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Chapter 4
Atrial Rhythms

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Overview

- Atria
  - Thin-walled, low-pressure chambers
  - Receive blood from the systemic circulation and lungs
  - Continuous flow of blood from the superior and inferior vena cavae into the atria
  - "Atrial kick"

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Overview

- The sinoatrial (SA) node, atrioventricular (AV) junction, and ventricular conduction system normally possess the property of automaticity
- Atrial dysrhythmias reflect abnormal electrical impulse formation and conduction in the atria

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Overview

- Atrial dysrhythmias may occur because of:
  - Altered automaticity
  - Reentry
- Altered automaticity is a disorder in impulse formation
- Reentry is a disorder in impulse conduction

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Atrial Dysrhythmias

- Most atrial dysrhythmias are not life-threatening
  - Some are associated with extremely fast ventricular rates
  - An excessively rapid heart rate may compromise cardiac output

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Premature Complexes

- Premature beats may be produced by the atria, AV junction, or the ventricles
- Premature beats appear early, that is, they occur before the next expected beat

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Premature Complexes

- Premature beats are identified by their site of origin
  - Premature atrial complexes (PACs)
  - Premature junctional complexes (PJCs)
  - Premature ventricular complexes (PVCs)

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Premature Atrial Complexes (PACs)

- PACs are identified by:
  - Early (premature) P waves
  - Positive (upright) P waves (in lead II) that differ in shape from sinus P waves
  - The early P wave may or may not be followed by a QRS complex

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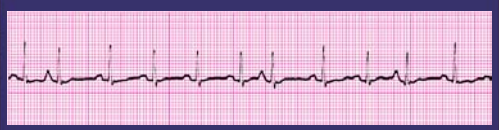
Premature Atrial Complexes (PACs)



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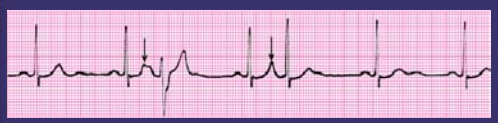
Premature Atrial Complexes (PACs)

- PACs associated with a wide QRS complex are called "aberrantly conducted" PACs, indicating conduction through the ventricles is abnormal



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Premature Atrial Complexes (PACs)

- A "noncompensatory" (incomplete) pause often follows a PAC
  - Represents the delay during which the SA node resets its rhythm for the next beat
- A "compensatory" pause often follows premature ventricular complexes (PVCs)

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Compensatory/Noncompensatory Pause

- To determine whether a pause following a premature complex is compensatory or noncompensatory:
  - Measure the distance between three normal beats
  - Compare that distance between three beats, one of which includes the premature complex

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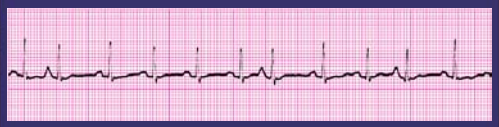
Compensatory/Noncompensatory Pause



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Compensatory/Noncompensatory Pause

- The pause is termed “noncompensatory” (incomplete) if the normal beat following the premature complex occurs before it was expected
  - When the distance is NOT the same
- The pause is “compensatory” (complete) if the normal beat following the premature complex occurs when expected
  - When the distance is the same

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Nonconducted PACs

- A PAC may occur very prematurely and close to the T wave of the preceding beat
  - Only a P wave may be seen with no QRS after it (appearing as a pause)
- This type of PAC is called a “nonconducted” or “blocked” PAC
  - P wave occurred too early (during depolarization of the ventricles) to be conducted

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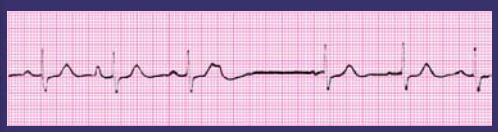
Nonconducted PACs



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PACs – Patterns

- Pairs (coupled): two sequential PACs
- Runs or bursts
  - Three or more sequential PACs are called “paroxysmal atrial tachycardia” (PAT) or “paroxysmal supraventricular tachycardia” (PSVT)
- Atrial bigeminy: every other beat is a PAC
- Atrial trigeminy: every third beat is a PAC
- Atrial quadrigeminy: every fourth beat is a PAC

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PACs – Causes

- Emotional stress
- Congestive heart failure
- Myocardial ischemia or injury
- Mental and physical fatigue
- Atrial enlargement
- Digitalis toxicity
- Hypokalemia
- Hypomagnesemia
- Hyperthyroidism
- Excessive intake of caffeine, tobacco, or alcohol

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PACs – Clinical Significance

