



Sinus and Atrial Dysrhythmias

Sinus Rhythms

- **SA node is pacemaker of heart**
 - Initiates electrical impulse that travels through heart
 - If SA node fails to do this, any other pacemaker cell within atria can initiate an impulse
 - Generates 60-100 impulses/minute (HR)
 - Known as the inherent heart rate of the SA node
- **Dysrhythmia = All cardiac rhythms except normal sinus rhythm**
- **Sinus rhythms/dysrhythmias = Rhythms originating from SA node**
 - Usually not serious dysrhythmias but assess patient
- **Atrial dysrhythmias = Rhythms originating from other atrial sites**

Sinus Rhythms

- **Sinus rhythm electrical impulse route**

SA node



Atria



AV node



Bundle of His and bundle branches

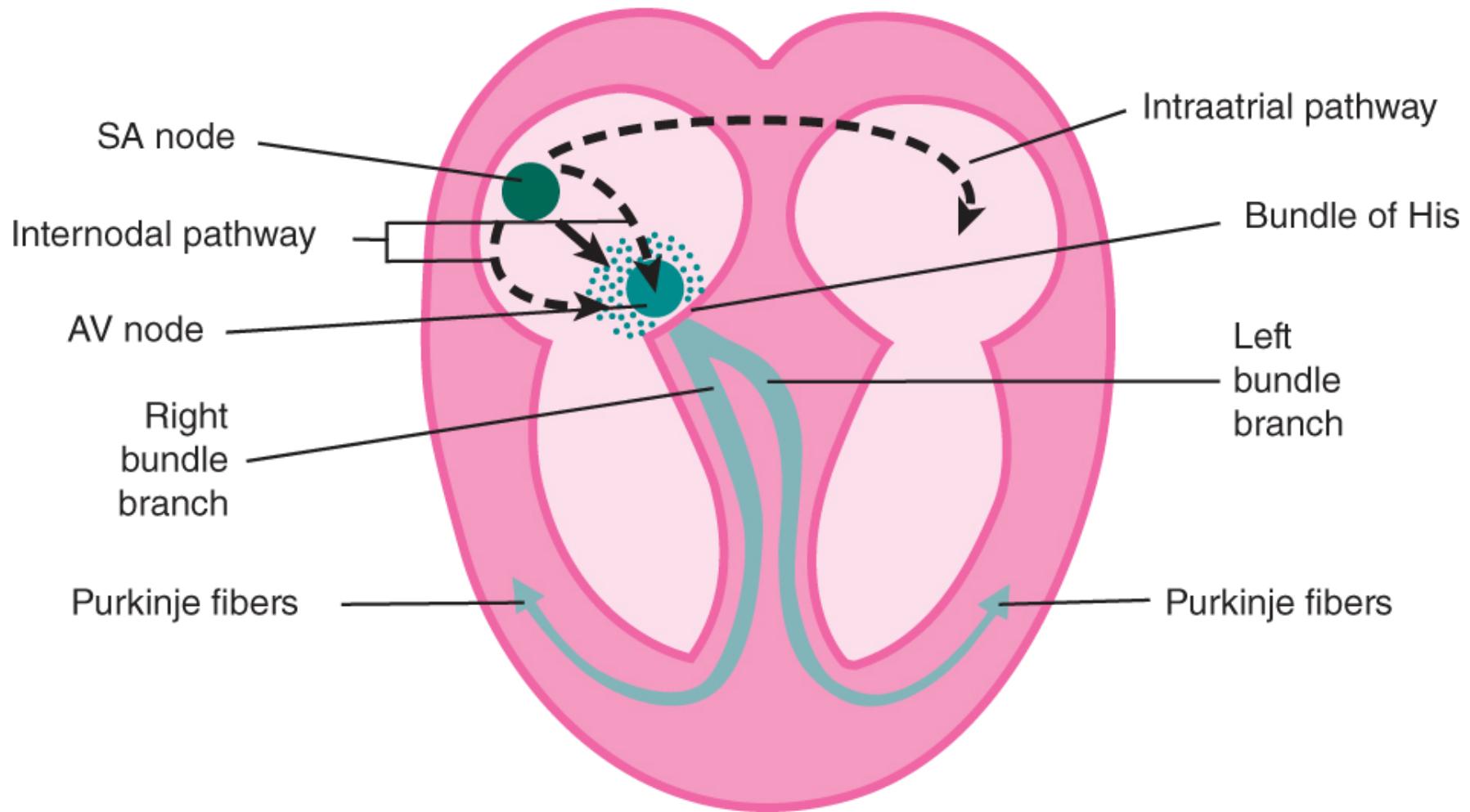


Purkinje's fibers



Ventricular muscle

Sinus Rhythms



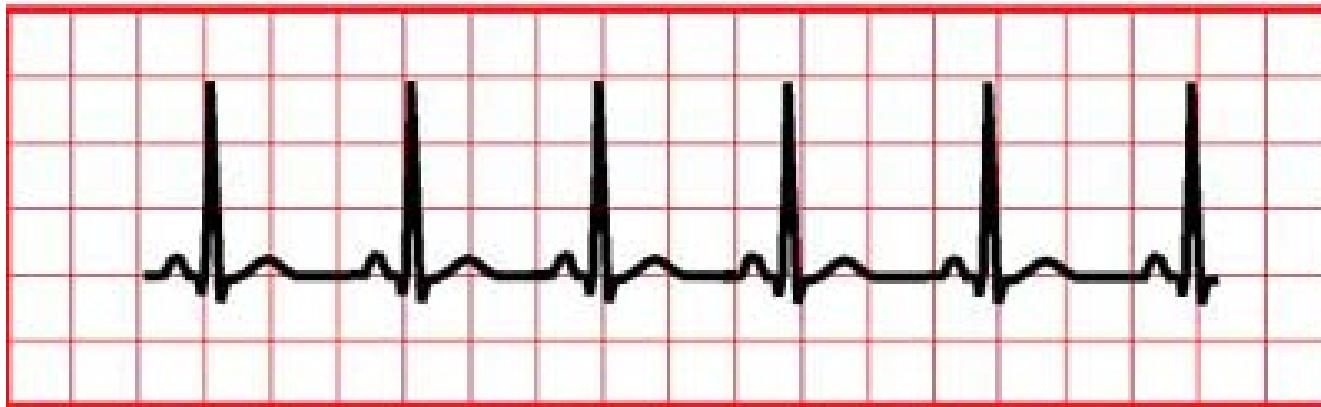
Normal cardiac electrical conduction pathway

Normal Sinus Rhythm

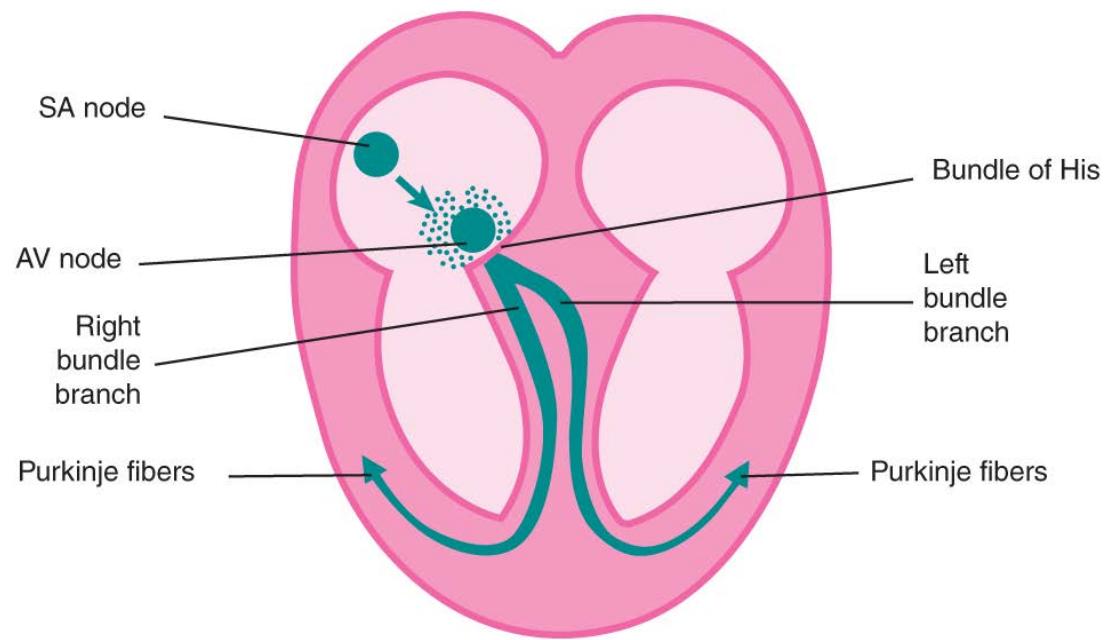
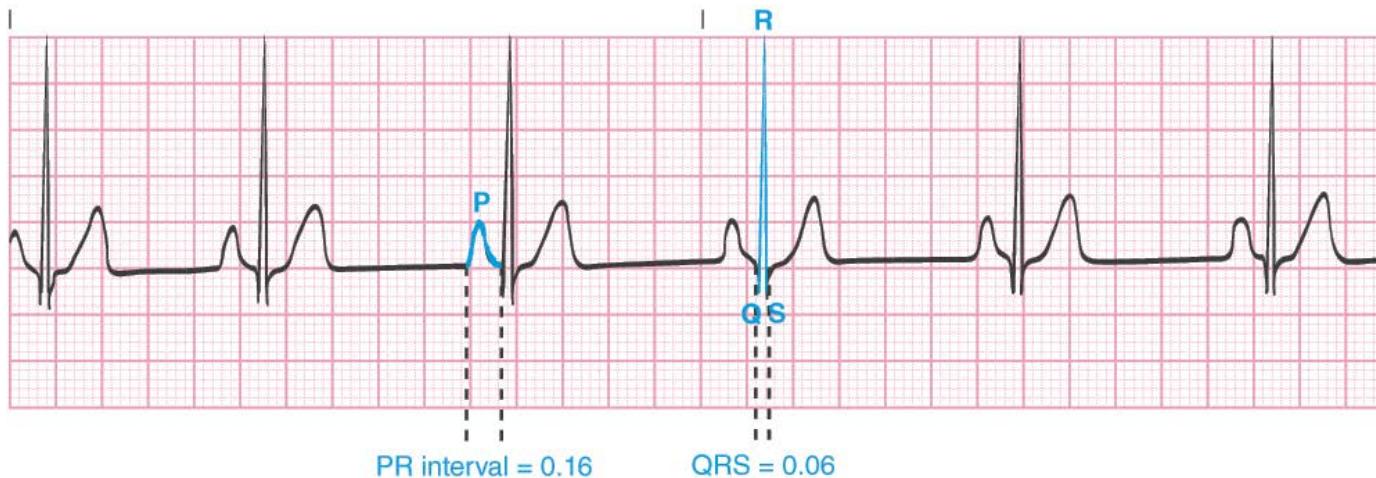
- Only rhythm considered “normal”
- Every electrical impulse follows normal conduction pathway
- Upright P wave precedes every QRS
 - All P waves look alike
- All PR intervals range from 0.12-0.20 second
- QRS complex = 0.04-0.12 second
 - All QRS complexes are same size and shape

Normal Sinus Rhythm

- P-P and R-R intervals are regular and same length
- HR = 60-100 impulses per min (ipm)



Normal Sinus Rhythm



Sinus Bradycardia

- **Dysrhythmia that occurs when all electrical impulses originate from SA node and follow normal conduction pathway but the rate is slower than 60 ipm**
- **Upright P wave precedes every QRS**
 - All P waves look alike
- **All PR intervals range from 0.12-0.20 second**
- **QRS complex = 0.04-0.12 second**
 - All QRS complexes are same size and shape

Sinus Bradycardia

- P-P and R-R intervals are regular and same length
- Rate can vary but must be < 60 ipm
- May be normal in sleeping individuals and athletes
- Can become dangerous if rate falls significantly or patient shows signs of poor cardiac output

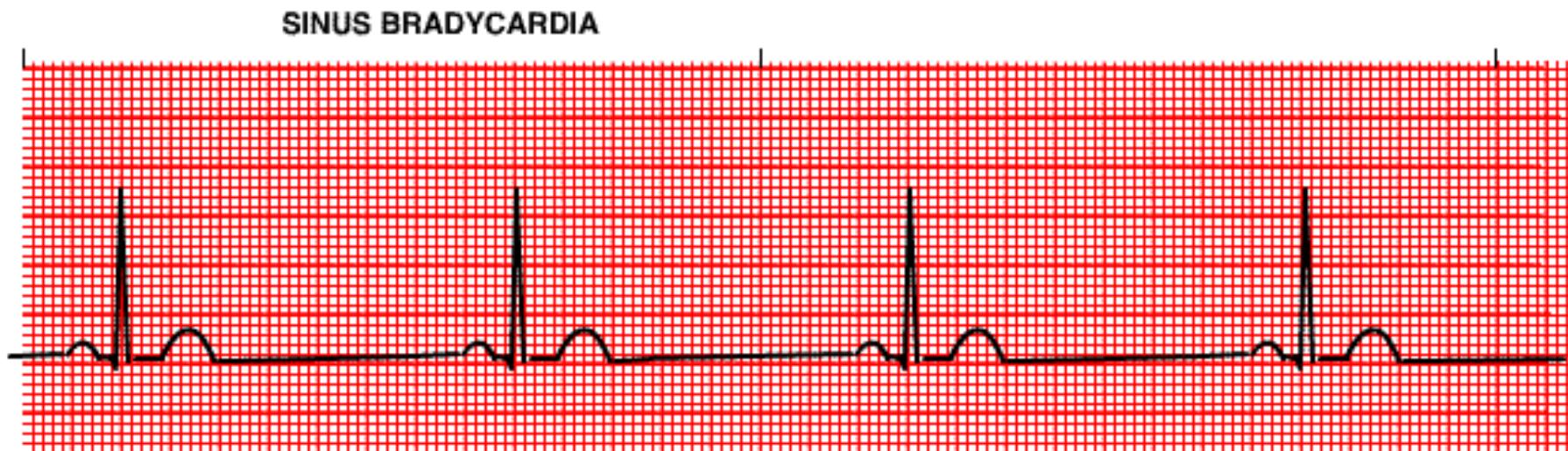
Sinus Bradycardia

- **Poor cardiac output signs and symptoms:**
 - Pale, cool, clammy skin
 - Cyanosis (Turn blue)
 - Dyspnea (shortness of breath)
 - Confusion or disorientation
 - Dizziness, weakness or faintness
 - Sudden decrease in BP
 - Nausea or vomiting
 - Decreased urinary output
 - Mild or severe chest pain
 - Unresponsiveness

