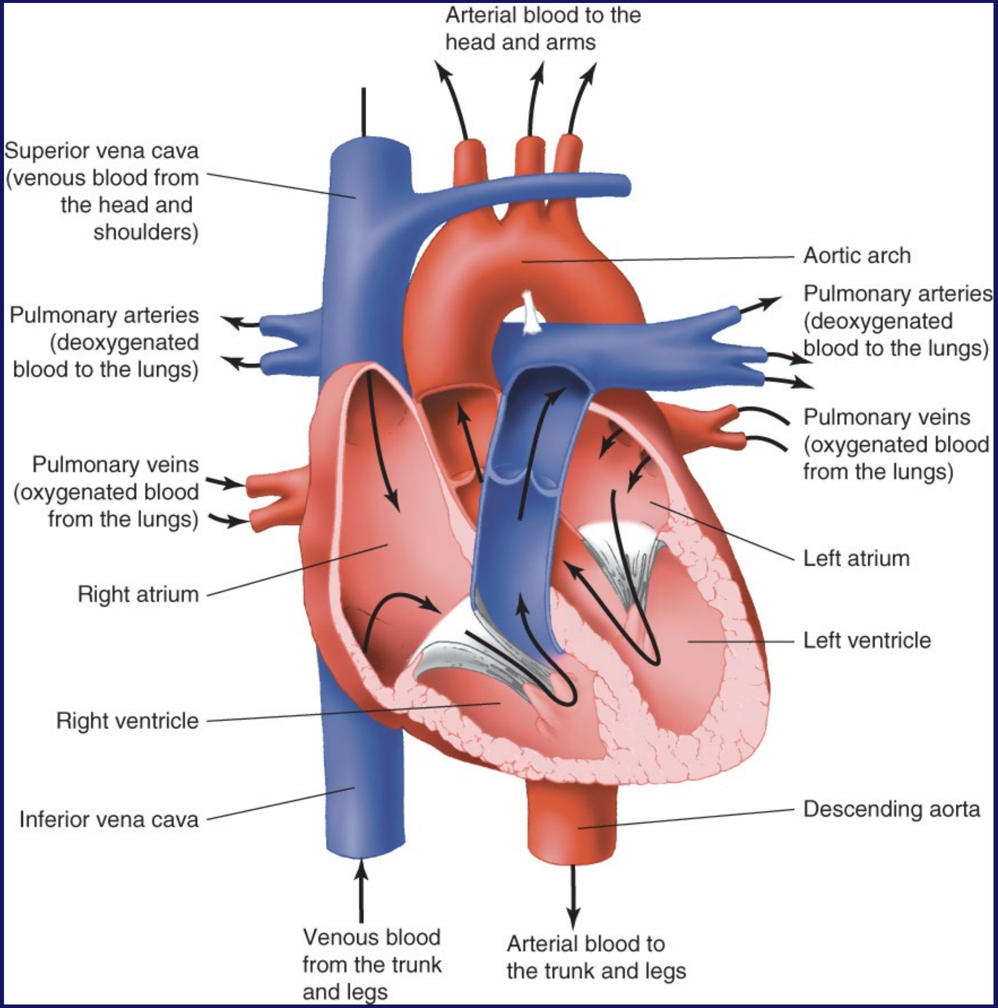
ECG Overview

Pea Ridge Fire Department EMS refresher

The Heart

- The heart has four chambers
  - Right atrium
  - Left atrium
  - Right ventricle
  - Left ventricle



The Heart

- Right atrium
  - Receives blood low in oxygen from the superior vena cava, inferior vena cava, and the coronary sinus
- Left atrium
  - Receives oxygenated blood from the lungs via the right and left pulmonary veins

The Heart

- Right ventricle
  - Pumps deoxygenated blood to the lungs
- Left ventricle
  - Pumps oxygenated blood throughout the body

The Heart

- The septa separate the heart into two functional pumps
  - Right heart: the right atrium and right ventricle
    - A low-pressure system (pulmonary circulation)
  - Left heart: the left atrium and left ventricle
    - A high-pressure system (systemic circulation)