- In persons with healthy hearts, occasional PACs are not clinically significant
- If PACs are frequent, the patient may complain of a "skip" or occasional "palpitations"

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PACs – Intervention

- Occasional PACs usually do not require treatment
- Frequent PACs may initiate episodes of atrial fibrillation, atrial flutter, or PSVT
- Frequent PACs are treated by correcting the underlying cause:
  - Stress reduction
  - Reduced consumption of caffeine-containing beverages
  - Treatment of congestive heart failure
  - Correction of electrolyte imbalance

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Wandering Atrial Pacemaker

- Multiformed atrial rhythm
  - Updated term for the rhythm formerly known as wandering atrial pacemaker
- Size, shape, and direction of P waves vary

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Wandering Atrial Pacemaker – ECG Characteristics

Rate	Usually 60 to 100 beats/min, but may be slow. If rate greater than 100 beats/min, the rhythm is termed "multifocal" (or chaotic) atrial tachycardia.
Rhythm	May be irregular as the pacemaker site shifts from the SA node to ectopic atrial locations and the AV junction.
P Waves	Size, shape, and direction may change from beat to beat. At least three different P wave configurations are required for a diagnosis of wandering atrial pacemaker or multifocal atrial tachycardia.
PR Interval	Variable
QRS Duration	Usually less than 0.10 second unless an intraventricular conduction defect exists.

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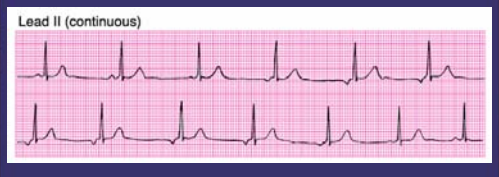
Wandering Atrial Pacemaker



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Wandering Atrial Pacemaker – Causes

- May be observed in normal, healthy hearts (particularly in athletes) and during sleep
- May also occur with some types of organic heart disease and with digitalis toxicity

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Wandering Atrial Pacemaker – Clinical Significance/Intervention

- Usually produces no signs and symptoms unless associated with a bradycardic rate
- If the rhythm occurs because of digitalis toxicity, the drug should be withheld

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Supraventricular Tachycardia (SVT)

- The term supraventricular tachycardia (SVT) may be used in two ways:
  - All tachydysrhythmias that originate above the bifurcation of the bundle of His
    - Sinus tachycardia
    - Atrial tachycardia
    - Atrial flutter
    - Atrial fibrillation
    - Junctional tachycardia
  - Dysrhythmias with a rapid ventricular rate (tachycardia) and a narrow-QRS complex but with an uncertain specific origin (atrial or junctional)

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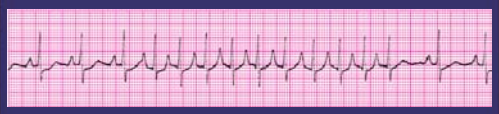
Paroxysmal Supraventricular Tachycardia (PSVT)

- "Paroxysmal supraventricular tachycardia" is a term used to describe SVT that starts and ends suddenly



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Paroxysmal Supraventricular Tachycardia (PSVT)

- Three primary types of PSVT:
  - Atrial tachycardia
  - Atrioventricular nodal reentrant tachycardia (AVNRT)
  - AV reentrant tachycardia (AVRT)

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Classification of SVT

- Supraventricular tachycardias can be classified into those that are AV nodal "passive" and those that are AV nodal "active"
- AV nodal passive SVT
  - AV node does not play a part in the maintenance of the tachycardia
  - Serves only to passively conduct the supraventricular rhythm into the ventricles

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Atrial Tachycardia

- "Atrial tachycardia" describes three or more sequential PACs occurring at a rate of more than 100/min
- Atrial tachycardia that starts or ends suddenly is called "paroxysmal atrial tachycardia" (PAT)

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Atrial Tachycardia

- Atrial tachycardia is a series of rapid beats from an atrial ectopic focus, often precipitated by a PAC
  - This rapid atrial rate overrides the SA node and becomes the pacemaker

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Atrial Tachycardia – ECG Characteristics

Rate	150 to 250 beats/min
Rhythm	Regular
P Waves	One positive P wave precedes each QRS complex in lead II but the P waves differ in shape from sinus P waves; with rapid rates, it is difficult to distinguish P waves from T waves
PR Interval	May be shorter or longer than normal and may be difficult to measure because P waves may be hidden in T waves
QRS Duration	0.10 second or less unless an intraventricular conduction delay is present