Sinus Bradycardia

- **Common causes:**
 - Vomiting
 - Sedating drugs
 - Infection
 - Decrease in sympathetic tone caused by beta-blockers
 - Calcium channel blockers
 - Disease in SA node
 - Hypothyroidism
 - Hypothermia
 - Hypoxia
 - During sleep and in trained athletes

Sinus Bradycardia



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Sinus Bradycardia



Sinus Tachycardia

- Occurs when all electrical impulses originate from SA node at rate between 101-150 ipm
- Upright P wave precedes every QRS
 - All P waves look alike
- All PR intervals range from 0.12-0.20 second
- QRS complex = 0.04-0.12 second
 - All QRS complexes are same size and shape
- P-P and R-R intervals are regular and same length

Sinus Tachycardia

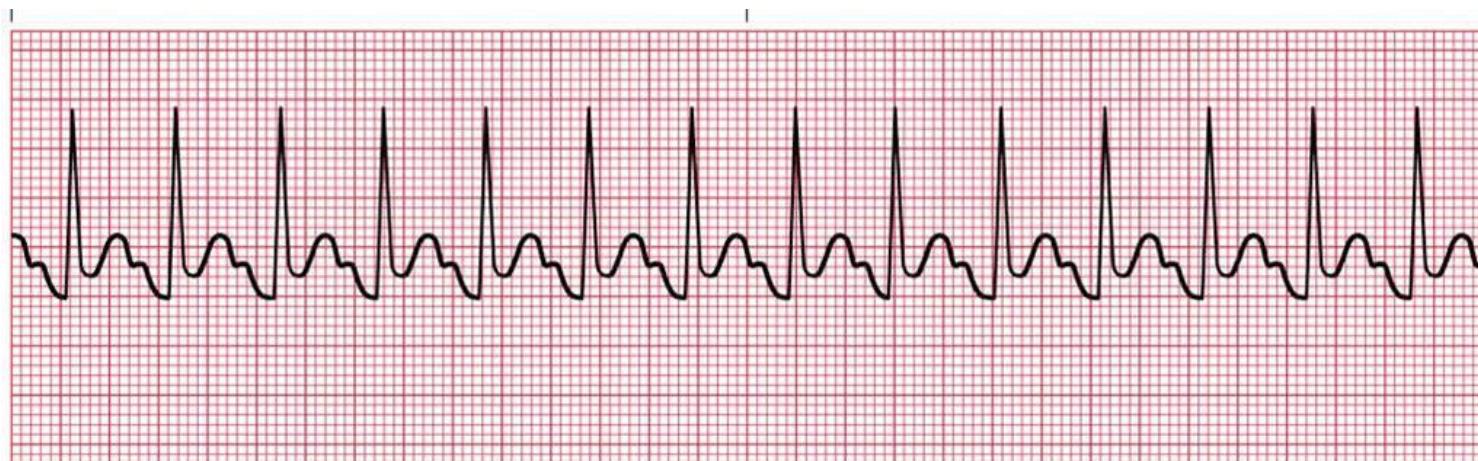
- As tachycardia rate increases, P waves frequently hidden in T wave of previous QRS
- Can become a serious dysrhythmia if patient becomes medically unstable
- Common causes:

Pain	Fever	Anemia	Hypovolemia
Dehydration	Hemorrhage	Exercise	Hypoxia
Some street drugs, like cocaine	Sudden excitement	Pulmonary embolism	Myocardial ischemia
Atropine	Nicotine	Caffeine	Shock
Fear	CHF	Anxiety	Hypotension

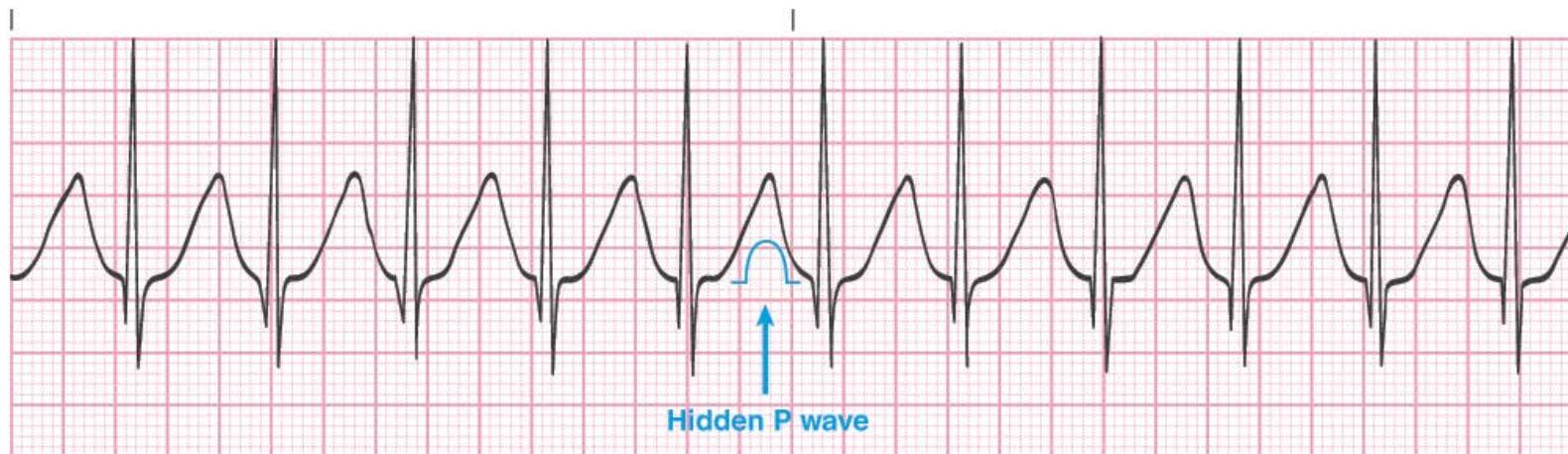
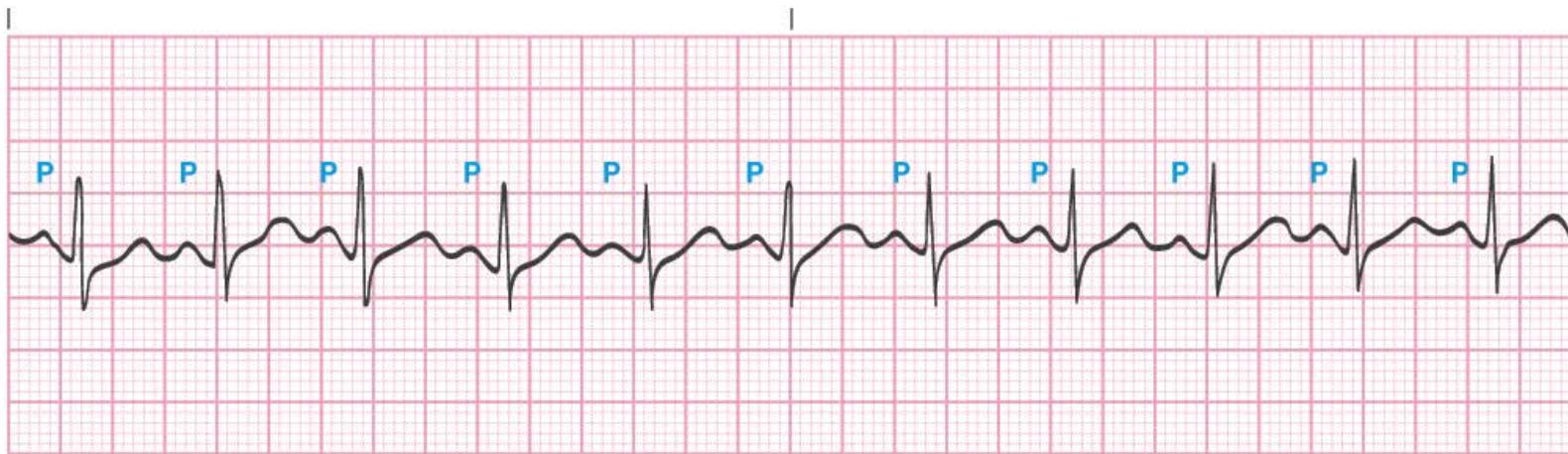
Sinus Tachycardia



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Sinus Tachycardia



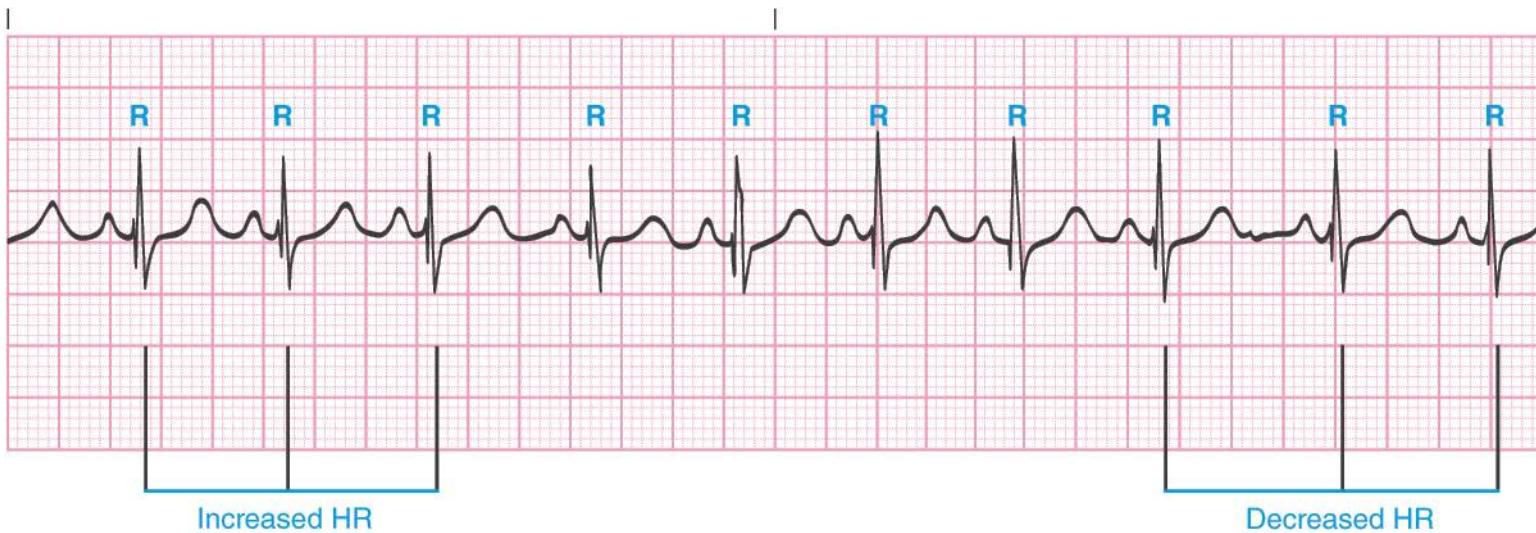
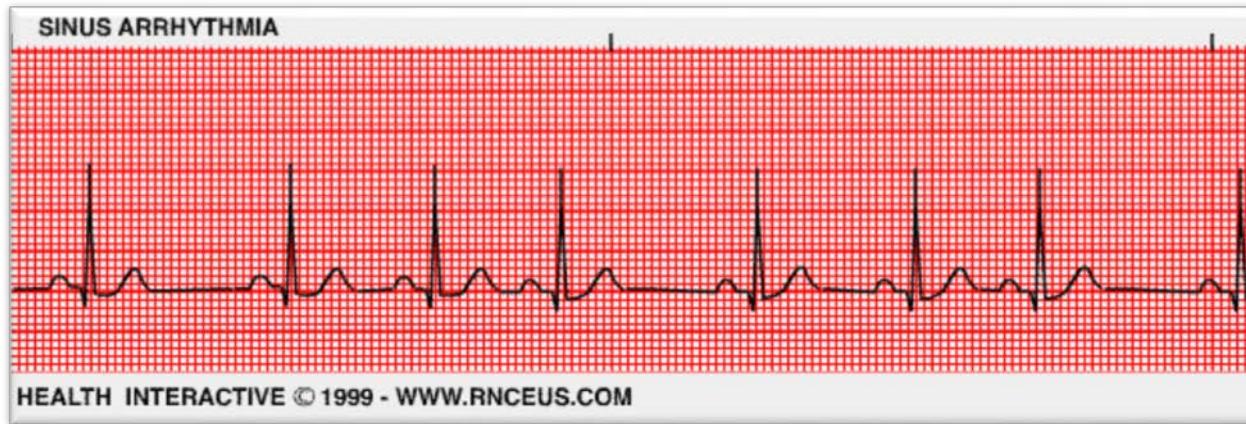
Sinus Arrhythmia

