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## Chapter 3 Sinus Mechanisms

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### Sinus Mechanisms – 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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### Overview

- The normal heartbeat is the result of an electrical impulse that originates in the SA node
- A rhythm originating from the SA node will have one positive (upright) P wave before each QRS complex

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### Overview

- Dysrhythmia (arrhythmia)
  - A manifestation of abnormal electrical activity
- Variations in rhythms originating from the SA node include differences in:
  - Rate (i.e., fast/slow) and/or pattern
  - Rhythm (regularity)

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### Sinus Rhythm

- The SA node normally initiates electrical impulses at a rate of 60 to 100 beats/min
  - Faster rate than any other part of conduction system
  - SA node is normally primary pacemaker

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### Sinus Rhythm

- Sinus rhythm is the name given to a rhythm reflecting normal electrical activity
  - Impulse originates in the SA node and follows the normal pathway of conduction, resulting in atrial and ventricular depolarization

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### Sinus Rhythm – ECG Characteristics

Rate	60 to 100 beats/min
Rhythm	Regular
P Waves	Uniform in appearance, positive (upright) in lead II, one precedes each QRS complex
PR Interval	0.12 to 0.20 second and constant from beat to beat
QRS Duration	0.10 second or less

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### Sinus Rhythm



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### Sinus Bradycardia

- If the SA node discharges fewer than 60 beats/min, the rhythm is termed "sinus bradycardia"
  - The rhythm originates in the SA node and follows the normal pathway of conduction

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### Sinus Bradycardia – ECG Characteristics

Rate	Less than 60 beats/min
Rhythm	Regular
P Waves	Uniform in appearance, positive (upright) in lead II, one precedes each QRS complex
PR Interval	0.12 to 0.20 second and constant from beat to beat
QRS Duration	0.10 second or less

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### Sinus Bradycardia



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### Sinus Bradycardia – Causes

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

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### Sinus Bradycardia – Other Causes

- Disease of the SA node
- Increased vagal (parasympathetic) tone
- Hypoxia
- Hypothermia
- Anorexia nervosa
- Hypothyroidism
- Hyperkalemia
- Uremia
- Glaucoma
- Sleep apnea syndrome
- Effects of medications
  - Calcium channel blockers (verapamil, diltiazem)
  - Digitalis
  - Beta-blockers (propranolol)

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### Sinus Bradycardia – Clinical Significance

- Cardiac output = Stroke volume  $\times$  Heart rate
  - A decrease in either stroke volume or heart rate may result in a decrease in cardiac output
- Signs and symptoms of hemodynamic compromise:
  - Hypotension
  - Chest pain
  - Shortness of breath
  - Changes in mental status
  - Left ventricular failure
  - Fall in urine output
  - Cold, clammy skin

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### Sinus Bradycardia – Intervention

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

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### Sinus Tachycardia

- If the SA node discharges at a rate greater than 100 times/min, the rhythm is termed a "sinus tachycardia"
- Sinus tachycardia begins and ends gradually

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### Sinus Tachycardia – ECG Characteristics

Rate	101 to 160 beats/min
Rhythm	Regular
P Waves	Uniform in appearance, positive (upright) in lead II, one precedes each QRS complex; at very fast rates, it may be difficult to distinguish between a P wave and T wave
PR Interval	0.12 to 0.20 second and constant from beat to beat
QRS Duration	0.10 second or less

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### Sinus Tachycardia



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### Sinus Tachycardia – Causes

- Fever
- Pain
- Anxiety
- Hypoxia
- CHF
- Acute MI
- Infection
- Shock
- Hypovolemia
- Exercise
- Fright
- Dehydration
- Medications
  - Epinephrine
  - Atropine
  - Caffeine, nicotine
  - Cocaine

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### Sinus Tachycardia – Clinical Significance

- In the setting of acute MI, sinus tachycardia is a warning signal for heart failure, hypovolemia, and increased risk for serious dysrhythmias

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### Sinus Tachycardia – Intervention

- Directed at correcting the underlying cause

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### Sinus Arrhythmia

- Sinus arrhythmia occurs when the SA node discharges irregularly
  - Sinus arrhythmia associated with the phases of respiration and changes in intrathoracic pressure is called "respiratory sinus arrhythmia"
  - Sinus arrhythmia unrelated to the respiratory cycle is called "nonrespiratory sinus arrhythmia"

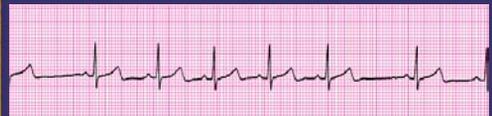
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### Sinus Arrhythmia – ECG Characteristics

Rate	Usually 60 to 100 beats/min, but may be slower or faster
Rhythm	Irregular, typically phasic with respiration; heart rate increases gradually during inspiration (R-R intervals shorten) and decreases with expiration (R-R intervals lengthen)
P Waves	Uniform in appearance, positive (upright) in lead II, one precedes each QRS complex
PR Interval	0.12 to 0.20 second and constant from beat to beat
QRS Duration	0.10 second or less

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### Sinus Arrhythmia



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### Sinus Arrhythmia – Causes

- Respiratory sinus arrhythmia
  - Associated with phases of respiration and changes in intrathoracic pressure
  - Most commonly observed in infants and children, but may be seen in any age group

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### Sinus Arrhythmia – Causes

- 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 due to the effects of medications such as digitalis and morphine
  - May be due to carotid sinus pressure

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### Sinus Arrhythmia – Intervention

- Does not usually require intervention unless accompanied by a bradycardia 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 – ECG Characteristics

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	Uniform in appearance, positive (upright) in lead II, one precedes each QRS complex
PR Interval	0.12 to 0.20 second and constant from beat to beat
QRS Duration	0.10 second or less

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### SA Block



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### SA Block – Causes

- 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 – Intervention

- None, 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

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

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### Sinus Arrest – ECG Characteristics

Rate	Usually normal but varies because of the pause
Rhythm	Irregular—the pause is of undetermined length (more than one PQRST complex is omitted) and is not the same distance as other P-P intervals
P Waves	Uniform in appearance, positive (upright) in lead II, one precedes each QRS complex
PR Interval	0.12 to 0.20 second and constant from beat to beat
QRS Duration	0.10 second or less

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### Sinus Arrest



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### Sinus Arrest – Causes

- 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 – Clinical Significance

- May be associated with signs of hemodynamic compromise:
  - Weakness
  - Lightheadedness
  - Dizziness
  - Syncope

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### SA Arrest – Intervention

- None, if episodes are transient and there are no significant signs or symptoms
- If hemodynamic compromise is present:
  - Possible atropine
  - Possible permanent pacemaker