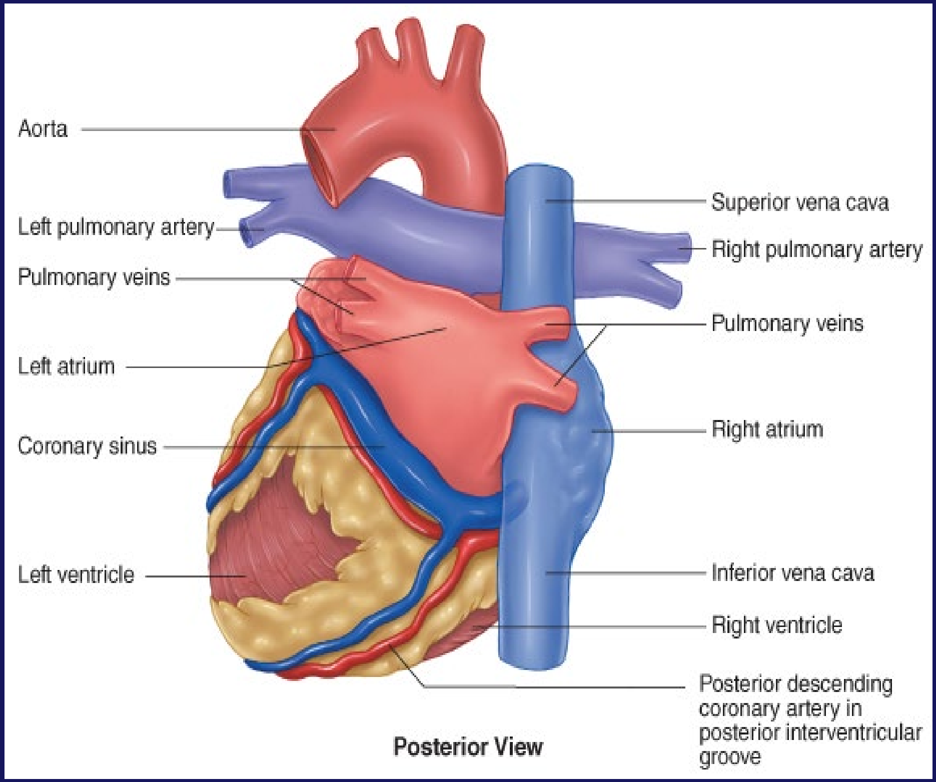
The Heart

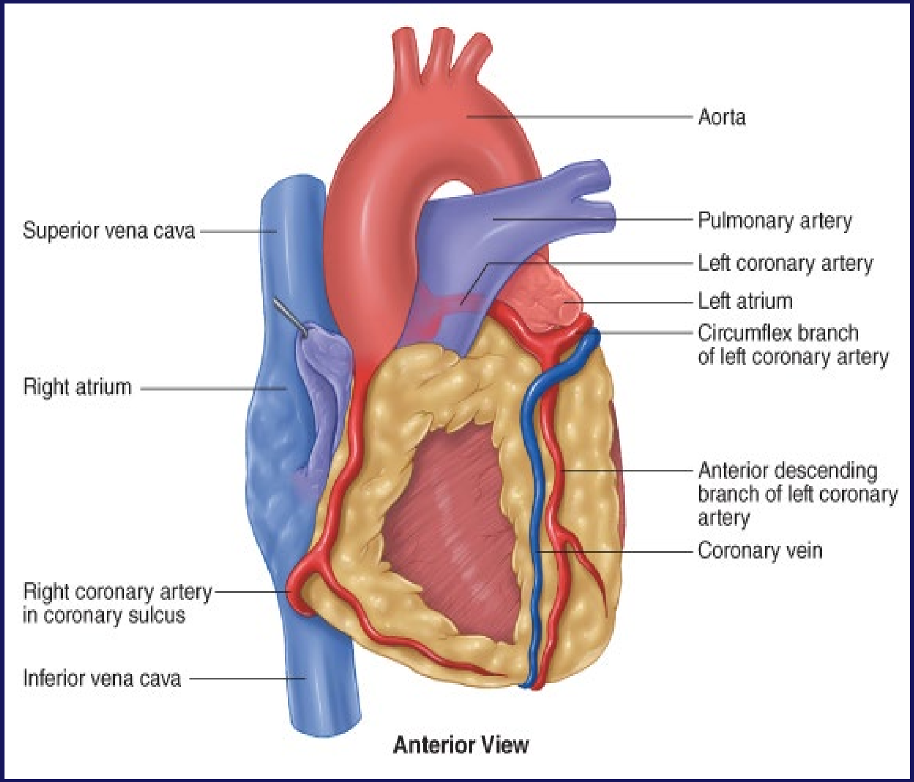
- The myocardium is the middle layer of the heart wall.
  - Composed of thick muscle tissue
  - Responsible for:
    - Cardiac contraction
    - Efficient ejection of blood from the heart

The Heart

- Coronary arteries
  - The left main coronary artery supplies:
    - Left ventricle
    - Interventricular septum
  - The right coronary artery (RCA) supplies:
    - Right atrium
    - Right ventricle
    - Part of the left ventricle
    - Portions of the conduction system