- Occurs when SA node initiates all impulses but at irregular intervals
- P-P and R-R intervals change with respirations
 - Longest R-R interval will be less than twice the length of any remaining R-R intervals
- Upright P wave precedes every QRS
 - All P waves look alike
- All PR intervals range from 0.12-0.20 second
- QRS complex = 0.04-0.12 second
 - All QRS complexes are same size and shape

Sinus Arrhythmia

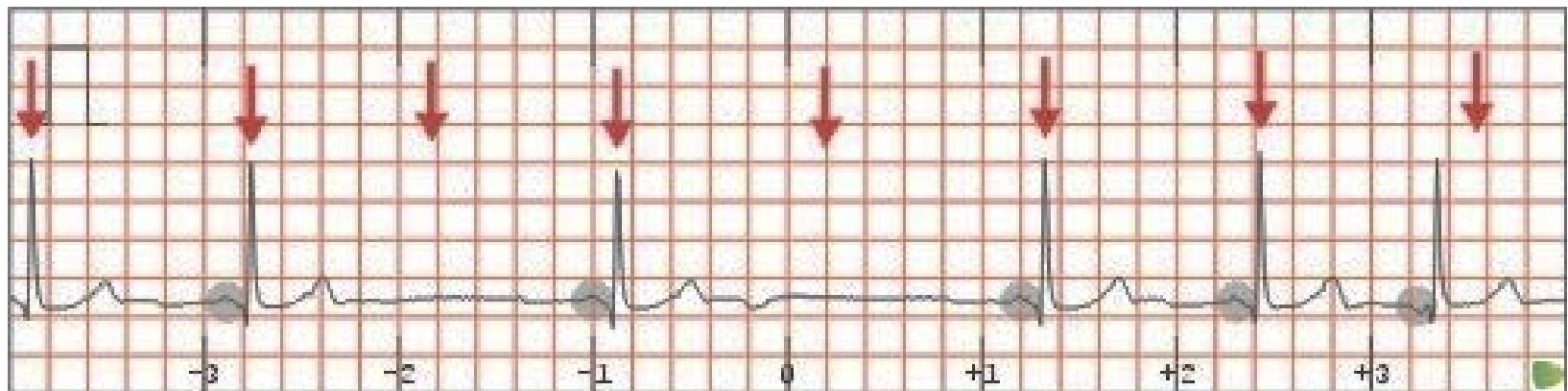
- HR increases as patient inhales and decreases during exhalation
 - 6 second rhythm strip more reliable for determining HR
- Overall HR = 60-100 ipm
- Sinus arrhythmia normal in infants and young children
- May be warning of diseased SA node or coronary artery disease in adults

Sinus Arrhythmia



Sinus Exit Block

- Occurs when SA node initiates impulse that is blocked and not conducted to atria
- Atria and ventricles do not polarize
- P wave not seen until next conducted complex



Sinus Arrest

- Occurs when SA node does not initiate an impulse
- Depolarization does not occur
- Next expected complex not seen



Sinus Exit Block and Sinus Arrest

- Both appear to be similar
- P waves absent
- QRS complexes absent due to no impulse conducted
- Forms a pause on the rhythm strip
- Length of pause distinguishes between two
 - Sinus exit block = Exactly 2 or more previous cardiac cycles of underlying rhythm
 - Rhythm is regular

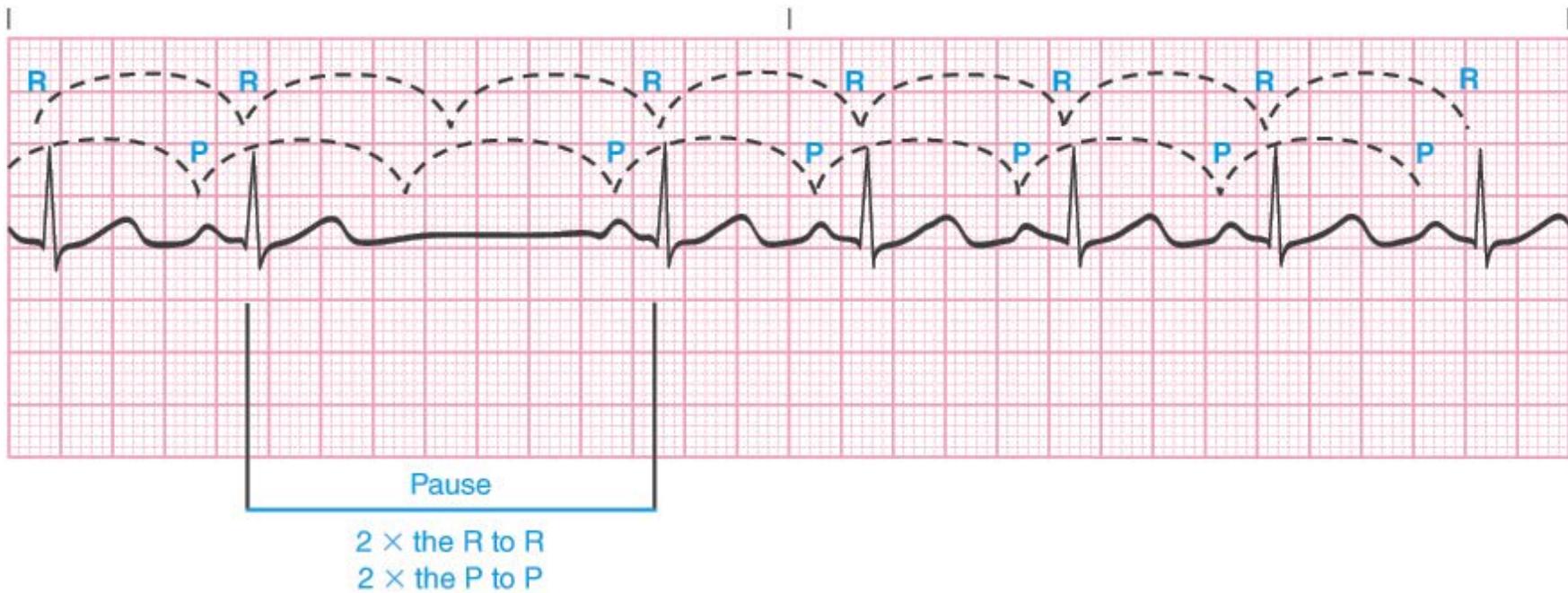
Sinus Exit Block and Sinus Arrest

- Sinus arrest = More than 2 times the cardiac cycle of underlying rhythm
 - Rhythm is irregular
- Any pacemaker cell in heart can begin to initiate electrical impulses
 - Complex that ends sinus arrest may be either atrial, junctional, or ventricular
 - Rhythm after sinus arrest may be different than rhythm before pause

Sinus Exit Block and Sinus Arrest

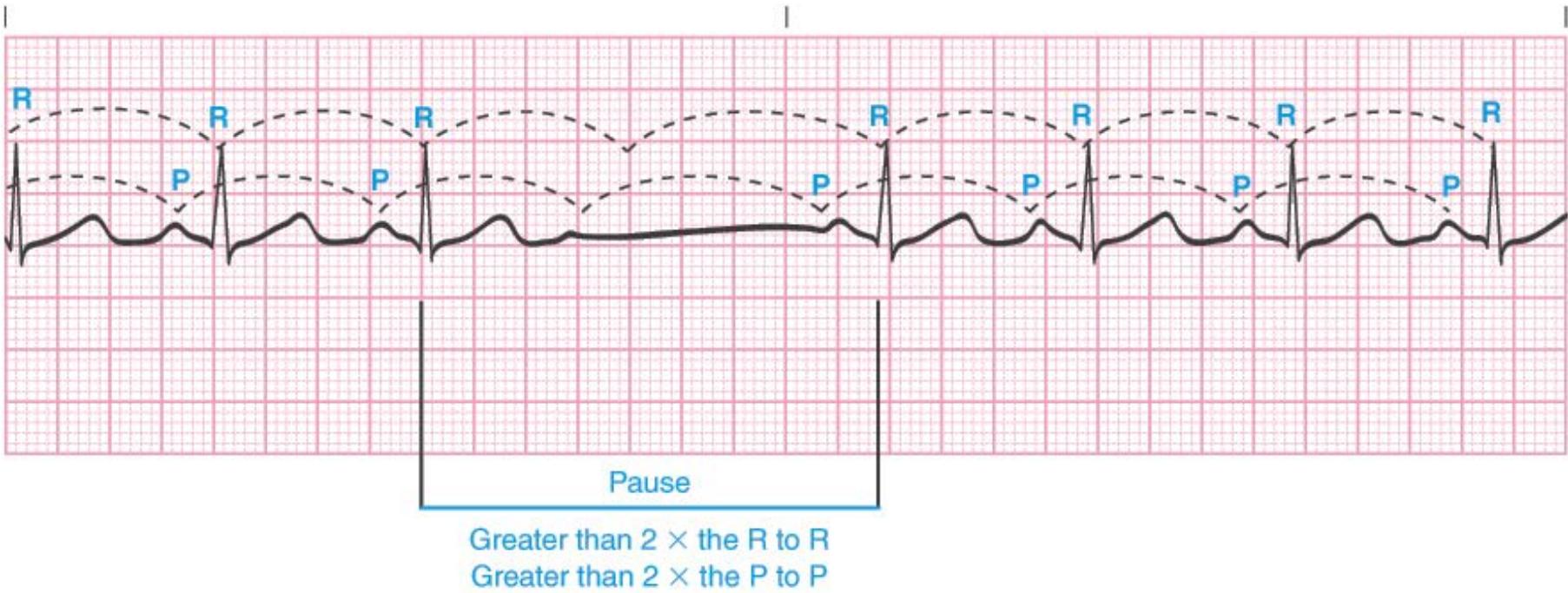
- **Causes:**
 - Myocardial infarction (MI)
 - Ischemia
 - Hypoxia
 - Hyperkalemia
 - Sleep apnea
 - Medications such as calcium channel blockers, beta-blockers, or digitalis
 - Damage to SA node
- **Make sure to assess patient tolerance**

Sinus Exit Block



- Sinus exit block. Pause will be equal to two previous cardiac cycles; overall heart rate, 70 beats/min.

Sinus Arrest



- Sinus arrest. Pause will be more than two times the previous cardiac cycle of the underlying rhythm; overall heart rate, 70 beats/min.

Atrial Dysrhythmias

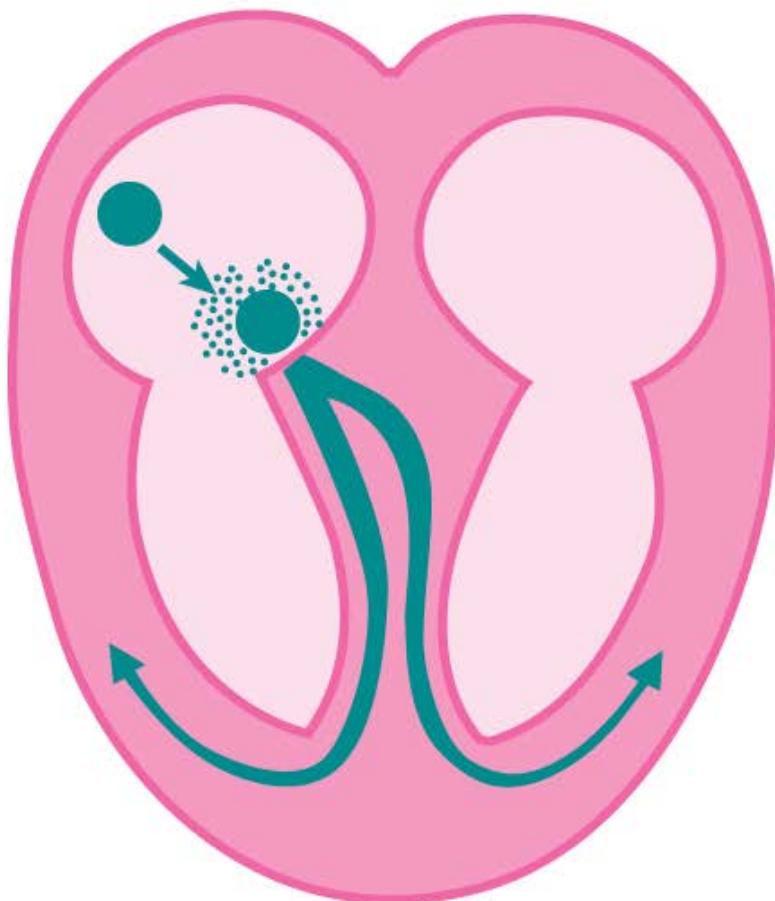
- When SA node fails to initiate, any other pacemaker site within atria can initiate
- Cardiac rhythms originating from atrial sites = Atrial dysrhythmias
- Impulse travels through atria to AV node, continues through Bundle of His and bundle branches to Purkinje's fibers and ends in ventricular muscle
- Depolarization of atria varies while ventricular depolarization normal
- Most of these arrhythmias not lethal

