ❖ Score ≥2= Anticoagulation

KNOW YOUR STROKE RISK

CHA2DS2-VASc Risk	Score	CHA2DS2-VASc Score	Adjusted stroke rate (% / year)
		0	0
CHF or LVEF <40%	1	1	1.3
Hypertension	1	2	2.2
Age > 75	2	3	3.2
Diabetes	1	4	4
Stroke / TIA / Thromboembolism	2	5	6.7
Vascular Disease	1	6	9.8
Age 65-74	1	7	9.6
Female	1	8	6.7
		9	15.2

*CHF = congestive heart failure; TIA - transient ischemic attack;
LVEF = left ventricular ejection fraction.*



Our Patient- Case #2

71-year-old man

He has a history of hypertension and diabetes mellitus type 2

No history of Stroke/TIA/PE

Echocardiogram- Ejection fraction 55%, no valvular abnormalities or fluid accumulation

KNOW YOUR STROKE RISK			
CHA2DS2-VASc Risk	Score	CHA2DS2-VASc Score	Adjusted stroke rate (% / year)
		0	0
CHF or LVEF <40%	1	1	1.3
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*CHF = congestive heart failure; TIA - transient ischemic attack;
LVEF = left ventricular ejection fraction.*

Score=3
Anticoagulate



Rate vs. Rhythm Control

- ❖ **Slow ventricular rate for symptomatic relief**
- ❖ *Rate control:*
- ❖ *Beta blockers, non-dihydropyridine calcium channel blockers, digoxin*
- ❖ **Decision regarding the long-term management**
- ❖ *Rhythm control:*
- ❖ *Electrical cardioversion, antiarrhythmic drug therapy, percutaneous catheter ablation*



Case #3

A 43-year-old woman is evaluated in the emergency department for palpitations, shortness of breath and chest tightness. Symptoms began 1 hour ago. She denies feeling dizzy or like she may faint. She has had palpitations before, but they have never lasted this long. Past medical history is significant for one healthy vaginal birth at 32 years of age and seasonal allergies. Current medications include a daily multivitamin and an antihistamine as needed.