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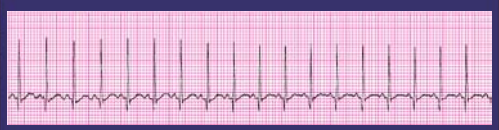
Atrial Tachycardia



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Preexcitation Syndrome

- Rhythms that originate from above the ventricles but in which the impulse travels via a pathway other than the AV node and bundle of His
- The supraventricular impulse excites the ventricles earlier than normal

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Preexcitation Syndrome

- In patients with preexcitation syndrome, strands of myocardial tissue between the atria and ventricles persist as working myocardial tissue
  - Called an “accessory pathway”
- Bypass tract
  - When one end of an accessory pathway is attached to normal conductive tissue

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Preexcitation Syndrome

- Three major forms of preexcitation syndrome
  - Differentiated by their accessory pathways or bypass tracts
    - Wolff-Parkinson-White (WPW) syndrome
    - Lown-Ganong-Levine (LGL) syndrome
    - Unnamed syndrome involving Mahaim fibers

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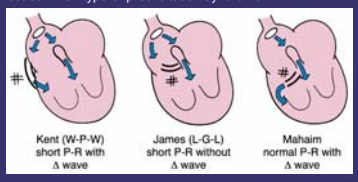
Preexcitation Syndrome

- Wolff-Parkinson-White (WPW) syndrome
  - Accessory pathway is called the "Kent bundle"
    - Connects the atria directly to the ventricles, completely bypassing the normal conduction system
  - Most common type of preexcitation syndrome



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Wolff-Parkinson-White Syndrome – ECG Characteristics

Rate	Usually 60 to 100 beats/min, if the underlying rhythm is sinus in origin
Rhythm	Regular, unless associated with atrial fibrillation
P Waves	Normal and positive in lead II unless WPW is associated with atrial fibrillation
PR Interval	If P waves are observed, less than 0.12 second
QRS Duration	Usually greater than 0.12 second; slurred upstroke of the QRS complex (delta wave) may be seen in one or more leads

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Delta Wave

- Delta waves are produced with accessory pathways that insert directly into ventricular muscle
  - Delta wave is the initial slurred deflection at the beginning of the QRS complex
  - Results from initial activation of QRS by conduction over the accessory pathway

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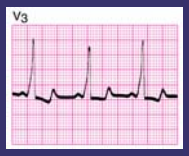
Wolff-Parkinson-White Syndrome

- Lead V3
- Typical WPW pattern showing:
  - Short PR interval
  - Delta wave
  - Wide QRS complex
  - Secondary ST and T wave changes



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WPW – Incidence

- More common in males than in females
- Approximately two thirds of individuals with WPW have no associated heart disease
- Occurs in approximately 4 out of 100,000 people
- One of the most common causes of tachydysrhythmias in infants and children
- Symptoms associated with preexcitation often do not appear until young adulthood

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WPW – Clinical Significance

- Individuals with preexcitation syndrome are predisposed to tachydysrhythmias
  - Loss of the protective blocking mechanism provided by the AV node
  - Accessory pathway provides a mechanism for reentry

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WPW – Clinical Significance

- Signs and symptoms associated with rapid ventricular rates may include:
  - Palpitations
  - Anxiety
  - Weakness
  - Dizziness
  - Chest pain
  - Shortness of breath
  - Shock

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Atrial Flutter

- Atrial flutter is an ectopic atrial rhythm in which an irritable site depolarizes regularly at an extremely rapid rate

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Atrial Flutter

- The extremely rapid atrial rate results in waveforms that resemble the teeth of a saw, or a picket fence
  - "Flutter" waves
- Flutter waves are best observed in leads II, III, aVF, and V_1

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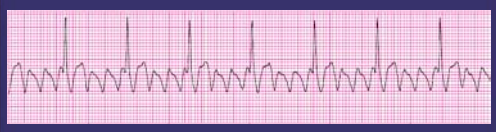
Atrial Flutter

- The AV node protects the ventricles from the extremely fast atrial rates by blocking some impulses before they reach the ventricles
  - If the AV node blocks the impulses at a regular rate, the resulting ventricular rhythm will be regular
  - If the AV node blocks impulses at an irregular rate, the resulting ventricular rhythm will be irregular



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Atrial Flutter – ECG Characteristics

Rate	Atrial rate 250 to 450 beats/min, typically 300 beats/min; ventricular rate variable—determined by AV blockade. The ventricular rate will usually not exceed 180 beats/min due to the intrinsic conduction rate of the AV junction.
Rhythm	Atrial regular, ventricular regular or irregular depending on AV conduction/blockade
P Waves	No identifiable P waves; saw-toothed "flutter" waves are present
PR Interval	Not measurable
QRS Duration	Usually less than 0.10 second but may be widened if flutter waves are buried in QRS complex or an intraventricular conduction delay exists