Premature Atrial Complex

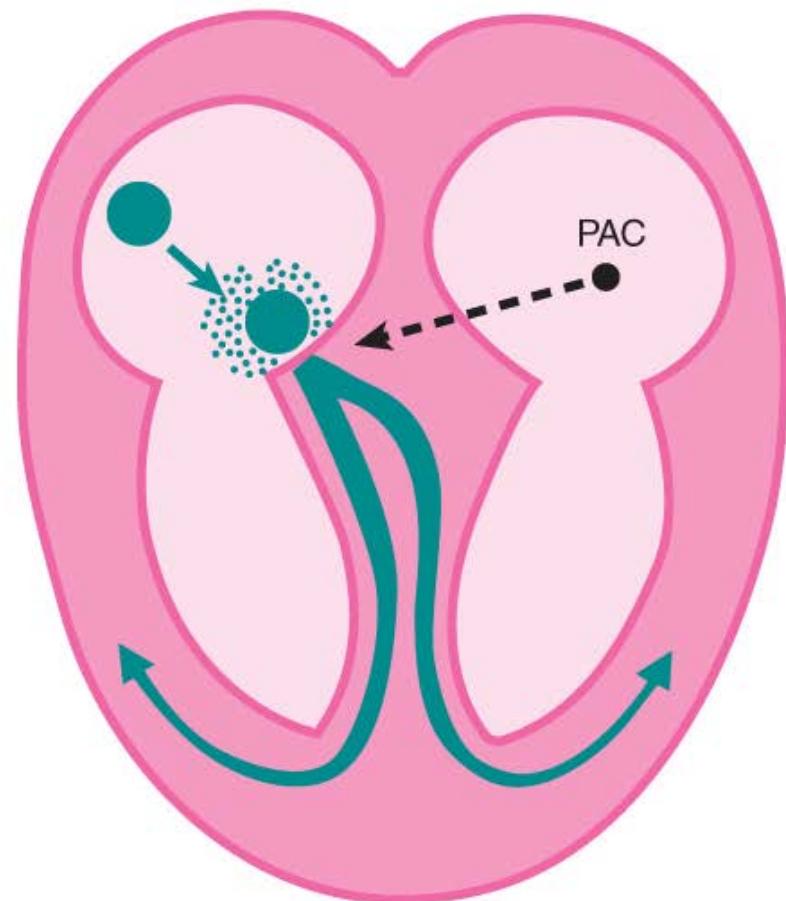
- Formerly known as premature atrial contraction
- Complex that occurs earlier than next expected complex of underlying rhythm
- Originates from any atrial site outside SA node
- P wave may appear different in size or shape or may be hidden in T wave of previous complex
- Followed by pause before rhythm returns

Premature Atrial Complex

Normal conduction

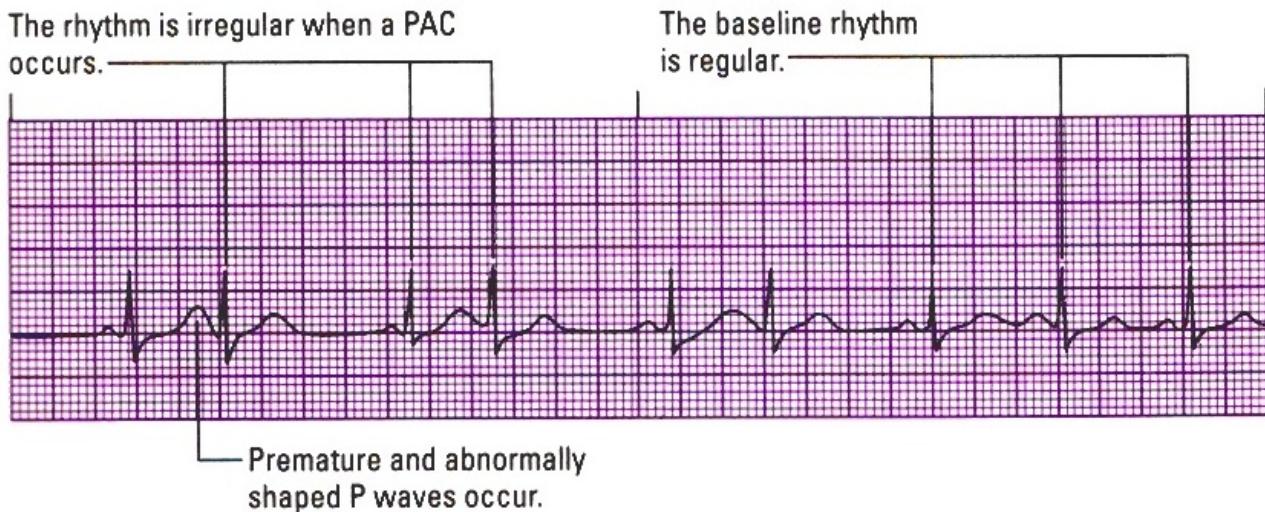


Abnormal conduction



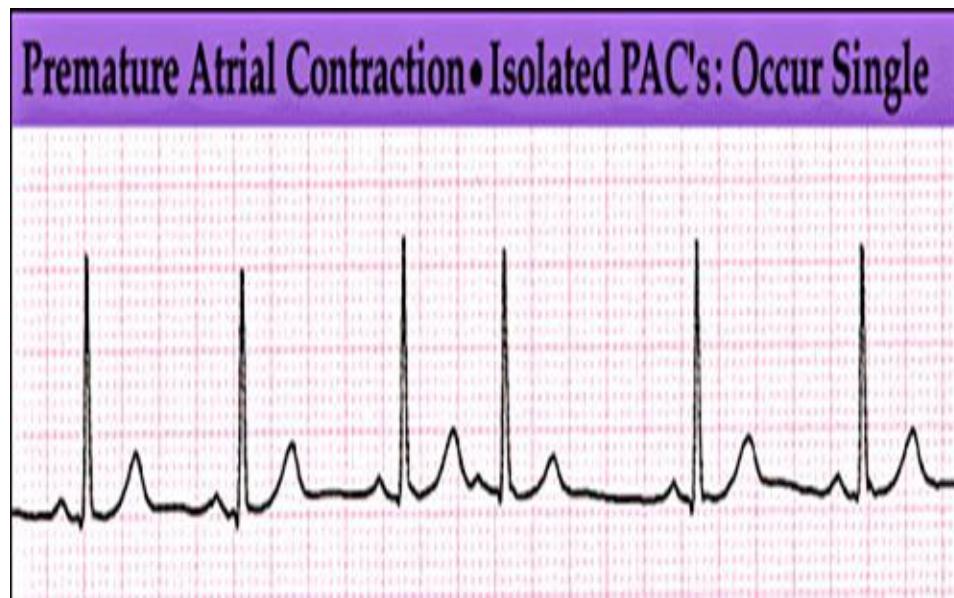
Premature Atrial Complex

- 2 types of pauses
 - Noncompensatory: Measure from R wave before to R wave after PAC
 - Measurement will be less than 2x R-R interval
 - Could indicate development of increased irritability in SA node



Premature Atrial Complex

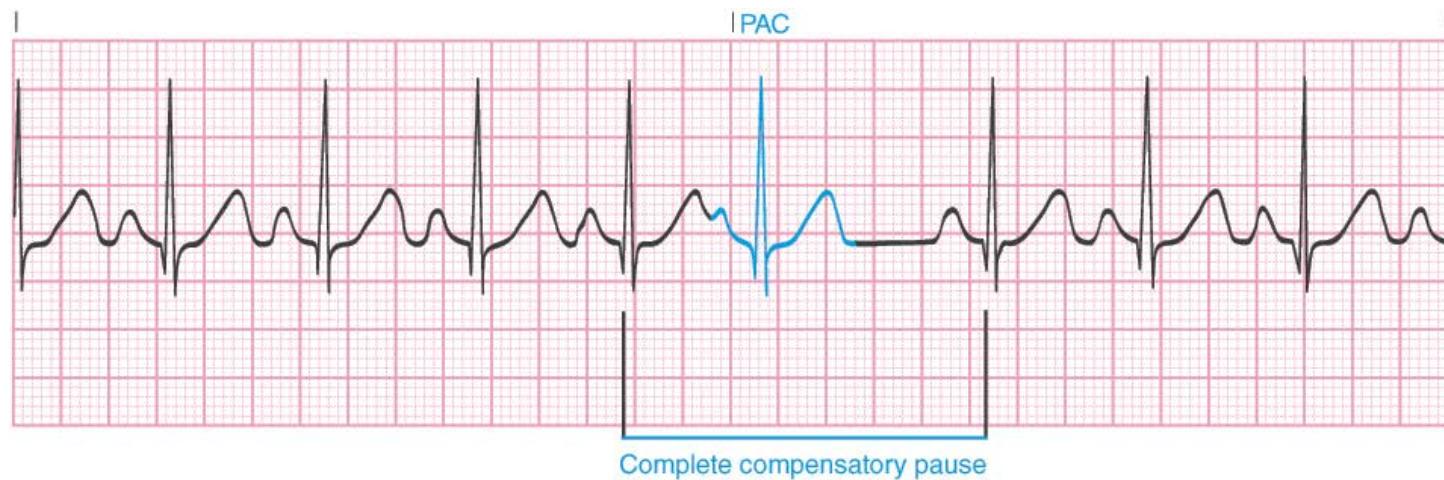
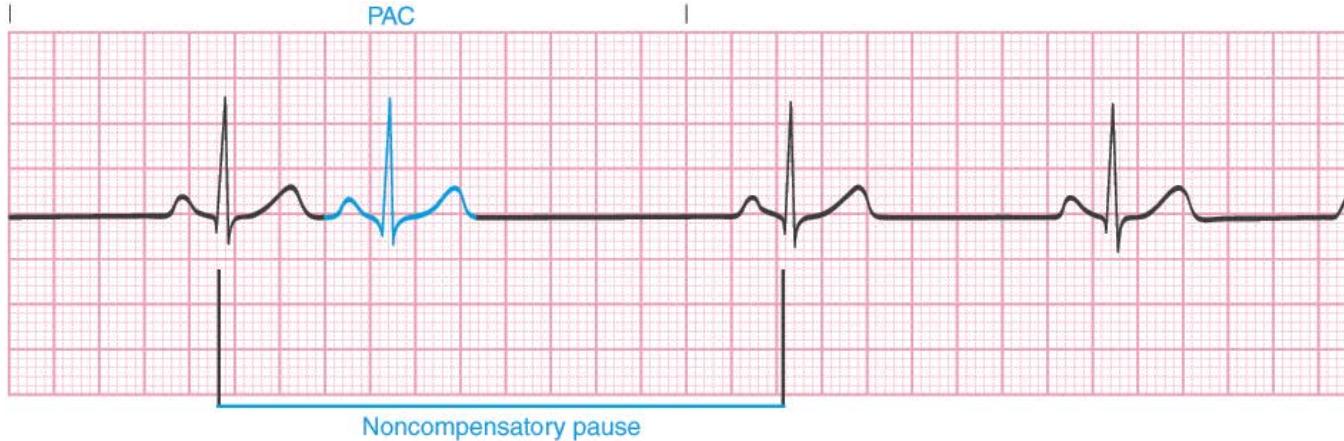
- 2 types of pauses
 - Compensatory: Measure from R wave before PAC to R wave after
 - Measurement will equal at least 2x R-R interval
 - SA node does not respond to premature beat



Premature Atrial Complex

- Followed normally by noncompensatory pause
- Must always identify the underlying rhythm
 - PACs may occur in any rhythm but easier to ID in sinus rhythm or bradycardic rhythms
- Represents irritability of atria
- Not a serious dysrhythmia by itself but may lead to a more serious dysrhythmia
- Not a true atrial dysrhythmia but rather an individual complex originating from atria

Premature Atrial Complex



- **A.** Premature atrial complex (PAC) with a noncompensatory pause in a sinus bradycardic rhythm; heart rate, 40 beats/min. **B.** PAC with a complete compensatory pause in a sinus rhythm; heart rate, 80 to 90 beats/min.

