

Chapter 3

Sinus Mechanisms



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Objectives

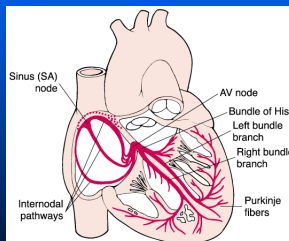
- Describe the ECG characteristics of a sinus rhythm
- Describe the ECG characteristics, possible causes, signs and symptoms, and emergency management for the following dysrhythmias that originate in the SA node:
 - Sinus bradycardia
 - Sinus tachycardia
 - Sinus arrhythmia
 - Sinoatrial block
 - Sinus arrest



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Sinus Mechanisms

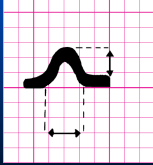
- The normal heartbeat is the result of an electrical impulse that starts in the SA node.



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Sinus Mechanisms

- A rhythm that begins in the SA node has:
 - Positive (upright) P wave before each QRS
 - P waves that look alike
 - Constant PR intervals
 - Regular atrial and ventricular rhythm (usually)



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Sinus Mechanisms

- Dysrhythmia (arrhythmia)
 - A sign of abnormal electrical activity



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Sinus Mechanisms

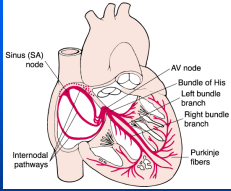
- An impulse that begins in the SA node may be affected by:
 - Medications
 - Diseases or conditions that:
 - Cause heart rate to speed up, slow down, or beat irregularly
 - Delay or block impulse from leaving the SA node
 - Prevent an impulse from being generated in the SA node



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Sinus Rhythm

- Sinus rhythm
 - Normal heart rhythm
 - Reflects normal electrical activity



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Sinus Rhythm

- SA node fires faster than any other part of conduction system
 - SA node is normally primary pacemaker

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Normal Heart Rates by Age

Age	Beats per Minute (BPM)*
Infant (1 to 12 months)	100-160
Toddler (1 to 3 years)	90-150
Preschooler (4 to 5 years)	80-140
School-age (6 to 12 years)	70-120
Adolescent (13 to 18 years)	60-100
Adult	60-100

*Pulse rates for a sleeping child may be 10% lower than the low rate listed in age group

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Sinus Rhythm—How Do I Recognize It?



Rate	60-100 bpm
Rhythm	P-P regular, R-R regular



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Sinus Rhythm—How Do I Recognize It?



P Waves	Positive (upright) in Lead II, one precedes each QRS complex, P waves look alike
PR Interval	0.12-0.20 sec Constant from beat to beat



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Sinus Rhythm—How Do I Recognize It?



QRS	≤0.10 sec unless an intraventricular conduction delay exists
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Sinus Rhythm—How Do I Recognize It?

Rate	60-100 bpm
Rhythm	P-P regular, R-R regular
P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists



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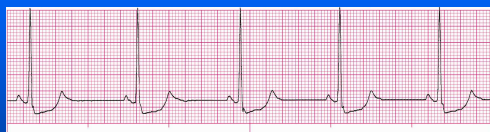
Sinus Bradycardia

- If the SA node fires at a rate slower than normal for the patient's age, the rhythm is called *sinus bradycardia*
 - In adults and adolescents, heart rate <60 bpm



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Sinus Bradycardia—How Do I Recognize It?




Rate	<60 bpm
Rhythm	P-P interval regular, R-R interval regular
P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike



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Sinus Bradycardia— How Do I Recognize It?



PR Interval	0.12-0.20 sec and Constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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Sinus Bradycardia— How Do I Recognize It?



- Sinus bradycardia at 48 bpm
 - ST-segment depression

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Sinus Bradycardia— How Do I Recognize It?

Rate	<60 bpm
Rhythm	P-P interval regular, R-R interval regular
P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike
PR Interval	0.12-0.20 sec Constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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Sinus Bradycardia— What Causes It?

- Occurs in adults and children during sleep
- Common in well-conditioned athletes
- Present in up to 35% of people <25 yrs while at rest



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Sinus Bradycardia— What Causes It?

- Common dysrhythmia associated with acute myocardial infarction (MI)
 - Often seen in inferior and posterior infarction



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Sinus Bradycardia— What Causes It?

- Vagal stimulation
 - Coughing
 - Vomiting
 - Straining to have a bowel movement
 - Sudden exposure of the face to cold water
 - Carotid sinus pressure



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Sinus Bradycardia— What Causes It?