The Heart


Aorta
Left pulmonary artery
Pulmonary veins
Left atrium
Coronary sinus
Left ventricle
Superior vena cava
Right pulmonary artery
Pulmonary veins
Right atrium
Inferior vena cava
Right ventricle
Posterior descending coronary artery in posterior interventricular groove
Posterior View


Superior vena cava
Right atrium
Right coronary artery in coronary sulcus
Inferior vena cava
Aorta
Pulmonary artery
Left coronary artery
Left atrium
Circumflex branch of left coronary artery
Anterior descending branch of left coronary artery
Coronary vein
Anterior View

The Heart

- Cardiac cells have four properties that help the heart function:
  - Automaticity
  - Excitability
  - Conductivity
  - Contractility

The Heart

- The cardiac conduction system comprises six parts:
  - Sinoatrial (SA) node
  - Atrioventricular (AV) node
  - The bundle of His
  - Right and left bundle branches
  - The Purkinje fibers

The Heart

- Nerve stimulation
  - Stimulation of sympathetic nerves
    - Strengthens the force of contraction
    - Increases the heart rate

The Heart

- Nerve stimulation (cont'd)
  - Stimulation of parasympathetic nerves
    - Slows the rate of discharge of the SA node
    - Slows conduction through the AV node
    - Weakens the strength of atrial contraction
    - Can cause a small reduction in the force of ventricular contraction

Electrophysiology

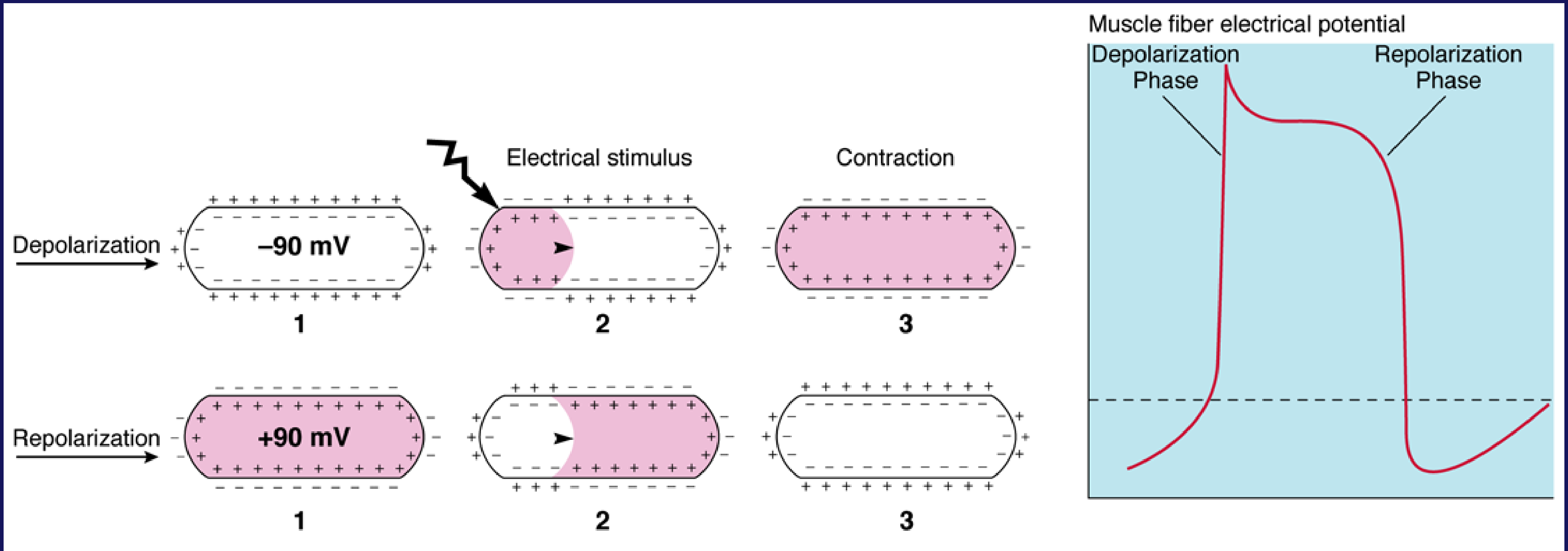
- Depolarization: Muscle fibers are stimulated to contract.
  - Occurs through changes in concentration of electrolytes across cell membranes

Electrophysiology

- Depolarization (cont'd)
  - The cell receives stimulus from conduction.
    - The permeability of the cell wall changes to allow sodium ions in.
    - Calcium ions also enter.
  - Depolarization spreads, causing a mechanical contraction.