Premature Atrial Complex

- **May be caused by:**

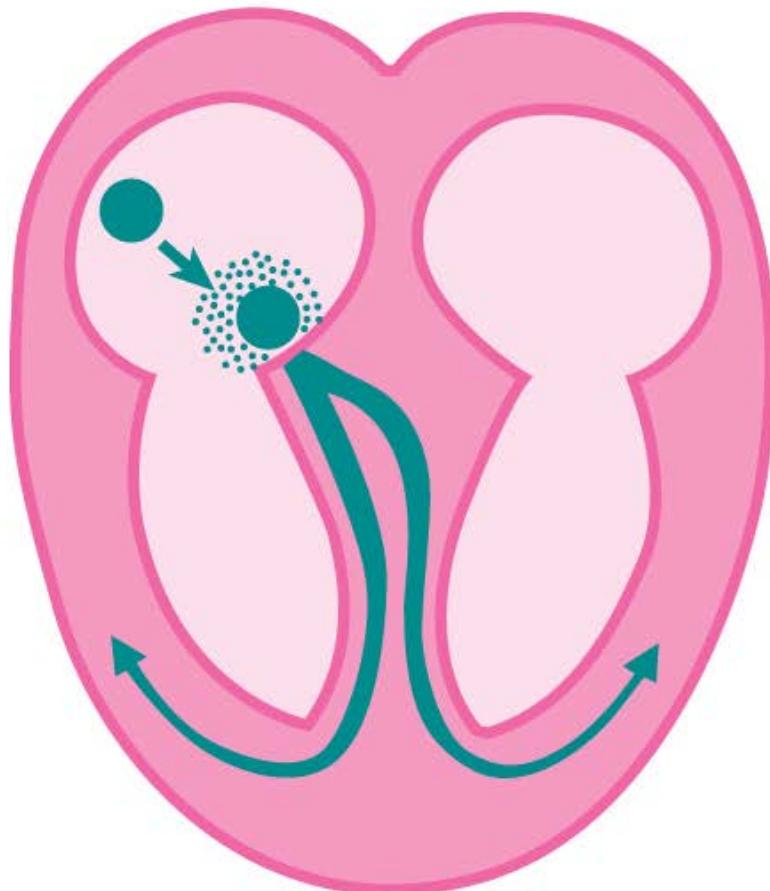
Pain	Fever	Fear
Anxiety	Sudden Excitement	Exercise
Digitalis	Atropine	Nicotine
Caffeine	Some Street Drugs	Infections
Emotional stress	Hypoxia	Cardiovascular disease
Dilated atria	Hypertrophied atria	

Paroxysmal Atrial Tachycardia / Paroxysmal Supraventricular Tachycardia

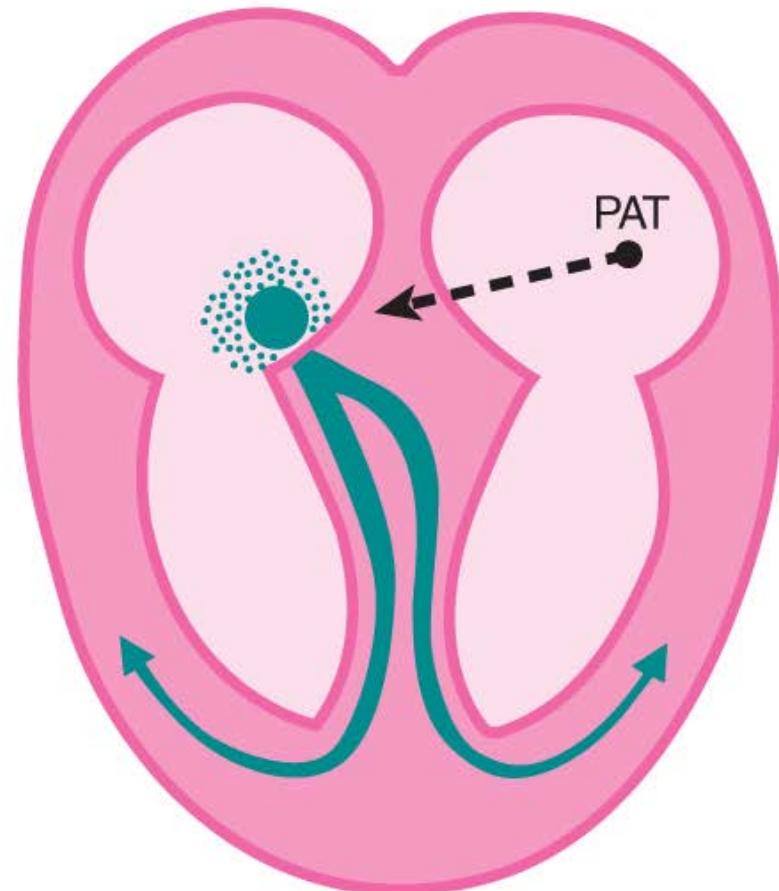
- **PAT = Sudden onset of tachycardia with rate greater than 150 ipm**
- **Most recently referred to as PSVT**
- **Triggered by PAC**
- **P wave before every QRS but may be hidden in T wave of previous complex**
- **With visible P wave:**
 - PR intervals range from 0.12-0.20 second
 - QRS complex = 0.04-0.12 second

Paroxysmal Atrial Tachycardia / Paraoxysmal Supraventricular Tachycardia

Normal conduction



Abnormal conduction

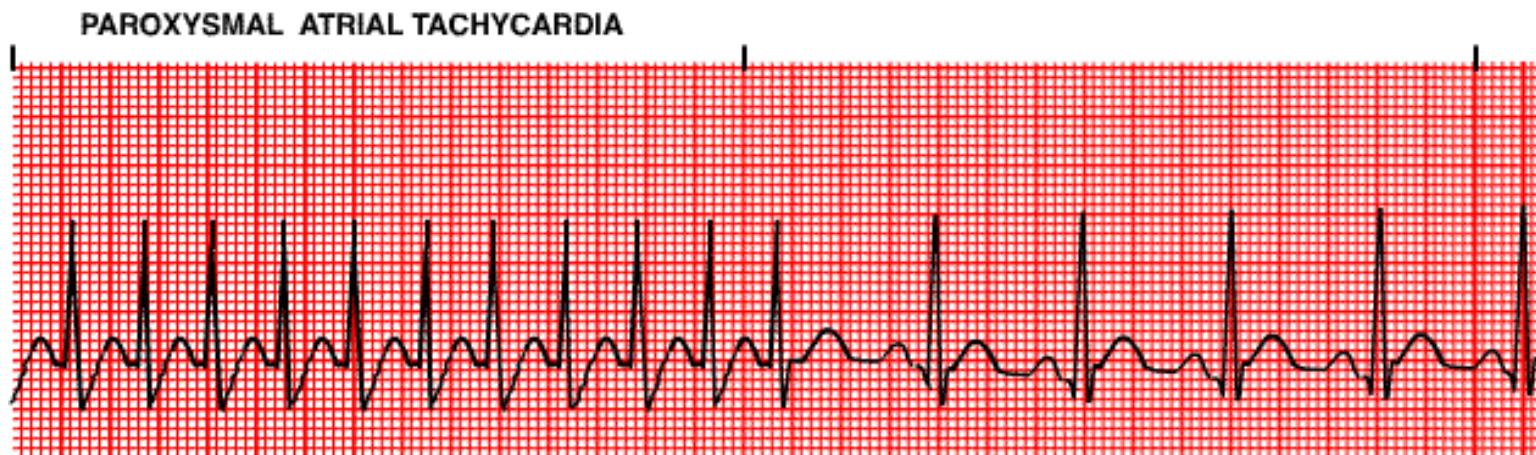


Paroxysmal Atrial Tachycardia / Paroxysmal Supraventricular Tachycardia

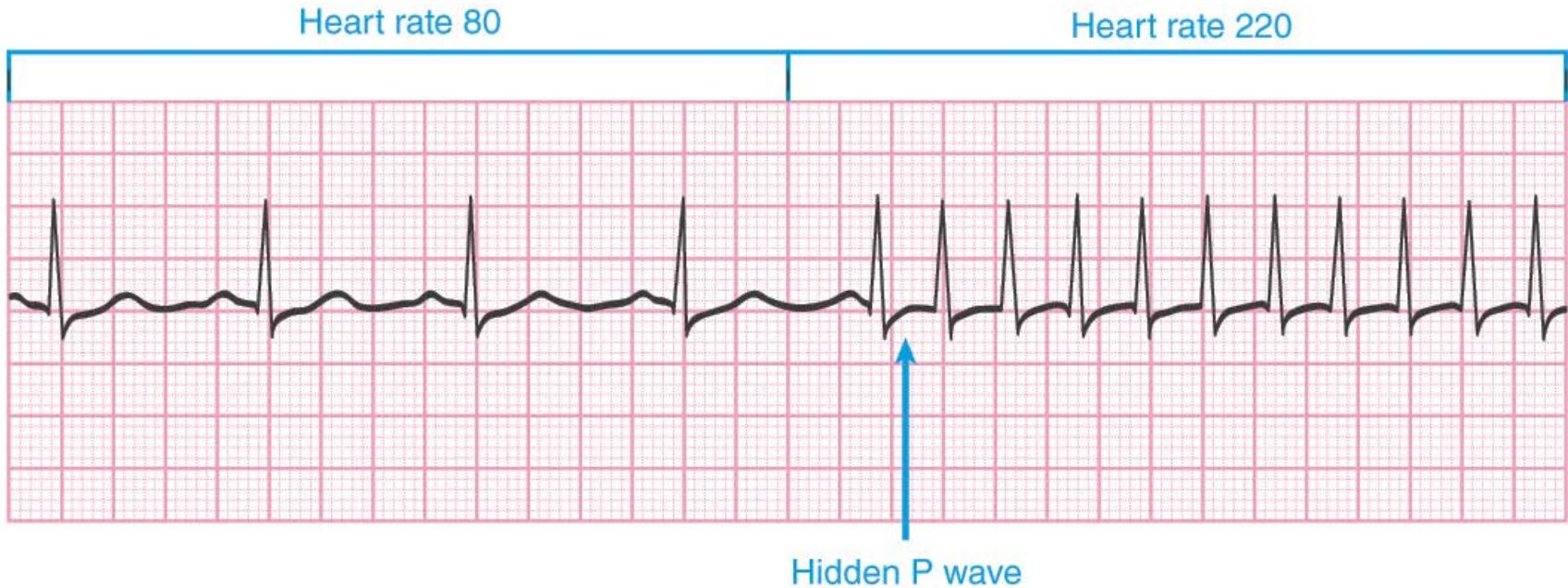
- P-P and R-R intervals are regular and same length
- Rate may vary from 151-250 ipm or higher
- Rapid rate may decrease amount of oxygenated blood circulated to heart muscle
- Causes decrease in cardiac output and possibly decrease in oxygenated blood circulated to heart muscle
- Symptoms include weakness, dizziness, palpitations
 - Seek medical treatment if patient becomes unstable

Paroxysmal Atrial Tachycardia / Paroxysmal Supraventricular Tachycardia

- Not a lethal dysrhythmia
- May be caused by stimulants
- To interpret PAT/PSVT:
 - Beginning of PAT/PSVT must be seen
 - Underlying rhythm preceding it must be identified



Paroxysmal Atrial Tachycardia / Paroxysmal Supraventricular Tachycardia



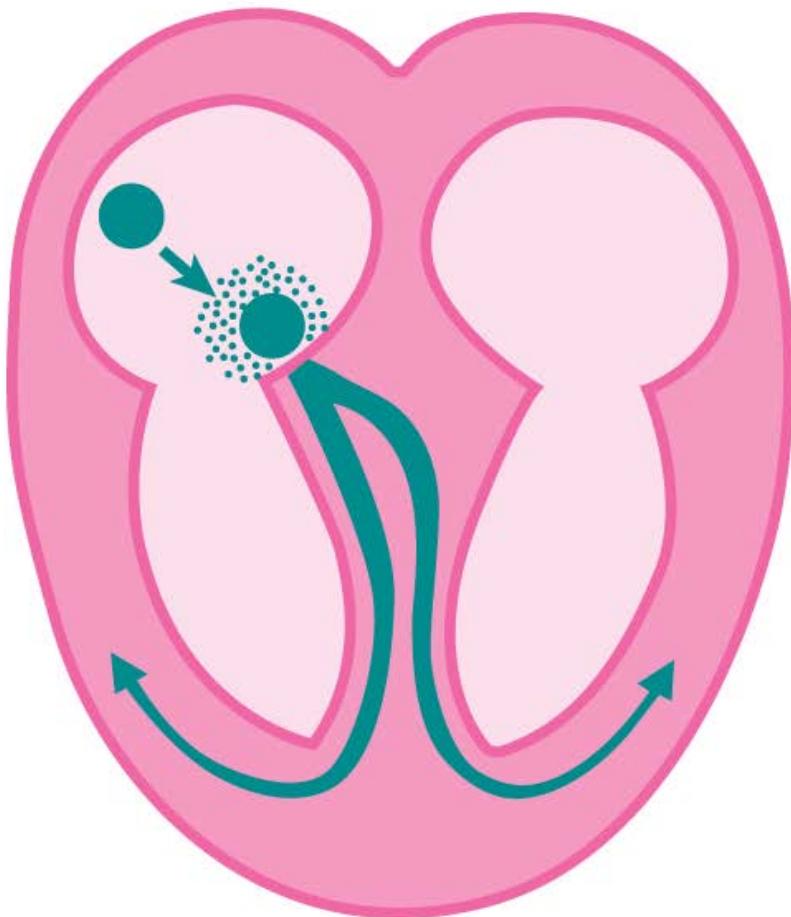
- Normal sinus rhythm (NSR) progressing to paroxysmal atrial tachycardia/paroxysmal supraventricular tachycardia; NSR: heart rate, 80 beats/min; PAT/PSVT: heart rate, 220 beats/min.