- ❖ Triage ECG reveals sinus tachycardia at 150bpm with narrow QRS complexes



Differential Diagnosis

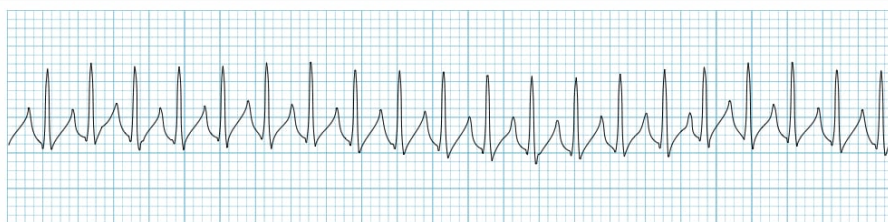


Image: <https://litfl.com/supra-ventricular-tachycardia-svt-ecg-library/>

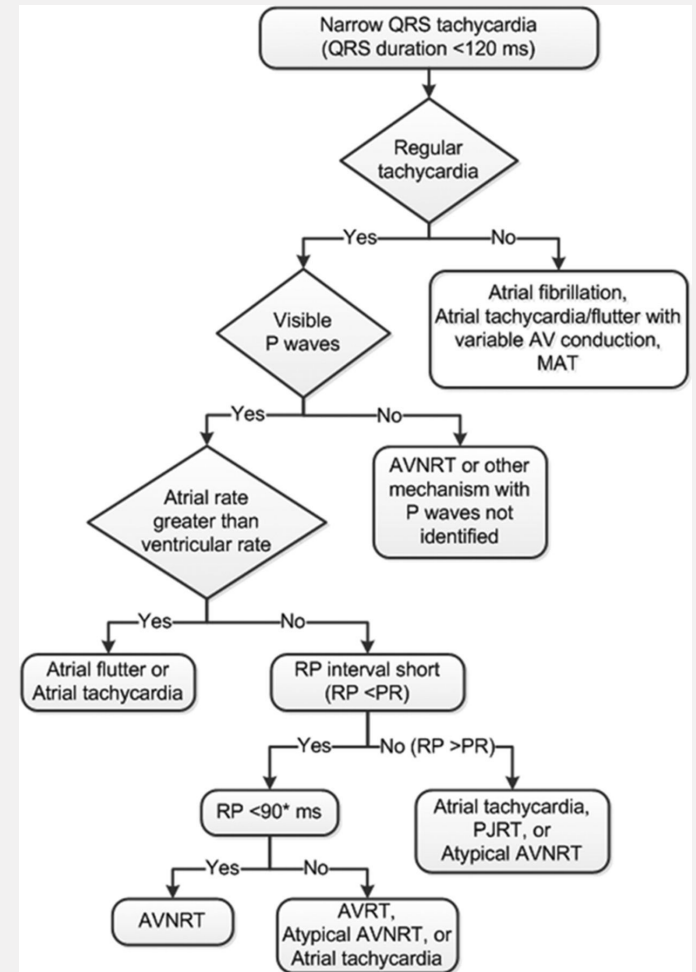


Image: <https://www.ahajournals.org/doi/epub/10.1161/CIR.0000000000000311>



Supraventricular Tachycardia

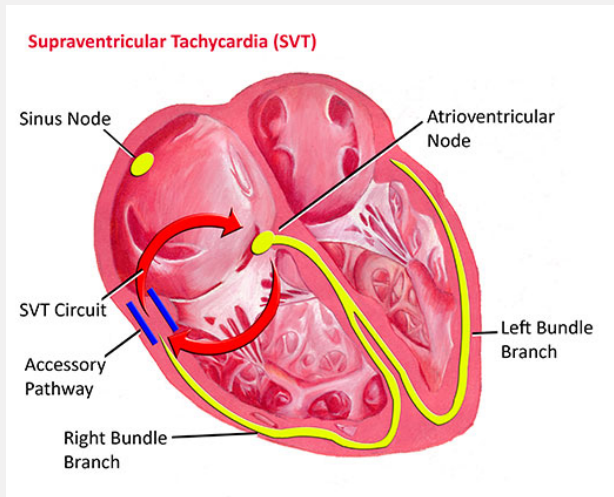


Image: <https://pediatricheartspecialists.com/heart-education/18-arrhythmia/189-supraventricular-tachycardia>

- ❖ Most common sinus tachycardia
- ❖ Sudden onset and termination
- ❖ Often found in patients with structural heart disease
- ❖ Also called AV nodal re-entrant tachycardia
- ❖ Reentrant circuit involves dual pathways (slow and fast) within the AV node until terminated



A 43-year-old woman is evaluated in the emergency department for palpitations, shortness of breath and chest tightness. Symptoms began 1 hour ago. She denies feeling dizzy or like she may faint. She has had palpitations before, but they have never lasted this long. Past medical history is significant for one healthy vaginal birth at 32 years of age and seasonal allergies. Current medications include a daily multivitamin and an antihistamine as needed.

❖ Triage ECG reveals sinus tachycardia at 150bpm with narrow QRS complexes

Our Patient- Case #3





Image: <https://www.buoyhealth.com/learn/chest-tightness-or-pain>

Clinical Presentation

- ❖ Important to distinguish when and how symptoms occur (i.e. rest, activity, duration, triggers)
- ❖ Abrupt Onset
- ❖ Palpitations
- ❖ Episodic tachycardia
- ❖ Light-headedness
- ❖ Dyspnea
- ❖ Fatigue
- ❖ Chest Tightness
- ❖ Physical Examination- assess for hemodynamic stability and orthostatics



Question #3

Which of the following type of QRS complex is typically found in supraventricular tachycardia?

