

Chapter 3

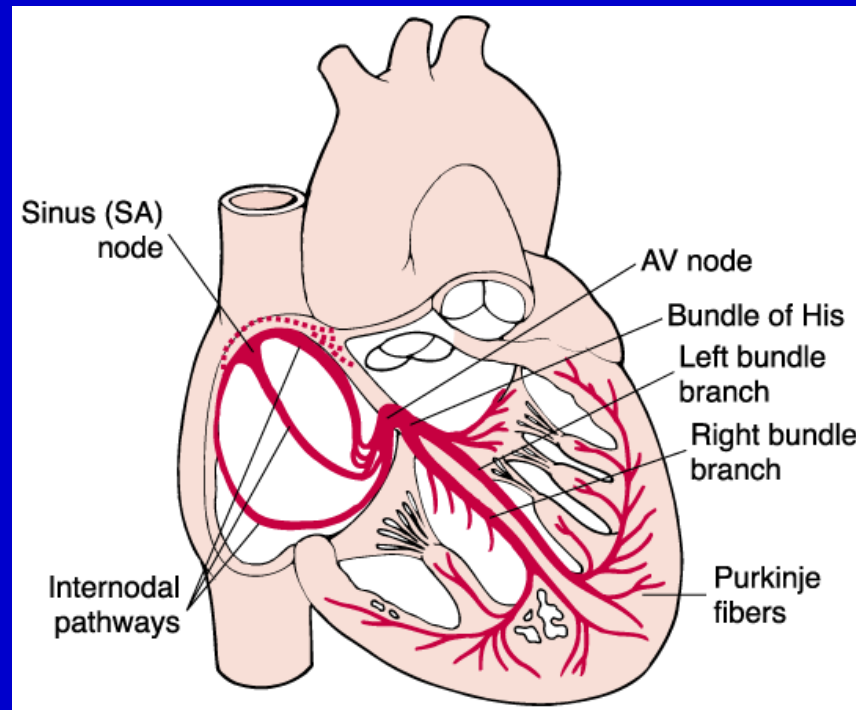
Sinus Mechanisms

Objectives

- Describe the ECG characteristics of a sinus rhythm.
- Describe the ECG characteristics, possible causes, signs and symptoms, and emergency management of sinus bradycardia.
- Describe the ECG characteristics, possible causes, signs and symptoms, and emergency management of sinus tachycardia.
- Describe the ECG characteristics, possible causes, signs and symptoms, and emergency management of sinus arrhythmia.
- Describe the ECG characteristics, possible causes, signs and symptoms, and emergency management of sinoatrial block.
- Describe the ECG characteristics, possible causes, signs and symptoms, and emergency management of sinus arrest.

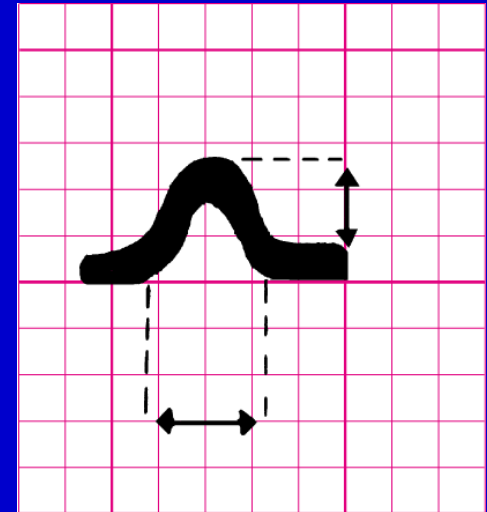
Sinus Mechanisms

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



Sinus Mechanisms

- A rhythm that begins in the SA node has the following characteristics:
 - A positive (upright) P wave before each QRS complex
 - P waves that look alike
 - A constant PR interval
 - A regular atrial and ventricular rhythm (usually)