Electrophysiology

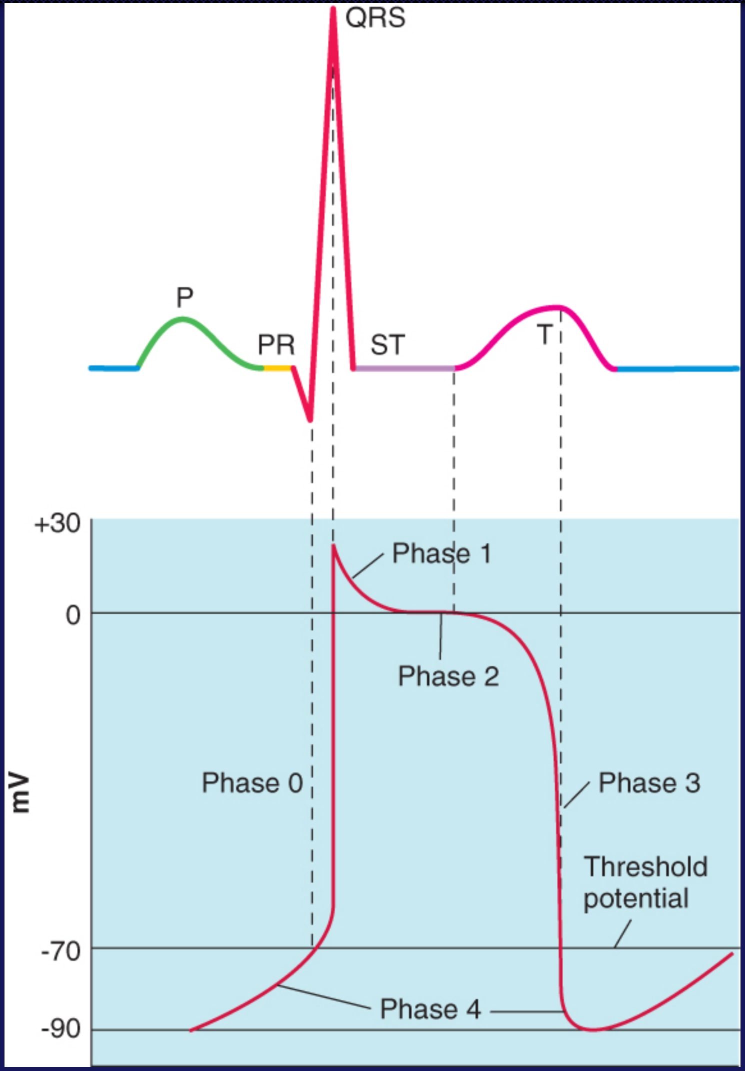
- Repolarization begins with the closing of sodium and calcium channels.
  - Sodium ions pumped out and potassium ions pumped in



Cardiac Action Potential

- Divided into five phases
  - Phase 0: Cell depolarizes and begins to contract.
  - Phase 1: Cell begins to repolarize.
  - Phase 2: Na^+ and Ca^{++} enter the cell; K^+ flows out.
  - Phase 3: Final phase of repolarization.
  - Phase 4: Resting phase.

Cardiac Action Potential



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Refractory Periods

- Periods in which the cell is depolarized or in the process or repolarizing
  - Absolute refractory period
  - Relative refractory period