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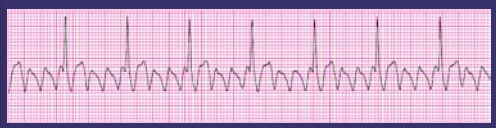
Atrial Flutter



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Atrial Flutter – Causes

- Atrial flutter is usually a paroxysmal rhythm precipitated by a PAC
  - May last for seconds to hours and occasionally lasts 24 hours or more
- Chronic atrial flutter is unusual
  - The rhythm usually reverts to sinus rhythm or atrial fibrillation, either spontaneously or with treatment

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Atrial Flutter – Causes

- May occur in conditions such as:
  - Pulmonary embolism
  - Chronic ventilatory failure
  - Alcohol intoxication
  - Ischemic heart disease
  - Hypoxia
  - Digitalis or quinidine toxicity
- Rarely occurs in patients without cardiac disease

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Atrial Flutter – Clinical Significance

- Severity of signs and symptoms vary depending on:
  - Ventricular rate
  - Duration of the dysrhythmia
  - Patient's cardiovascular status

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Atrial Flutter – Intervention

- Vagal maneuvers may help differentiate atrial flutter from other dysrhythmias
- If rapid ventricular rate, control ventricular response
- If serious signs and symptoms, synchronized cardioversion

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Atrial Fibrillation

- In atrial fibrillation, the atria are depolarized at a rate of 400 to 600 beats/min
  - Cause the muscles of the atria to quiver (fibrillate)
- Results in:
  - Ineffectual atrial contraction
  - Subsequent decrease in cardiac output
  - Loss of atrial kick

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Atrial Fibrillation

- Because of the quivering of the atrial muscle, and because there is no uniform wave of depolarization in atrial fibrillation, there is no P wave
  - Instead, the baseline appears erratic (wavy)
    - Wavy deflections are termed "fibrillatory" waves

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Atrial Fibrillation (Afib)

- Atrial depolarization occurs very irregularly
  - Ventricular response (rhythm) is usually very irregular
    - Described as “irregularly irregular”
- “Controlled” atrial fibrillation
  - Ventricular rate is less than 100 beats/min
- “Uncontrolled” atrial fibrillation
  - Ventricular rate is more than 100 beats/min

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Atrial Fibrillation – ECG Characteristics

Rate	Atrial rate usually greater than 400 to 600 beats/min; ventricular rate variable
Rhythm	Ventricular rhythm usually irregularly irregular
P Waves	No identifiable P waves; fibrillatory waves present; erratic, wavy baseline
PR Interval	Not measurable
QRS Duration	Usually less than 0.10 second but may be widened if an intraventricular conduction delay exists

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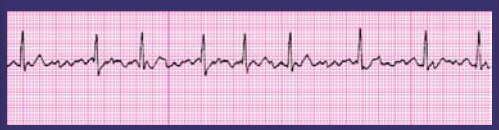
Atrial Fibrillation



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Atrial Fibrillation – Causes

- Rheumatic heart disease
- Coronary artery disease
- Hypertension
- Mitral or tricuspid valve disease
- Congestive heart failure
- Pericarditis
- Pulmonary embolism
- Cardiomyopathy
- Hypoxia
- Drugs or intoxicants
  - Alcohol
  - Carbon monoxide
- Acute or chronic pulmonary disease
- Enhanced vagal tone
- Enhanced sympathetic tone
- Hypokalemia
- Hyperthyroidism

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Atrial Fibrillation – Clinical Significance

- Patients experiencing atrial fibrillation may develop intra-atrial emboli
  - Atria are not contracting
  - Blood stagnates in atrial chambers
  - Predisposes the patient to systemic emboli, particularly stroke

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Atrial Fibrillation – Clinical Significance

- Severity of signs and symptoms vary depending on:
  - Ventricular rate
  - Duration of the dysrhythmia
  - Patient’s cardiovascular status

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Atrial Fibrillation – Intervention

- In the stable patient with atrial fibrillation associated with a rapid ventricular rate, treatment is first directed toward controlling the ventricular response
- If cardiac function is normal:
  - Calcium channel blockers
  - Beta-blockers
- If cardiac function is impaired:
  - Digoxin
  - Amiodarone

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Atrial Fibrillation – Intervention

- If the patient experiences serious signs and symptoms, synchronized cardioversion is recommended