- Inferior MI
- Posterior MI
- Disease of the SA node
- Vagal stimulation
- Hypoxia
- Hypothermia
- Increased intracranial pressure
- Post heart transplant
- Hypothyroidism
- Hypo- or hyperkalemia
- Obstructive sleep apnea
- Medications
 - Calcium channel blockers
 - Digitalis
 - Beta-blockers
 - Amiodarone
 - Sotalol



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Signs and Symptoms of Hemodynamic Compromise

- Changes in mental status
 - Restlessness
 - Confusion
 - Possible loss of consciousness
- Low blood pressure
- Chest pain
- Shortness of breath
- Signs of shock
- Congestive heart failure
- Pulmonary congestion
- Fall in urine output
- Cold, clammy skin



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Sinus Bradycardia— What Do I Do About It?

- No treatment if not symptomatic
- If symptomatic because of the slow rate, treatment may include:
 - Oxygen
 - IV access
 - Atropine
 - Transcutaneous pacing (TCP)



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Atropine

- Vagolytic
 - Vago refers to vagus nerves (right and left)
 - Lytic refers to "lyse," which means to interfere with
- Blocks chemicals at endings of vagus nerves
- Allows more sympathetic nervous system activity
 - Rate at which the SA node can fire is increased
 - Increases speed of conduction through AV node



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Sinus Tachycardia

- If the SA node fires at a rate faster than normal for the patient's age, the rhythm is called sinus tachycardia
- Sinus tachycardia begins and ends gradually



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Sinus Tachycardia— How Do I Recognize It?

- Normal heart rates vary with age
- Sinus tachycardia
 - In adults, rate is usually 101-180 bpm
 - In infants, >200 bpm
 - In a child >5 yrs, rate >160 bpm



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Sinus Tachycardia— How Do I Recognize It?



Rate	101-180 bpm
Rhythm	P-P interval regular, R-R interval regular

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Sinus Tachycardia— How Do I Recognize It?



P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike
	At very fast rates it may be hard to tell the difference between a P wave from a T wave

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Sinus Tachycardia— How Do I Recognize It?



PR Interval	0.12-0.20 sec (may shorten with faster rates) and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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Sinus Tachycardia— How Do I Recognize It?



QT Interval	Normally shortens as heart rate increases
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Sinus Tachycardia— How Do I Recognize It?



- Sinus tachycardia at 129 bpm
 - ST-segment depression

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Sinus Tachycardia— How Do I Recognize It?

Rate	101-180 bpm
Rhythm	P-P interval regular, R-R interval regular
P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike At very fast rates it may be hard to tell the difference between a P wave and a T wave
PR Interval	0.12-0.20 sec Constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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Sinus Tachycardia—What Causes It?

- Exercise
- Fever
- Pain
- Fear and anxiety
- Hypoxia
- Congestive heart failure
- Acute MI
- Infection
- Sympathetic stimulation
- Shock
- Dehydration, hypovolemia
- Pulmonary embolism
- Medications
 - Epinephrine
 - Atropine
 - Dopamine
 - Dobutamine
- Caffeine-containing beverages
- Nicotine
- Cocaine



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Sinus Tachycardia— What Do I Do About It?

- Directed at correcting the underlying cause
 - Fluid replacement
 - Relief of pain
 - Removal of offending medications or substances
 - Reducing fever or anxiety



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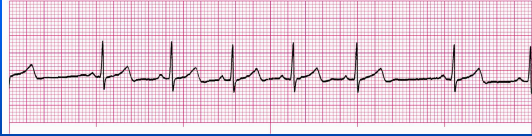
Sinus Arrhythmia

- When the SA node fires irregularly, the resulting rhythm is called *sinus arrhythmia*
- Respiratory sinus arrhythmia
 - Associated with the phases of respiration and changes in intrathoracic pressure
- Nonrespiratory sinus arrhythmia
 - Not related to the respiratory cycle



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Sinus Arrhythmia— How Do I Recognize It?



Rate	Usually 60-100 bpm, but may be slower or faster
Rhythm	<ul style="list-style-type: none"> •Irregular, phasic with respiration •Heart rate increases during inspiration (R-R intervals shorten) and decreases with expiration (R-R intervals lengthen)

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Sinus Arrhythmia— How Do I Recognize It?



P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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Sinus Arrhythmia— How Do I Recognize It?



- Sinus arrhythmia at 54-88 bpm

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Sinus Arrhythmia— How Do I Recognize It?

Rate	Usually 60-100 bpm, but may be slower or faster
Rhythm	<ul style="list-style-type: none"> • Irregular, phasic with respiration • Heart rate increases during inspiration (R-R intervals shorten) and decreases with expiration (R-R intervals lengthen)
P Waves	Positive (upright) in lead II, one precedes each QRS complex, P waves look alike
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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Sinus Arrhythmia— What Causes It?