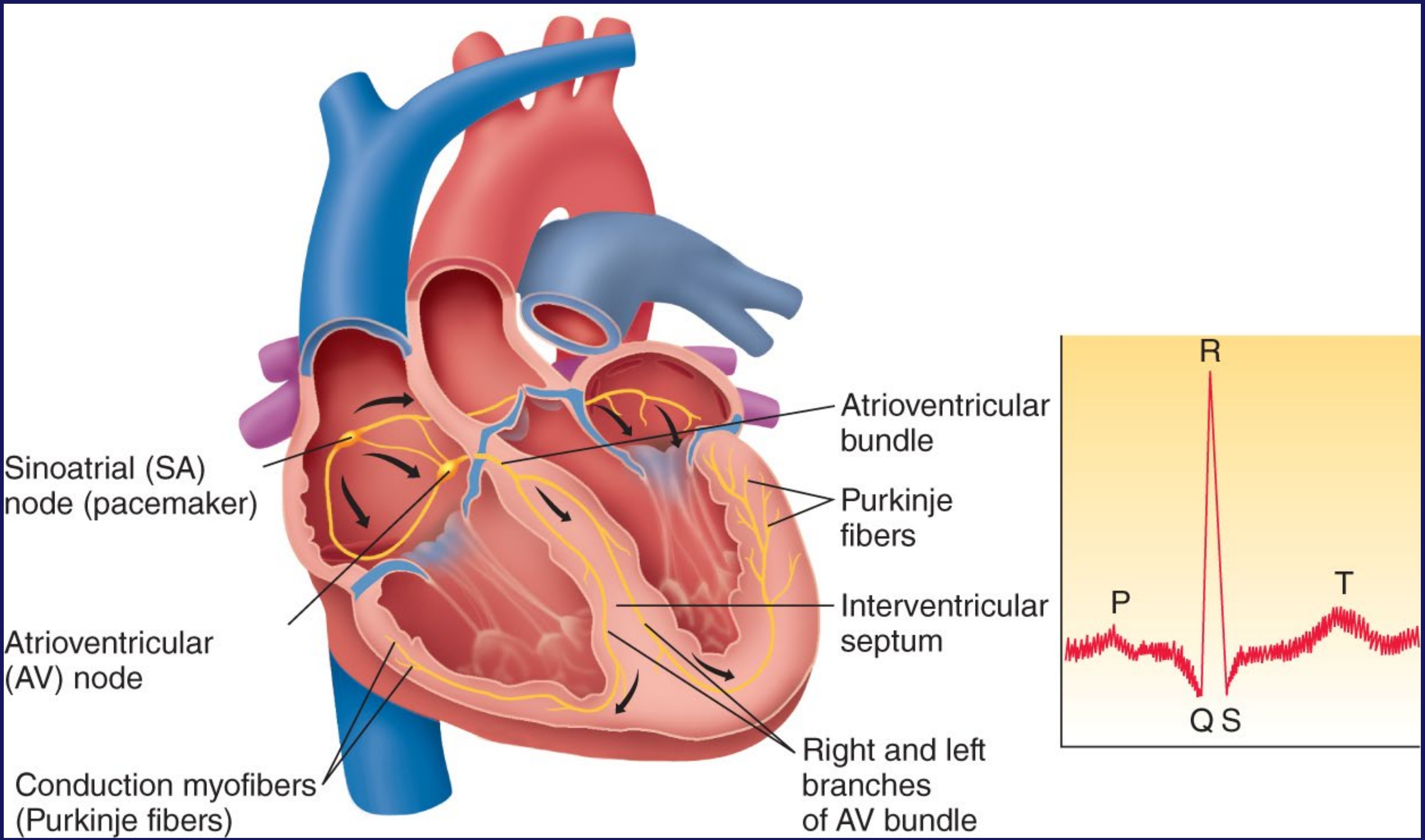
The Electrical Conduction System

- Specialized conduction tissue propagates electrical impulses to the muscular tissue.
- SA node
  - Located in the right atrium
  - Receives blood from the RCA
  - Dominant pacemaker
    - Impulses are spread through internodal pathways, causing contraction.

The Electrical Conduction System

- AV node:
  - Electrical impulses move from the SA node to the AV node.
    - Impulse conduction is delayed so the atria will empty into the ventricles.

The Electrical Conduction System



The Electrical Conduction System

- AV node (cont'd):
  - If the atrial rate becomes rapid, not all impulses go through the AV junction.
  - Impulses then normally pass into the:
    - Bundle of His
    - Right and left bundle branches
    - Purkinje fibers

The Electrical Conduction System

- Secondary pacemakers
  - Any conduction system component can act as a secondary pacemaker if the SA node is damaged.

Table 17-2 **Pacemaker Intrinsic Rates**

Pacemaker	Rate (beats/min)
SA node	60–100
AV junction	40–60
Purkinje network	20–40

Abbreviations: SA, sinoatrial; AV, atrioventricular

The Electrical Conduction System

- Conduction pathways that allow current to bypass AV node:
  - The James fibers are in the internodal pathways.
  - The Mahaim fibers extend into the ventricles.
  - The Bundle of Kent enables early depolarization of ventricular tissue.