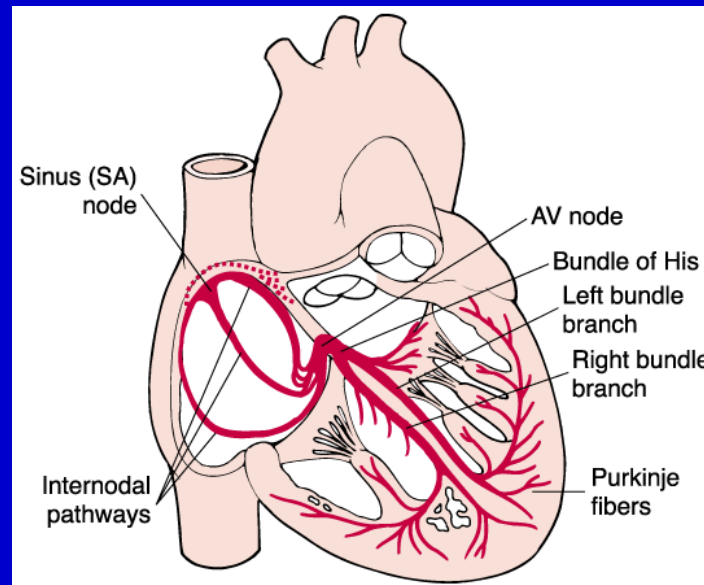
Sinus Mechanisms

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

Sinus Rhythm

Sinus Rhythm

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



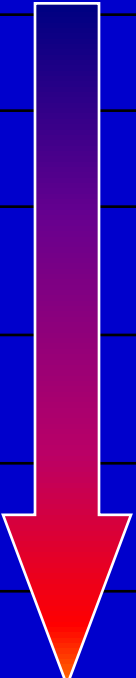
Sinus Rhythm

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

Normal Heart Rates by Age

Age	Beats per Minute*
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.



Sinus Rhythm – How Do I Recognize It?



Rate 60–100 bpm

Rhythm P-P interval regular, R-R interval regular

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 second and constant from beat to beat

Sinus Rhythm — How Do I Recognize It?



QRS duration 0.10 second or less unless an intraventricular conduction delay exists

Sinus Rhythm — ECG Characteristics

Rate	60–100 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 second and constant from beat to beat
QRS duration	0.10 second or less unless an intraventricular conduction delay exists

Sinus Bradycardia



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, a sinus bradycardia has a heart rate of less than 60 bpm

Sinus Bradycardia — How Do I Recognize It?



- Rate** Less than 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

Sinus Bradycardia — How Do I Recognize It?



PR interval 0.12–0.20 second and constant from beat to beat

QRS duration 0.10 second or less unless an intraventricular conduction delay exists

Sinus Bradycardia — How Do I Recognize It?



- Sinus bradycardia at 46 bpm
 - ST-segment depression

Sinus Bradycardia — ECG Characteristics

Rate	Less than 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 second and constant from beat to beat
QRS duration	0.10 second or less unless an intraventricular conduction delay exists

Sinus Bradycardia — What Causes It?

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



Sinus Bradycardia — What Causes It?

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

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

Sinus Bradycardia — What Causes It?

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

Sinus Bradycardia — What Do I Do About It?

Signs and symptoms of hemodynamic compromise:

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

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)

Atropine

- Vagolytic
- Blocks chemicals at endings of vagus nerves
- Allows more sympathetic activity
 - Rate at which the SA node can fire is increased
 - Increases speed of conduction through AV node

Sinus Tachycardia

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

Sinus Tachycardia — How Do I Recognize It?

- Sinus tachycardia
 - Looks like a sinus rhythm only faster
 - At very fast rates, it may be hard to tell the difference between a P wave and T wave
 - QT interval normally shortens as heart rate increases

Sinus Tachycardia — How Do I Recognize It?

- Normal heart rates vary with age
- Sinus tachycardia
 - In adults, rate is usually between 101 and 180 bpm
 - In infants, rate of more than 200 bpm
 - In a child over 5 years of age, rate of more than 160 bpm

Sinus Tachycardia — How Do I Recognize It?



Rate 101–180 bpm

Rhythm P-P interval regular, R-R interval regular

Sinus Tachycardia — How Do I Recognize It?



P waves Positive (upright) in lead II, one precedes each QRS complex, P waves look alike

Sinus Tachycardia — How Do I Recognize It?



PR interval 0.12–0.20 second (may shorten with faster rates) and constant from beat to beat

QRS duration 0.10 second or less unless an intraventricular conduction delay exists

Sinus Tachycardia — How Do I Recognize It?



- Sinus tachycardia at 125 bpm with ST-segment depression

Sinus Tachycardia — ECG Characteristics

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
PR interval	0.12–0.20 second (may shorten with faster rates) and constant from beat to beat
QRS duration	0.10 second or less unless an intraventricular conduction delay exists

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
- Caffeine-containing beverages
- Nicotine
- Cocaine

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

Sinus Arrhythmia

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

Sinus Arrhythmia — How Do I Recognize It?