Supraventricular Tachycardia

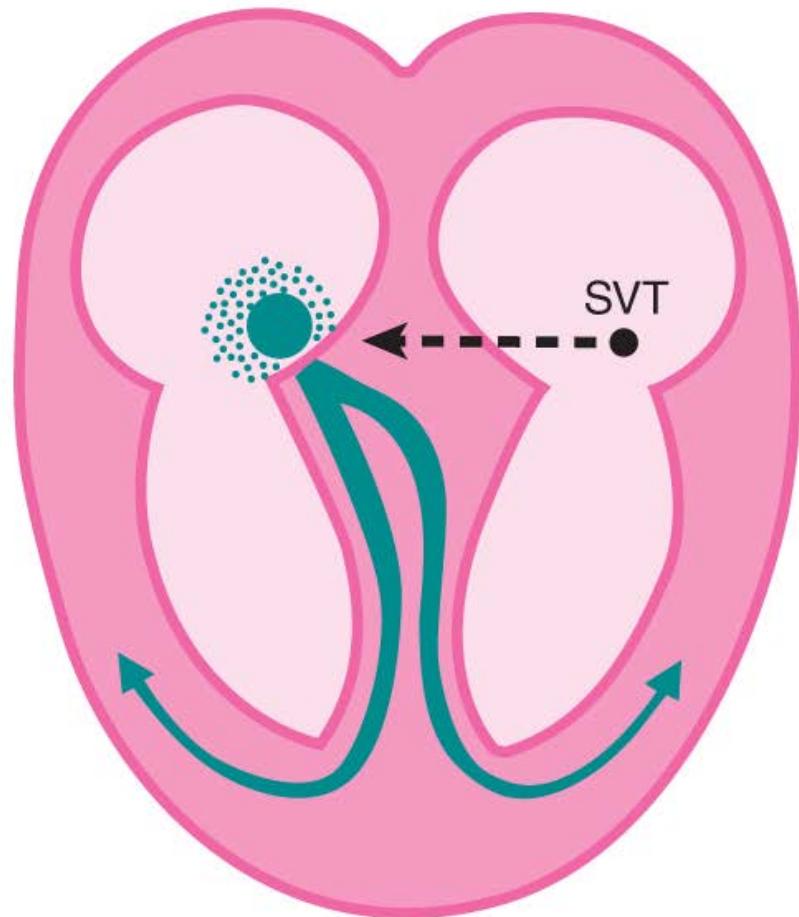
- Dysrhythmia fits all criteria of PAT/PSVT but beginning of dysrhythmia is not seen
- Refers to any dysrhythmia that can't be identified by another means
 - Originates from irritable site above Bundle of His
 - Rate > 150 bpm
- P wave before every QRS but may be hidden in T wave of previous complex

Supraventricular Tachycardia

Normal conduction



Abnormal conduction

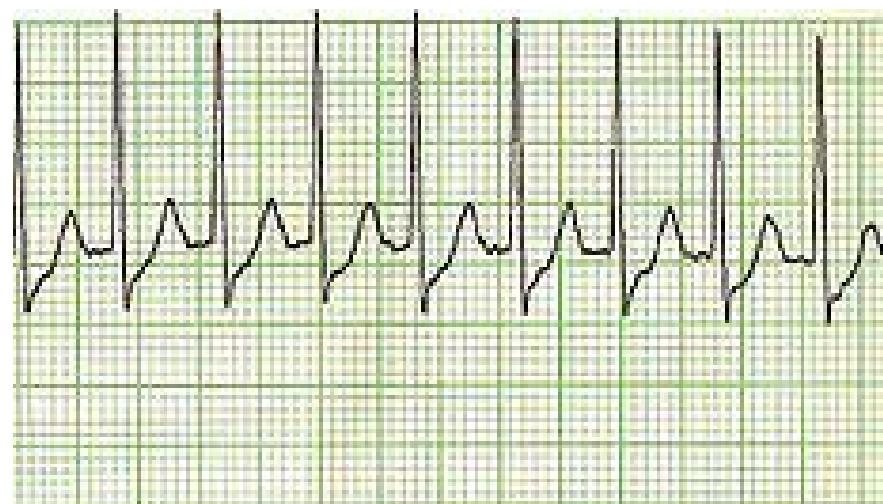


Supraventricular Tachycardia

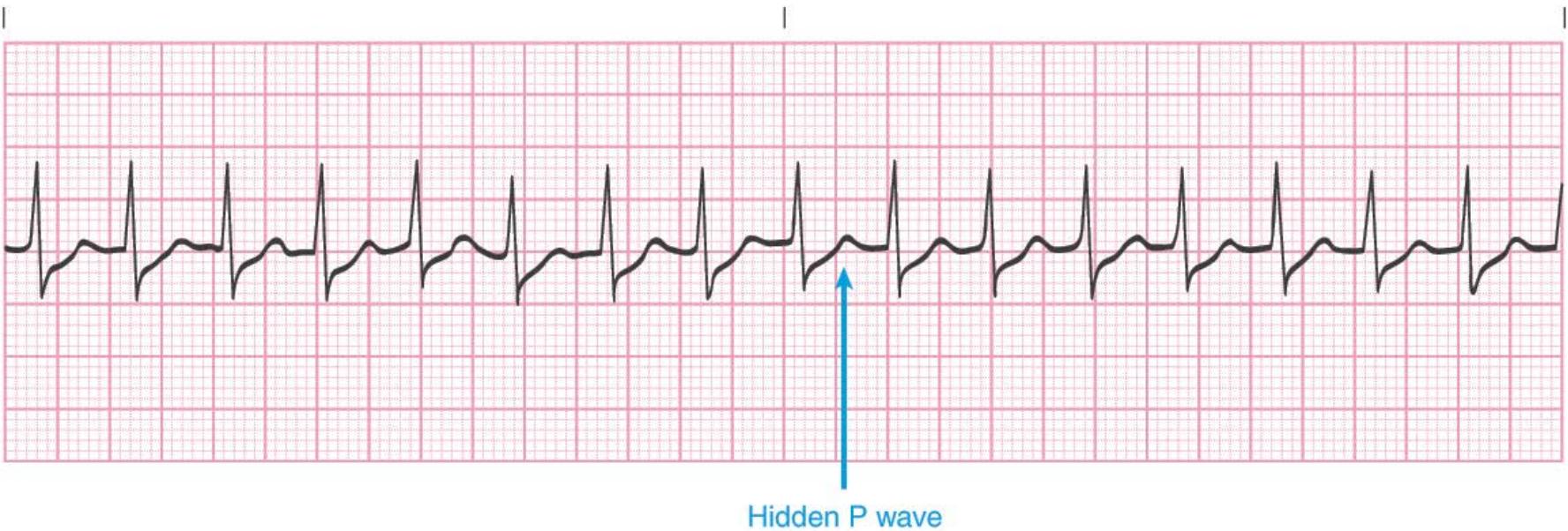
- **With visible P wave:**
 - PR intervals range from 0.12-0.20 second
 - QRS complex = 0.04-0.12 second
 - P waves usually look alike
- **P-P and R-R intervals are regular and same length**
- **Rate varies from 151-250 bpm or more**
- **Sinus tachycardia = If rhythm resembles SVT but HR < 151**

Supraventricular Tachycardia

- Triggered by irritable site within atria
 - Irritability can be caused by stimulants
- Usually not lethal
- Seek treatment if patient becomes unstable
- Persistent SVT requires treatment to terminate rhythm



Supraventricular Tachycardia



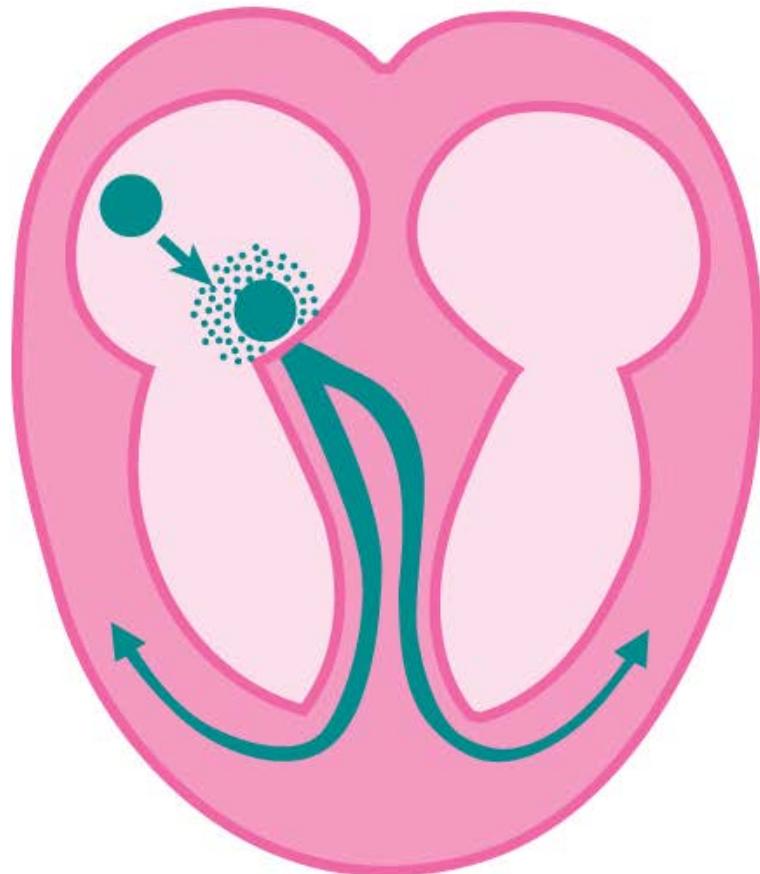
- Supraventricular tachycardia (SVT). P waves are hidden in preceding T waves; onset not seen; depressed ST segment; prolonged QT intervals; heart rate, 160 beats/min.

Atrial Flutter

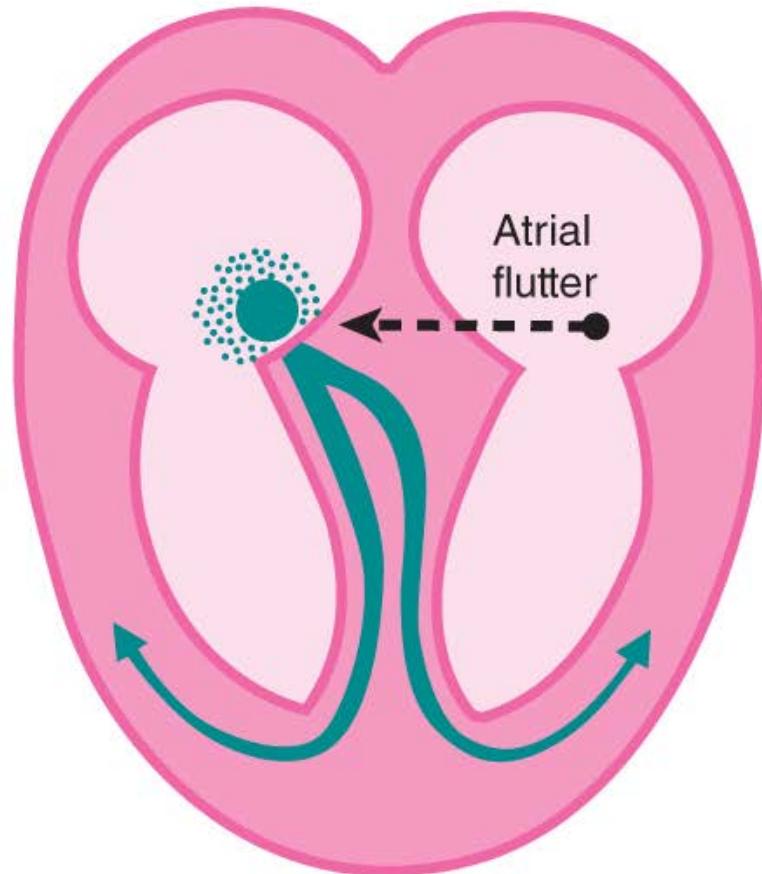
- Occurs when single irritable site in atria initiates many impulses at a rapid rate
- Impulses are so rapid that P waves are not formed
 - Flutter waves (F waves) present instead
 - Sawtoothed or jagged appearance
 - Negative (\downarrow) stroke represents atrial depolarization conducted through abnormal electrical pathway
 - Positive (\uparrow) stroke = atrial repolarization

Atrial Flutter

Normal conduction



Abnormal conduction



Atrial Flutter

- Atria depolarize faster than normal but AV node delays some impulses
- Ventricles depolarize at normal rate
- Every atrial impulse is not conducted to ventricles and QRS not present for every flutter wave
- QRS complex = 0.04-0.12 second and regular

Atrial Flutter

- Ventricular rate (VR) = 60-100 ipm
- Atrial rate (AR) = 250-350 ipm
- Atrial flutter with slow ventricular response = when VR < 60 ipm
- Controlled atrial flutter = VR of 60-100 ipm
- Atrial flutter with rapid ventricular response = VR of 101-150 ipm
- Atrial flutter with variable ventricular response = If number of F waves varies before every QRS and R-R interval irregular