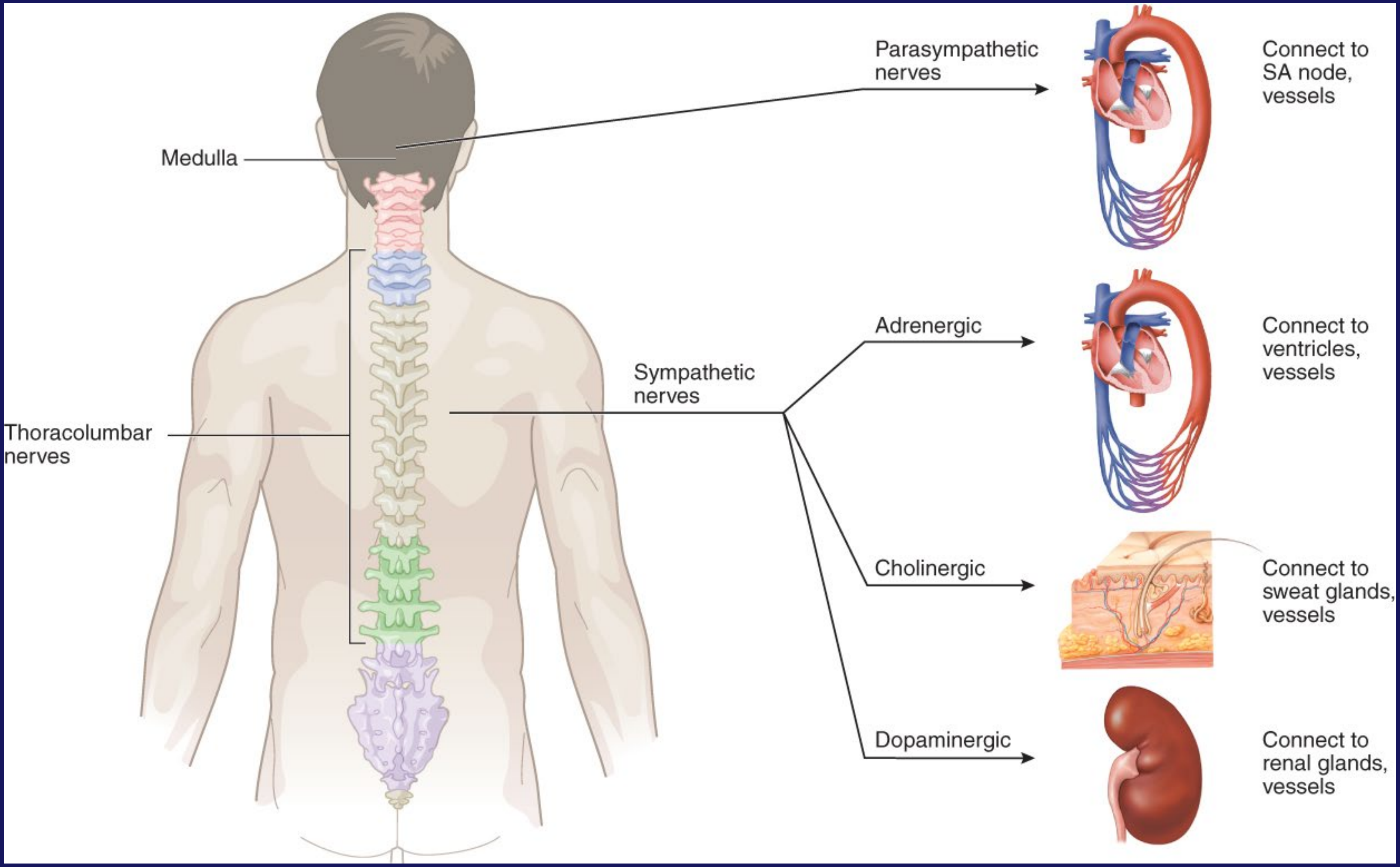
The Autonomic Nervous System and the Heart

- Both the sympathetic and parasympathetic divisions of the autonomic nervous system affect the heart.

The Autonomic Nervous System and the Heart

- Sympathetic nervous system
  - Adapts to changing demands
    - Increases heart rate
    - Adaptive responses to increase cardiac output (CO)