- A. Wide
- B. Narrow
- C. No QRS

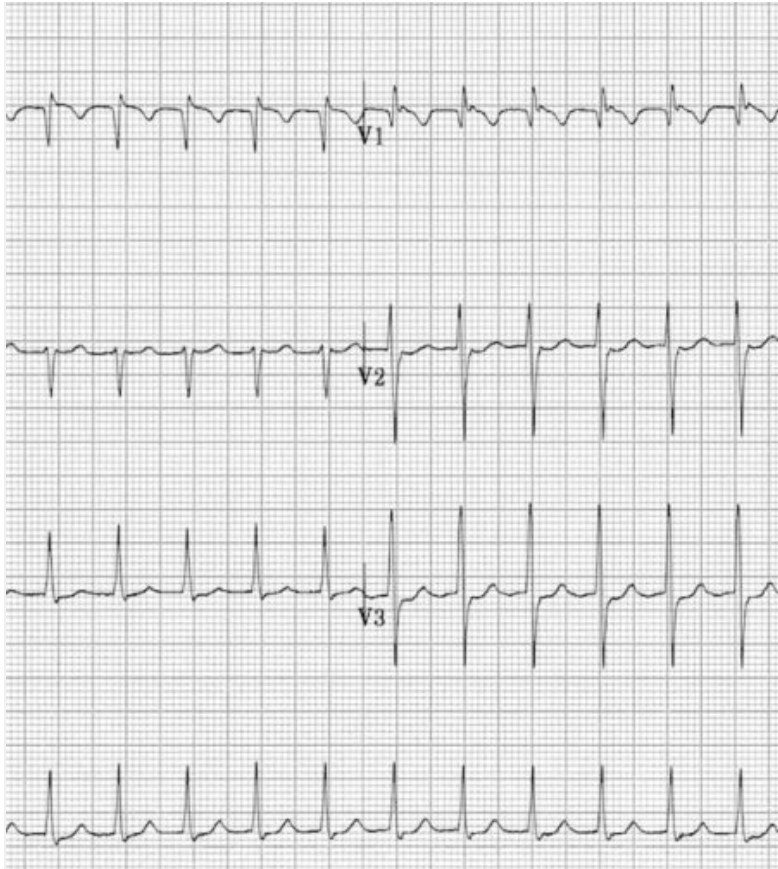


Question #3

Which of the following type of QRS complex is typically found in supraventricular tachycardia?

- A. Wide
- B. **Narrow**
- C. No QRS





Electrocardiogram

- ❖ ECG should be performed in all patients with suspected SVT
- ❖ Different types
- ❖ Tachycardia ~150bpm
- ❖ Typically narrow QRS complex
- ❖ Wide QRS complex possible with BBB or accessory pathway
- ❖ P wave formation difficult to visualize
- ❖ Evaluate for ischemia, ventricular tachycardia, WPW
- ❖ If paroxysmal Holter monitor is warranted

Image: <https://litfl.com/supraventricular-tachycardia-svt-ecg-library/>



Diagnostic Testing

- ❖ **Electrocardiogram**
- ❖ **Holter monitor evaluation**
- ❖ **Laboratory testing: CBC, TSH, BMP, Cardiac enzymes if concerned about ischemia**
- ❖ **Other diagnostics based on history and physical exam findings***



Treatment

Hemodynamically stable

- ❖ Vagal Maneuvers
- ❖ Adenosine IV
- ❖ Beta Blocker or Calcium Channel Blocker
- ❖ Consultation

Hemodynamically unstable

- ❖ Synchronized cardioversion
- ❖ Adenosine

Widened QRS

- ❖ Adenosine if monomorphic
- ❖ Antiarrhythmic infusion
- ❖ Consultation

Image: <https://www.ismp.org/improving-intravenous-drug-delivery-safety>



Case #4

Emergency medical services is called on a 58-year-old man with chest pain. He admits to dyspnea and chest “heaviness”. He appears pale and diaphoretic but is alert and responsive. The monitor reveals a ventricular arrhythmia.





What we know...

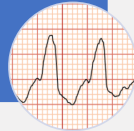
- ❖ Ventricular arrhythmias occur commonly in clinical practice
- ❖ Vary in their presentation and degree of severity
- ❖ Structural heart disease is an important factor
- ❖ Ventricular arrhythmias originate from cells capable of automaticity in the ventricles
- ❖ Wide complex rhythms on an electrocardiogram (ECG)
- ❖ Ventricular tachycardias (VT) and ventricular fibrillation



Terminology

- 3 or more successive ventricular complexes at a rate faster than 100 bpm
- Transition to ventricular fibrillation

VT



- VT that terminates spontaneously within 30 seconds

Non-sustained VT



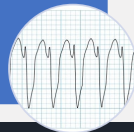
- VT that persists greater than 30 seconds or requires termination due to hemodynamic instability

Sustained VT



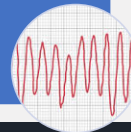
- QRS complexes have the same morphology (VF)

Monomorphic VT



- Continually changing QRS complex morphology (Torsade de Pointes)

Polymorphic VT



- Medical emergency and left untreated will result in cardiac death

VF



Question #4

In ventricular arrhythmias, which of the following symptoms is often linked with an increased risk of sudden cardiac death?

- A. Palpitations
- B. Exercise intolerance
- C. Syncope
- D. Dizziness



Question #4

In ventricular arrhythmias, which of the following symptoms is often linked with an increased risk of sudden cardiac death?