Atrial Flutter

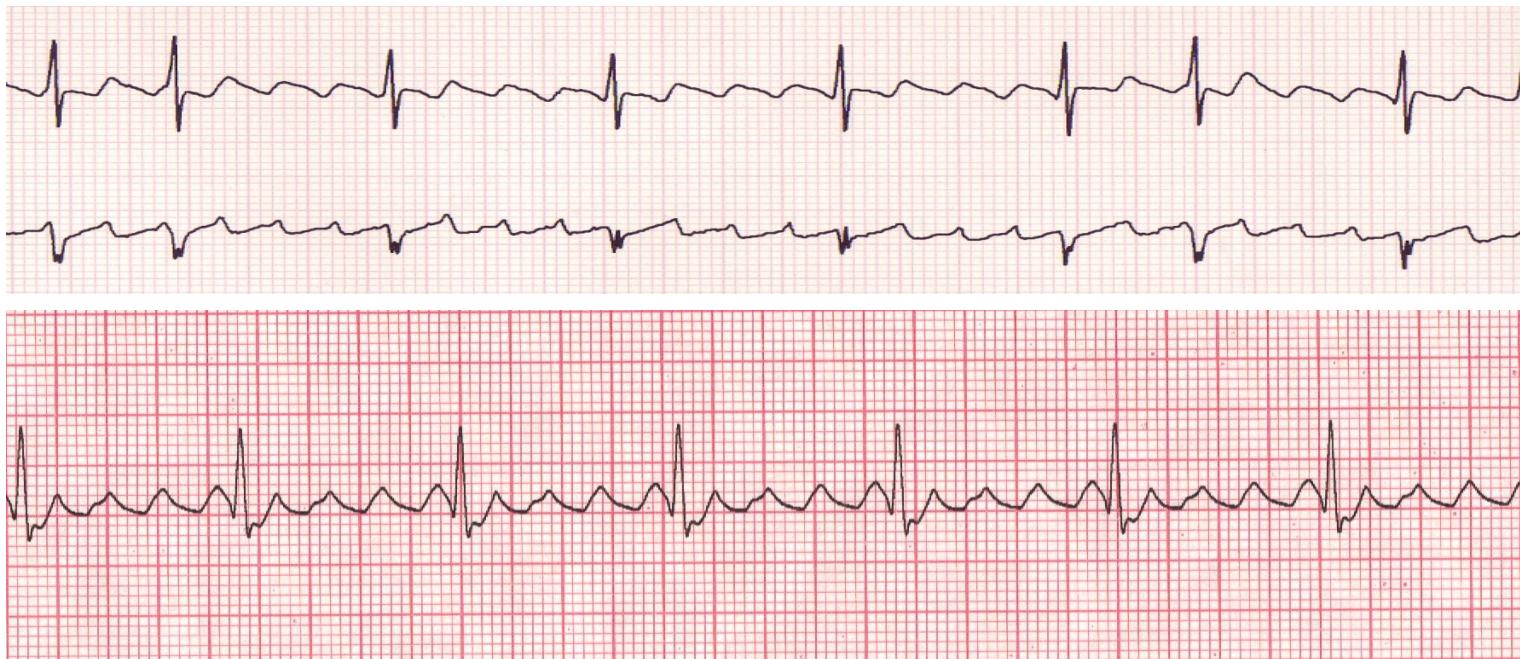
- **Block/ratios: # of F waves per 1 QRS**
 - Example: 2 F waves with 1 QRS = 2:1
- **Calculating atrial flutter:**
 - Method 1: # of F waves in 6-second strip x 10
 - Method 2: # of F waves in block/ratio x VR
 - Example: 3:1 ratio with 100 VR
 - 3 F waves x 100 VR = 300 F waves or AR 300
 - Example: 4:1 ration with 60 VR
 - 4 F waves x 60 VR = 240 F waves or AR 240
 - Can only be used if block/ratio doesn't vary

Atrial Flutter

- **Causes:**
 - **Chronic atrial flutter:**
 - Advanced rheumatic heart disease
 - Coronary or hypertensive heart disease
 - **Transient atrial flutter:**
 - Cardiomyopathy
 - Atrial dilation
 - Medication toxicity
 - Hypoxia
 - Acute or chronic cor pulmonale
 - CHF
 - Pericarditis or myocarditis
 - Alcoholism
 - MI

Atrial Flutter

- **Usually not lethal**
- **Symptoms vary and frequently treated**



Atrial Flutter



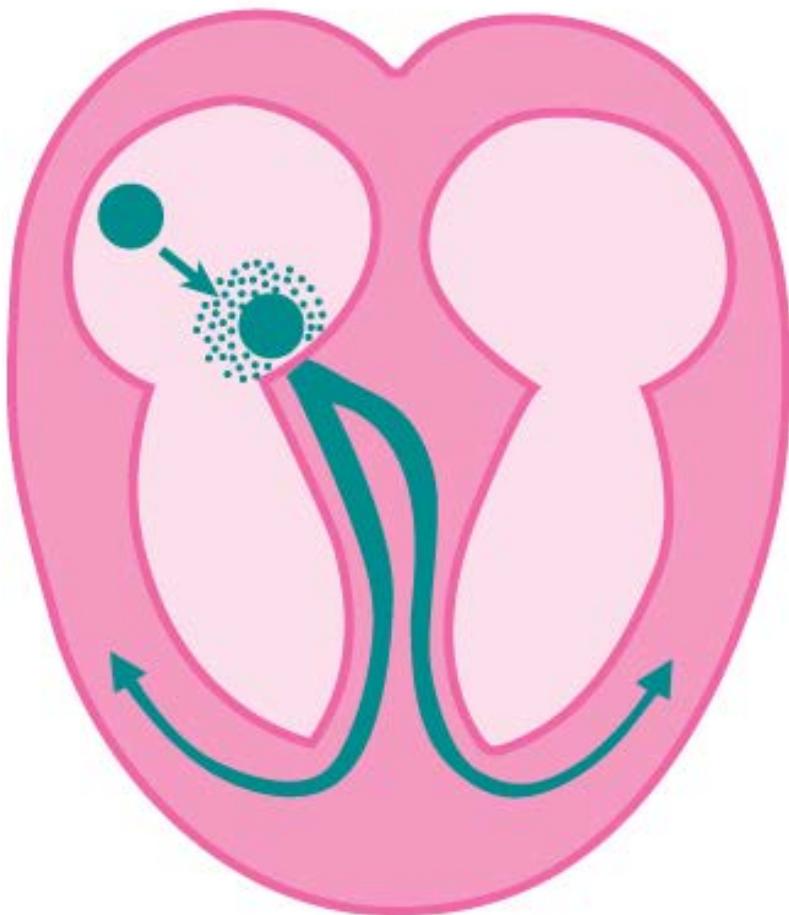
- A. Atrial flutter with an atrial heart rate of 270 beats/min, if counting F waves (or 300 if calculated by $\times 100$); ventricular heart rate of 100 beats/min, 3:1 block/ratio.
- B. Atrial flutter with an atrial heart rate of 260 beats/min, if counting F waves (or 240 beats/min if calculated by 4×60); ventricular heart rate of 60 beats/min, 4:1 block/ratio.

Atrial Fibrillation (A Fib)

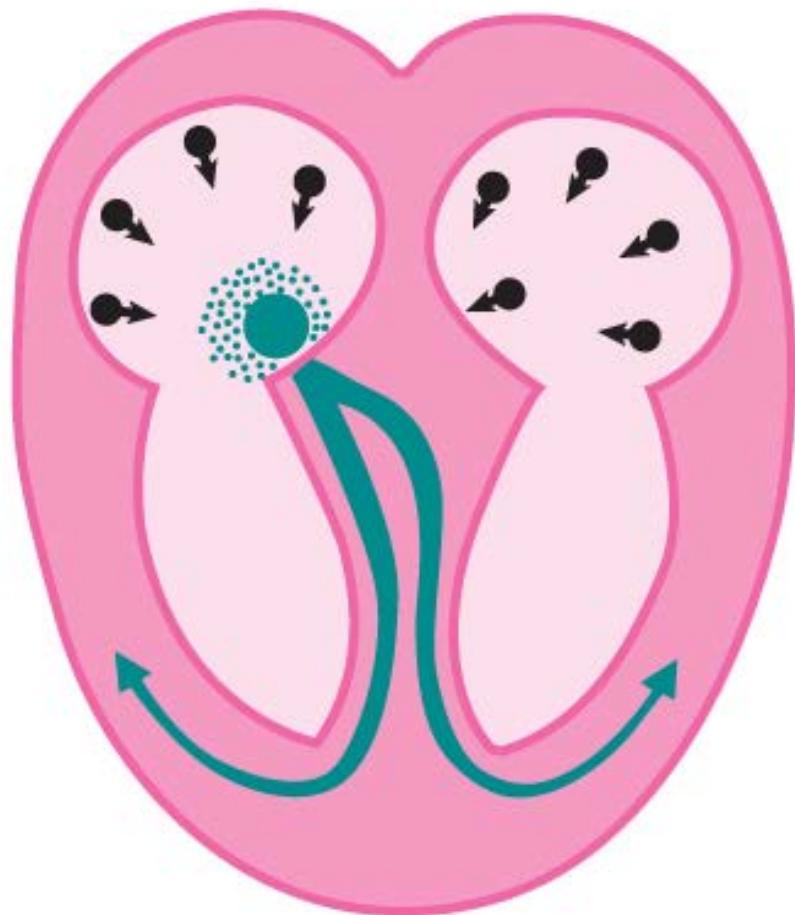
- **Increased irritability of all cardiac cells in atria, and many sites within atria try to fire impulses at same time**
- **With so many impulses, most are not conducted so atria doesn't depolarize each time**
- **Atria conduct in a quivering movement (fibrillatory waves or fib waves)**
 - **Wavy baseline between QRS**
 - **No true P waves or PR intervals**

Atrial Fibrillation (A Fib)

Normal conduction



Abnormal conduction



Atrial Fibrillation (A Fib)

- **QRS = 0.04-0.12 second**
- **R-R intervals irregularly irregular—no rhyme or reason to irregularity**
- **AR = 350-500 ipm or more**
- **Controlled atrial fibrillation = VR is normal (60-100 ipm)**
- **Atrial fibrillation with a slow ventricular response = VR < 60 ipm**

Atrial Fibrillation (A Fib)

- **Atrial fibrillation with a rapid ventricular response = VR of 101-150 ipm**
- **Uncontrolled atrial fibrillation = VR > 150 ipm**
- **Atria may not completely empty, causing blood pooling which may lead to blood clots**
- **Not usually considered lethal**
- **Frequently occurs in elderly**
- **Treated with medication or electrical therapy**

Atrial Fibrillation (A Fib)

- **Signs and symptoms:**
 - Ashen, pale, cool, clammy skin
 - Nausea and vomiting
 - Dizziness, weakness, faintness
 - Shortness of breath
 - Hypotension
 - Tachycardia
 - Diaphoresis
 - Mild to severe chest pain
 - Confusion or disorientation
 - Cyanosis
 - Decreased urinary output
 - Unresponsiveness

Atrial Fibrillation (A Fib)

- **Causes:**
 - Advanced rheumatic heart disease
 - Hypertensive or coronary heart disease
 - Cardiomyopathy
 - Acute myocarditis and pericarditis
 - Heart valve disease
 - MI
 - Chest trauma
 - Pulmonary disease
 - Digitalis
 - Stress
 - Excessive alcohol/ caffeine use

Atrial Fibrillation (A Fib)

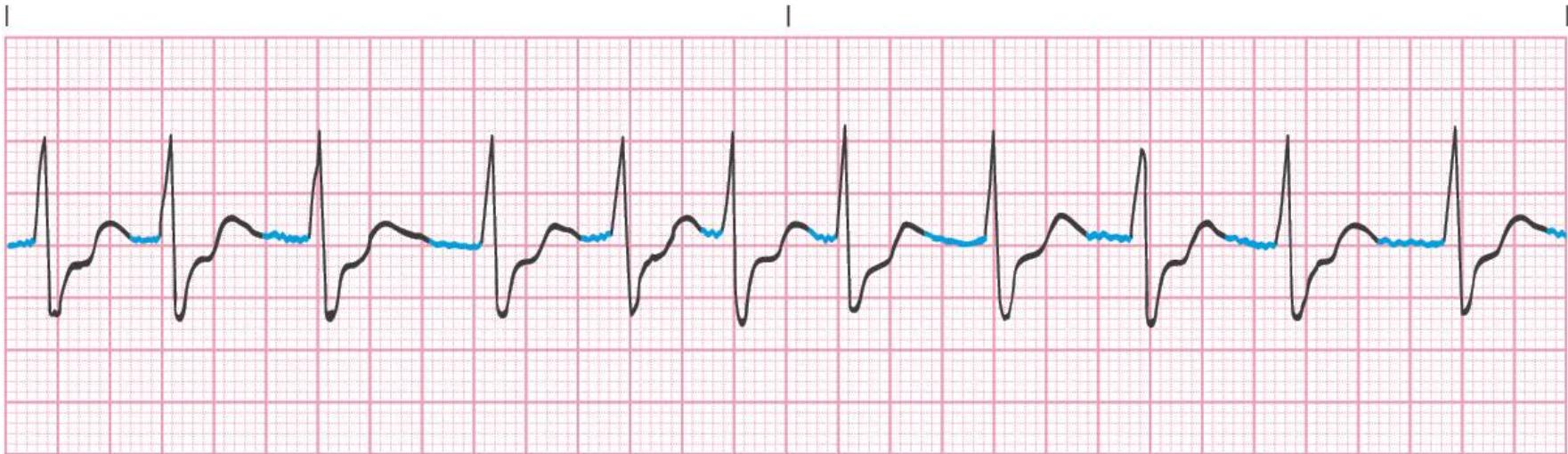
- Atrial fib/flutter = Combo of atrial flutter and A Fib in same strip
- Do not confuse A Fib with V Fib
 - V Fib lethal dysrhythmia, A Fib usually not lethal



Atrial Fibrillation (A Fib)



Atrial Fibrillation (A Fib)