The Autonomic Nervous System and the Heart



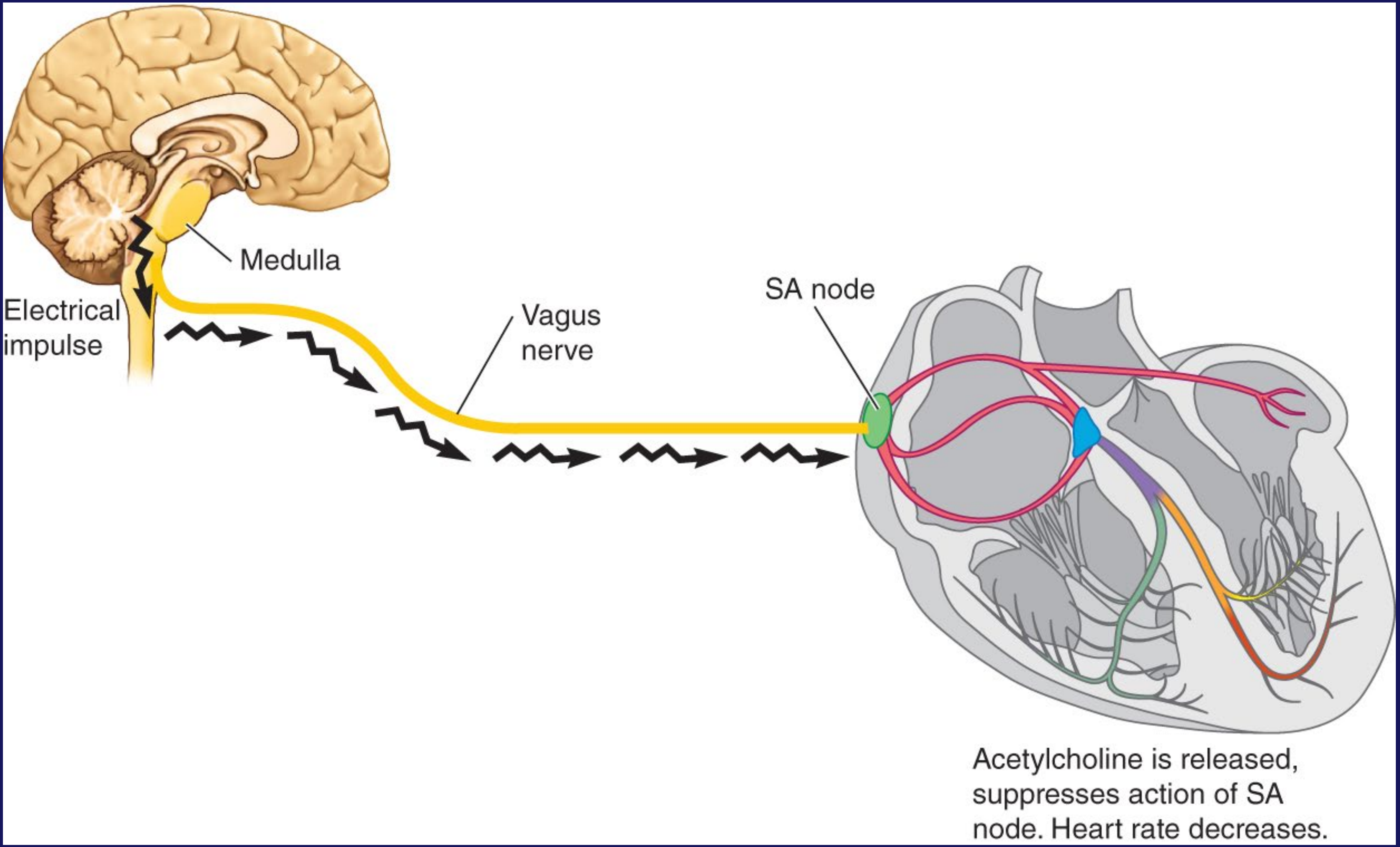
The Autonomic Nervous System and the Heart

- Parasympathetic nervous system
  - Sends messages through the vagus nerve, which can be stimulated by:
    - Pressure on the carotid sinus
    - Straining against a closed glottis (Valsalva maneuver)
    - Distention of a hollow organ

The Autonomic Nervous System and the Heart

- Parasympathetic nervous system (cont'd)
  - If the brain senses the heart should slow its pace:
    - The electrical impulse travels to the SA node.
    - This causes release of acetylcholine (ACh).
    - The ACh signals the SA node to slow the heart.
    - Another ACh molecule travels to the AV node of the heart as a reminder.

The Autonomic Nervous System and the Heart



The Autonomic Nervous System and the Heart

- Baroreceptors
  - Sensors composed of specialized nerve tissue
    - Baroreceptors detect changes in blood pressure.
    - When stimulated, they generate a reflex response in either the sympathetic or parasympathetic division of the ANS.

The Autonomic Nervous System and the Heart

- Chemoreceptors
  - Detect changes in the concentration of hydrogen ions (pH), oxygen, and carbon dioxide in the blood