- Respiratory sinus arrhythmia
 - Associated with phases of respiration and changes in intrathoracic pressure
 - Most commonly observed in children and adults <30 yrs

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Sinus Arrhythmia— What Causes It?

- Nonrespiratory sinus arrhythmia
 - Seen in older individuals and in those with heart disease
 - Common after acute inferior wall MI
 - May be seen with increased intracranial pressure
 - May be caused by the effects of medications
 - Digitalis
 - Morphine

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Sinus Arrhythmia— What Do I Do About It?

- Does not usually require treatment unless accompanied by a slow rate that causes hemodynamic compromise
 - If hemodynamic compromise is present, IV atropine may be indicated



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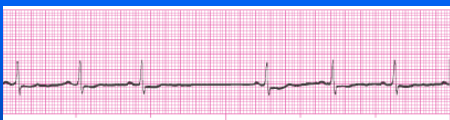
Sinoatrial (SA) Block

- Also called “sinus exit block”
- SA node generates impulses
- Impulses are blocked as they exit the SA node
- Results in periodically absent PQRST complexes



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SA Block— How Do I Recognize It?




Rate	Usually normal but varies because of the pause
Rhythm	Irregular due to the pause(s) caused by the SA block—the pause is the same as (or an exact multiple of) the distance between two other P-P intervals



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SA Block— How Do I Recognize It?



P Waves	<ul style="list-style-type: none"> • Positive (upright) in lead II, P waves look alike. • When present, one precedes each QRS complex.
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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SA Block— How Do I Recognize It?



- Sinus rhythm at a rate of 36-71 bpm with an episode of SA block

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SA Block— How Do I Recognize It?

Rate	Usually normal but varies because of the pause
Rhythm	Irregular due to the pause(s) caused by the SA block — the pause is the same as (or an exact multiple of) the distance between two other P-P intervals
P Waves	<ul style="list-style-type: none"> • Positive (upright) in lead II, P waves look alike. • When present, one precedes each QRS complex.
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists

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SA Block— What Causes It?

- Acute MI
- Digitalis, quinidine, procainamide, or salicylate administration
- Coronary artery disease
- Myocarditis
- Congestive heart failure
- Carotid sinus sensitivity
- Increased vagal tone



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SA Block— What Do I Do About It?

- No treatment if episodes are transient and there are no significant signs or symptoms
- If hemodynamic compromise is present:
 - Possible atropine
 - Possible permanent pacemaker



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Sinus Arrest

- Sinus impulses are not generated
- When the SA node fails to generate an impulse, an escape pacemaker should assume pacing responsibility
 - AV junction
 - Ventricles
- Results in absent PQRST complexes



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Sinus Arrest— How Do I Recognize It?

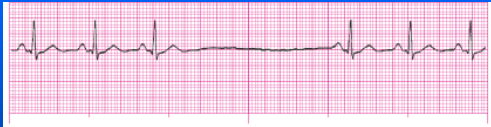


Rate	Usually normal but varies because of the pause
Rhythm	Irregular—the pause is of undetermined length (more than one PQRST complex is missing) and is not the same distance as other P-P intervals



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Sinus Arrest— How Do I Recognize It?

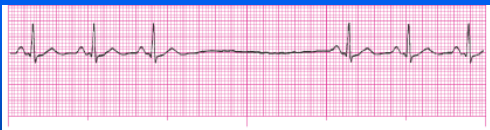


P Waves	Positive (upright) in lead II, P waves look alike. When present, one precedes each QRS complex.
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists



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Sinus Arrest— How Do I Recognize It?



- Sinus rhythm at a rate of 24-81 bpm with an episode of sinus arrest



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Sinus Arrest— How Do I Recognize It?

Rate	Usually normal but varies because of the pause
Rhythm	Irregular—the pause is of undetermined length (more than one PQRST complex is missing) and is not the same distance as other P-P intervals
P Waves	Positive (upright) in lead II, P waves look alike. When present, one precedes each QRS complex.
PR Interval	0.12-0.20 sec and constant from beat to beat
QRS	≤0.10 sec unless an intraventricular conduction delay exists



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Sinus Arrest— What Causes It?

- Hypoxia
- Myocardial ischemia or infarction
- Hyperkalemia
- Digitalis toxicity
- Reactions to medications such as beta-blockers and calcium channel blockers
- Carotid sinus sensitivity
- Increased vagal tone



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Sinus Arrest— What Do I Do About It?

- No treatment if episodes are transient and there are no significant signs or symptoms
- If hemodynamic compromise is present:
 - Possible atropine
 - Possible permanent pacemaker



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Questions?



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