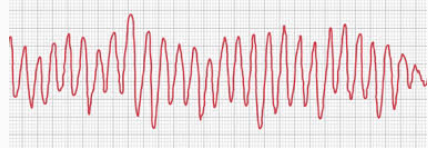
- A. Palpitations
- B. Exercise intolerance
- C. Syncope
- D. Dizziness



Clinical Presentation

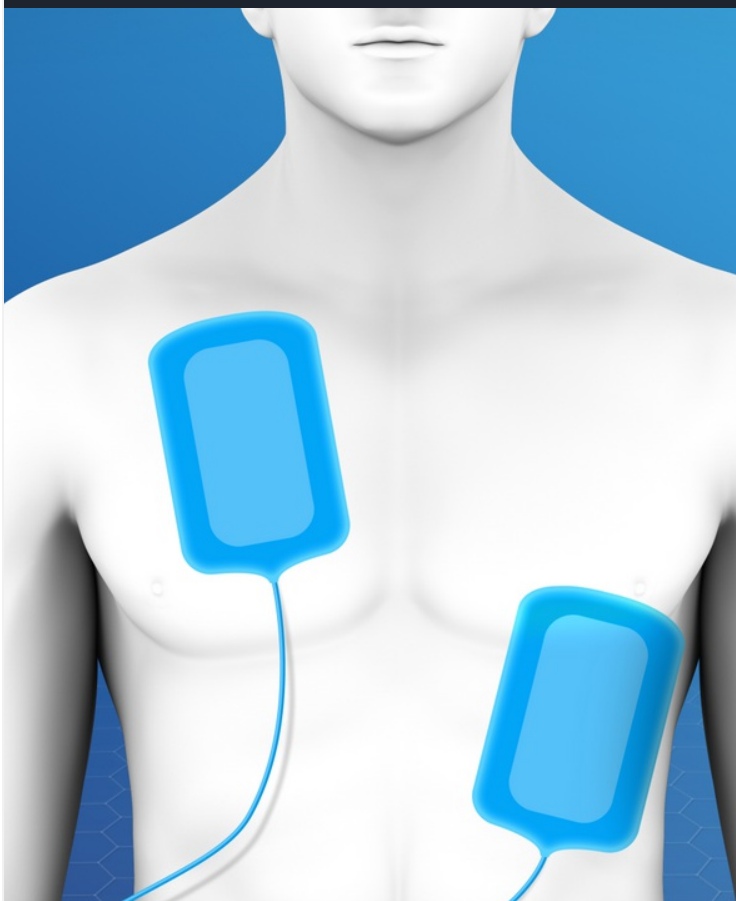
- ❖ Palpitations
- ❖ Dyspnea
- ❖ Chest pain
- ❖ Dizziness
- ❖ Syncope- often linked to an increased risk for cardiac arrest leading to sudden death
- ❖ Thorough review of medications- electrolyte imbalances, prolong QT interval





Electrocardiogram





Treatment

- ❖ Duration of the arrhythmia
- ❖ Degree of hemodynamic compromise
- ❖ Presence of structural heart disease
- ❖ Hemodynamically unstable patients may require cardioversion
- ❖ Ventricular fibrillation is a medical emergency and requires immediate electrical defibrillation
- ❖ Symptomatic patients with non-sustained VT- beta blockers or calcium channel blockers
- ❖ Acute VT- antiarrhythmics (i.e., amiodarone, procainamide)
- ❖ Torsades de Pointes- IV magnesium, correction of electrolyte imbalances, removal of any drugs/toxins
- ❖ Recurrent sustained ventricular arrhythmias may benefit from radiofrequency ablation or an implantable cardioverter defibrillator (ICD)



Take Home Points

- ❖ 2.3 million affected by Atrial Fibrillation
- ❖ 90,000 cases of supraventricular tachycardia
- ❖ 75% to 80% of cases of sudden cardiac death are due to ventricular arrhythmias
- ❖ 184,000 to 450,000 lives lost in the United States per year
- ❖ PACs and PVCs have an increased risk of adverse cardiovascular outcomes
- ❖ AF increases risk of stroke by 5%
- ❖ SVT is the most common sinus tachycardia
- ❖ VT can lead to SCD
- ❖ Degree of symptoms vary- hemodynamically stable vs. unstable
- ❖ ECG- narrow vs. wide QRS, rate vs. rhythm
- ❖ Treatment- evaluate CV risk, emergent or not



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QUESTIONS?

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