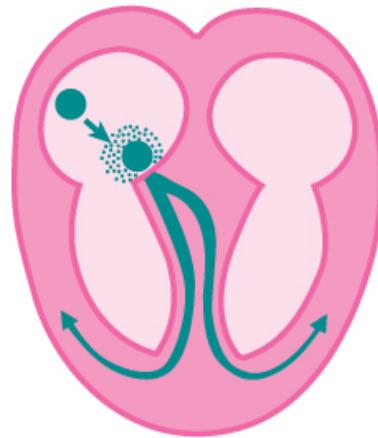
- Atrial fibrillation with a rapid ventricular response: no distinguishable P waves; atrial heart rate, 350 to 500 beats/min; ventricular heart rate, 110 beats/min (notice depressed ST segments)

Wolff-Parkinson-White Syndrome

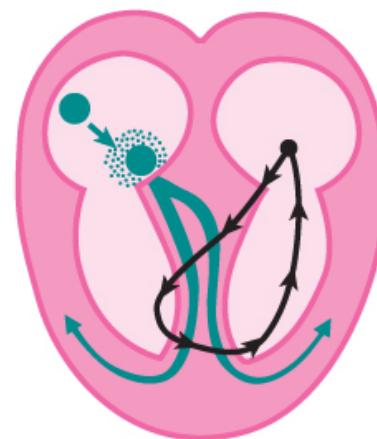
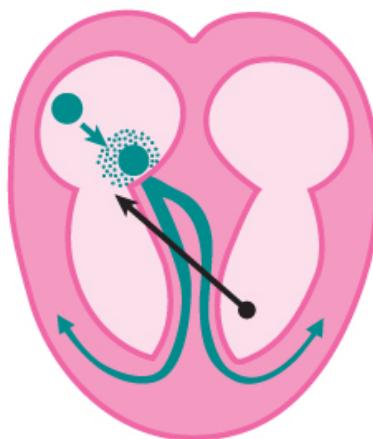
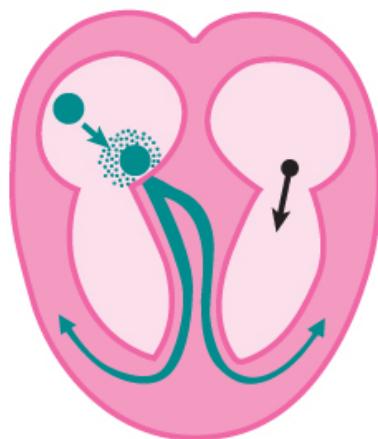
- Occurs when impulse follows an additional or abnormal electrical conduction pathway called the bundle of Kent (known as an accessory pathway)
- Reaches ventricles after bypassing AV node
- 3 different travel patterns:
 - Antegrade: ↓ from atria to ventricles
 - Retrograde: ↑ from ventricles to atria
 - Continuous: Both ↓ and ↑ in continuous cycle

Wolff-Parkinson-White Syndrome

Normal conduction



Abnormal conduction

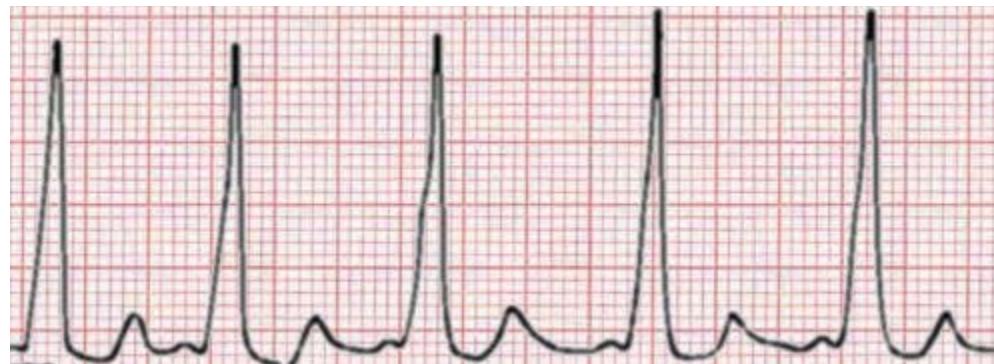
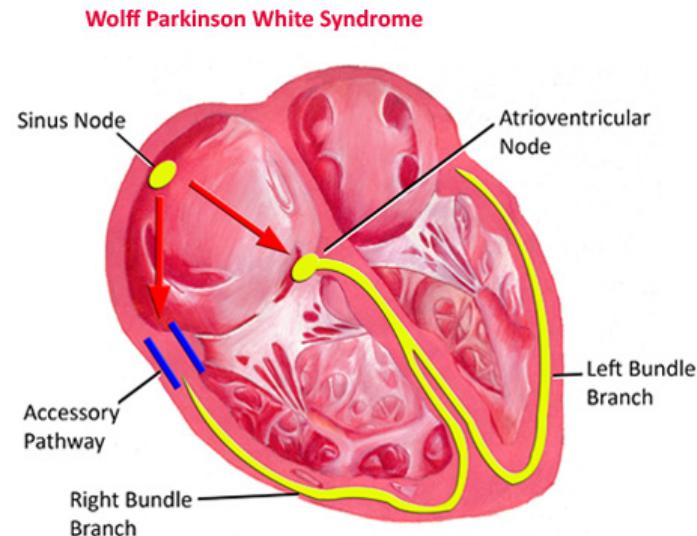
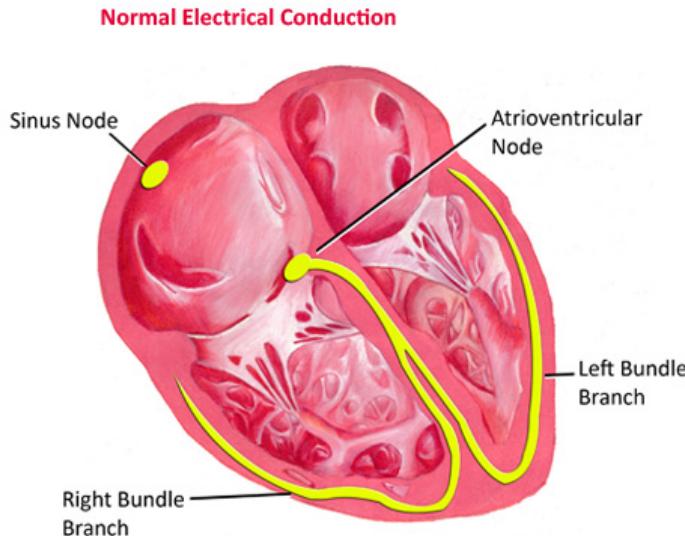


Antegrade

Retrograde

Continuous cycle

Wolff-Parkinson-White Syndrome



Wolff-Parkinson-White Syndrome

- PR interval < 0.12 second if P wave present
- Widened QRS > 0.12 second in retrograde or continuous
- QRS ranges from 0.04-0.12 second if impulse travels from atria to ventricles
- R wave “slurred” or curved at beginning
- Delta wave: Extra bump seen in curved section of QRS formed by depolarization of ventricles through accessory pathway

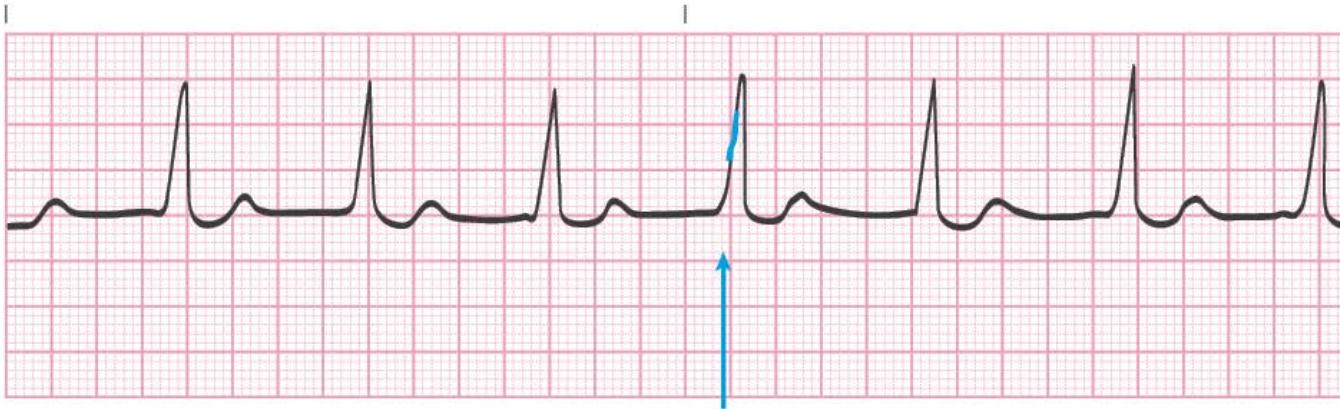
Wolff-Parkinson-White Syndrome

- P-P and R-R intervals and rate vary
- Ventricles usually depolarize quickly, causing tachycardia
- Not usually a dangerous dysrhythmia
 - Usually undiagnosed until found on routine ECG
 - Only life threatening if VR increases to 200-300 ipm
- Associated with SVT, atrial flutter, and A Fib
- Can sometimes visually mimic V Tach if QRS wide and rapid rate

Wolff-Parkinson-White Syndrome

- **May have no symptoms or may have the following symptoms:**
 - Palpitations
 - Racing heart
 - Dizziness
 - Weakness
 - Faintness
 - Shortness of breath
 - Chest pain

Wolff-Parkinson-White Syndrome



Delta wave

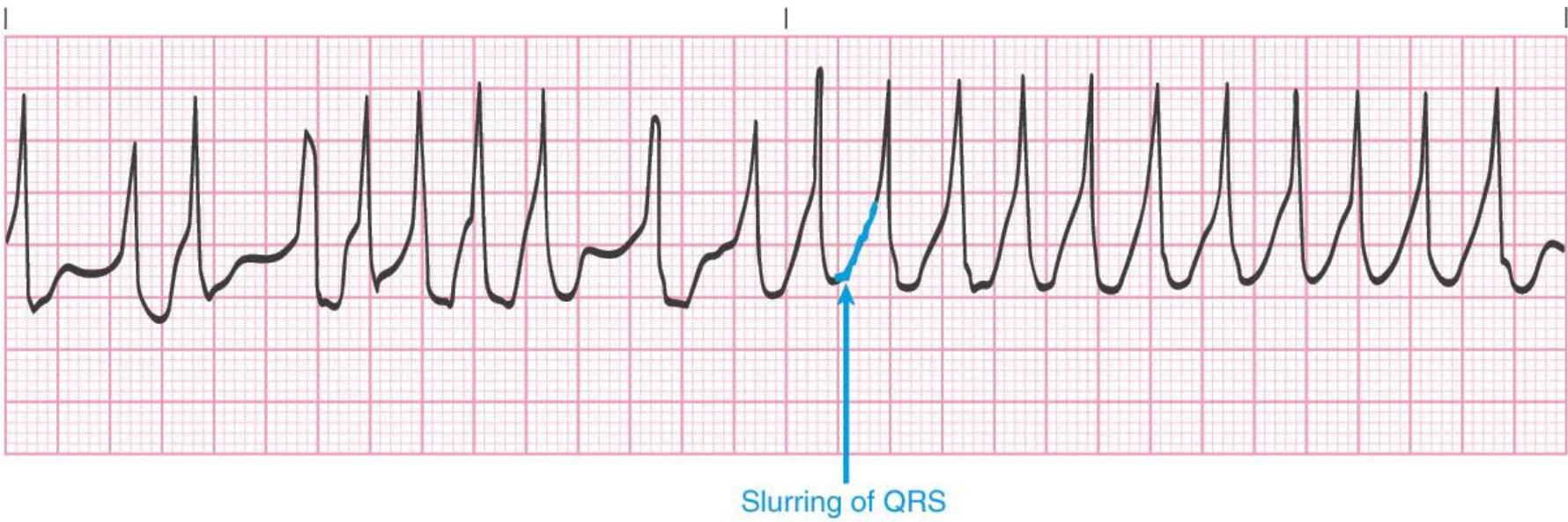


Slurring of QRS

Delta wave

- A. Sinus rhythm with WPW syndrome showing delta waves; heart rate, 70 beats/min
- B. Sinus bradycardia with WPW syndrome showing slurring of QRS and delta waves; heart rate, 50 beats/min (notice biphasic/diphasic T waves)

Wolff-Parkinson-White Syndrome



- C. Uncontrolled atrial fibrillation with WPW syndrome mimicking ventricular tachycardia and showing slurring of QRS; atrial heart rate 350 to 500 beats/min; ventricular heart rate, 210 beats/min (notice depressed ST segments)

Wandering Atrial Pacemaker

- **Characteristics:**
 - Originates from at least 3 different sites above Bundle of His
 - May include SA node, any pacemaker site in atria, AV junction, or combo of these areas
 - Atrial dysrhythmia but includes some junctional complexes
 - Not usually lethal but frequently treated
 - Patient's symptoms vary

Wandering Atrial Pacemaker

- **Characteristics:**
 - Size and shape of each complex determined by site of origin
 - If atria, P wave occurs followed by QRS of 0.04-0.12 second
 - PR interval usually 0.12-0.20 second but may vary
 - If AV junction, P waves may be inverted, buried or retrograde
 - PR interval may vary or be absent
 - P-P (if present) and R-R intervals vary
 - Rate may vary but usually between 60-100 ipm

Wandering Atrial Pacemaker

- **Causes:**
 - May be normal phenomenon in very young or elderly and in athletes
 - Inhibitory vagal effect of respiration on the SA node and AV junction
 - Digitalis

Wandering Atrial Pacemaker

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