- A sinus arrhythmia usually occurs at a rate of 60 to 100 bpm
- If sinus arrhythmia is associated with a slower than normal rate, it is called *sinus bradyarrhythmia*
- If the rhythm is associated with a faster than normal rate, it is known as *sinus tachyarrhythmia*

Sinus Arrhythmia — How Do I Recognize It?



Rate

Usually 60–100 bpm, but may be slower or faster

Rhythm

Irregular, phasic with respiration; heart rate increases gradually during inspiration (R-R intervals shorten) and decreases with expiration (R-R intervals lengthen)

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 second and constant from beat to beat
- QRS duration** 0.10 second or less unless an intraventricular conduction delay exists

Sinus Arrhythmia — How Do I Recognize It?



- Sinus arrhythmia at 54 to 88 bpm

Sinus Arrhythmia — How Do I Recognize It?

Rate	Usually 60-100 bpm, but may be slower or faster
Rhythm	Irregular, phasic with respiration; heart rate increases gradually 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 second and constant from beat to beat
QRS duration	0.10 second or less unless an intraventricular conduction delay exists

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 less than 30 years of age



Sinus Arrhythmia — What Causes It?

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



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

Sinoatrial (SA) Block

Sinoatrial 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

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

SA Block — 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 second and constant from beat to beat
- QRS duration** 0.10 second or less unless an intraventricular conduction delay exists

SA Block — How Do I Recognize It?



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

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** Positive (upright) in lead II, P waves look alike. When present, one precedes each QRS complex.
- PR interval** 0.12–0.20 second and constant from beat to beat
- QRS duration** 0.10 second or less unless an intraventricular conduction delay exists

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

SA Block — What Do I Do About It?

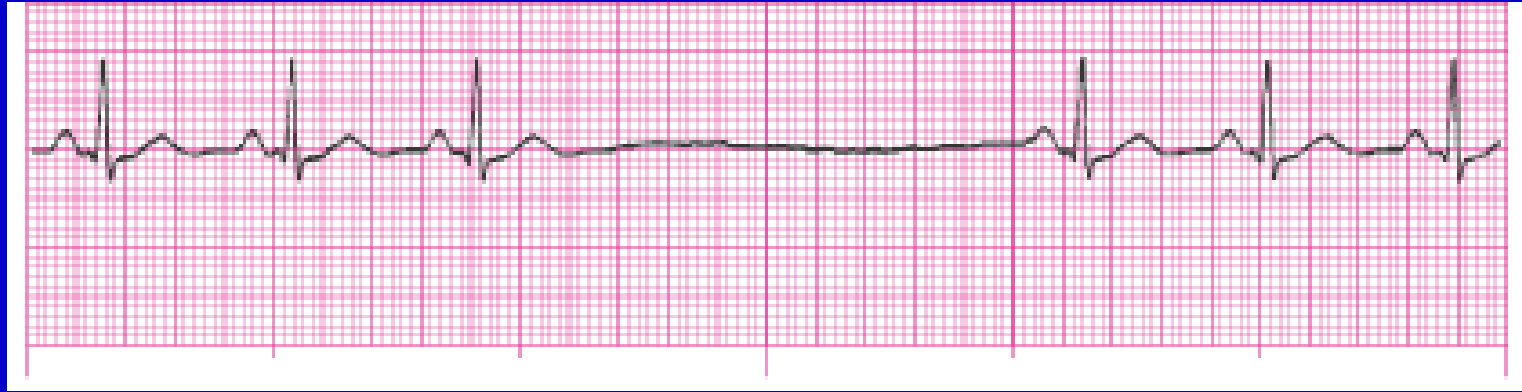
- No treatment if episodes are transient and there are no significant signs or symptoms
- If hemodynamic compromise is present:
 - Possible atropine
 - Possible permanent pacemaker

Sinus Arrest

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

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

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 second and constant from beat to beat

QRS duration

0.10 second or less unless an intraventricular
conduction delay exists

Sinus Arrest — How Do I Recognize It?



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

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 second and constant from beat to beat
- QRS duration** 0.10 second or less unless an intraventricular conduction delay exists

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

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

Questions?