Causes of Cardiac Dysrhythmia

- Cardiac dysrhythmia
  - Evaluate in context with overall condition

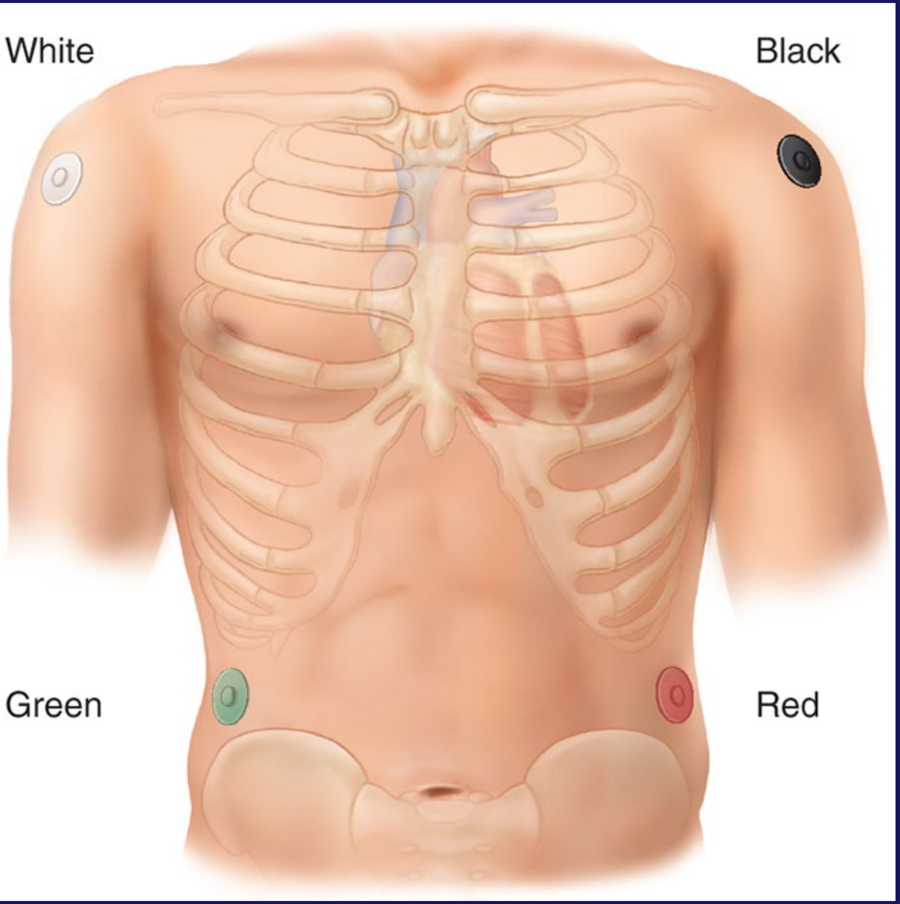
Table 17-3	Causes of Cardiac Dysrhythmias
Acid-base disturbance	
ANS imbalance	
Central nervous system damage	
Certain poisons (eg, organophosphate insecticides)	
Cor pulmonale (right ventricular failure caused by pulmonary disease)	
Distention of cardiac chambers (as in heart failure)	
Drug effects (phenothiazines, tricyclic antidepressants, and drugs used to treat dysrhythmias)	
Electrolyte disturbances, especially those involving potassium, calcium, or magnesium	
Endocrine disorders (hyperthyroidism, hypothyroidism)	
Hypothermia	
Hypoxemia from any cause	
Increased sympathetic output	
Increased vagal (parasympathetic) tone	
Myocardial ischemia or infarction	
Normal variation	
Rheumatic heart disease	
Trauma (eg, cardiac contusion)	

The Electrocardiogram

- Three standard limb leads:
  - Lead I
  - Lead II
  - Lead III
- Provides detailed information about the heart's conduction system

Electrode Placement

- Predetermined spots
- Usually adhesive with gel center



Electrode Placement

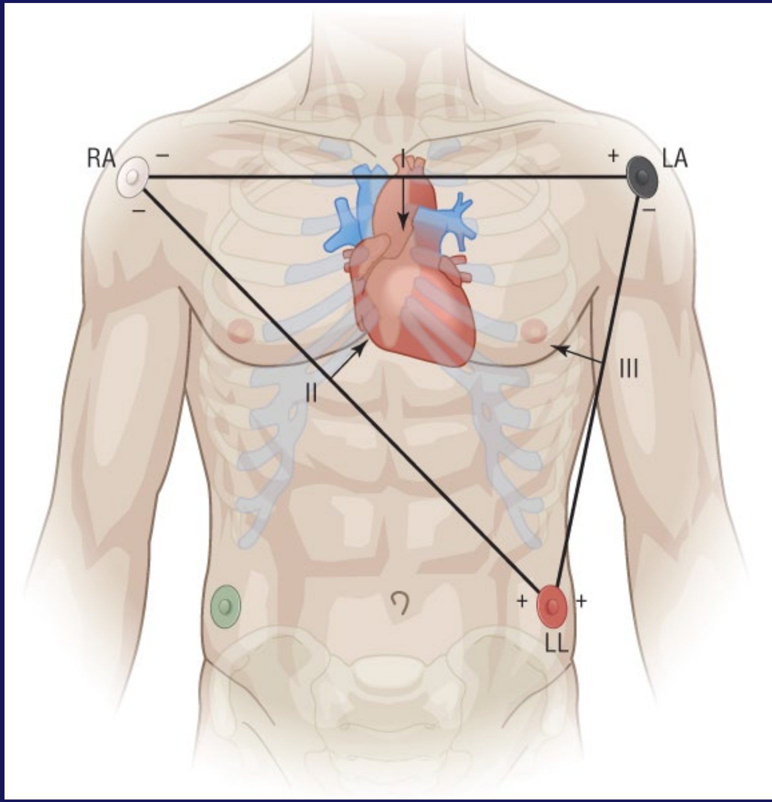
- Basic principles:
  - Shave body hair, if necessary.
  - Rub the site briskly with a dry gauze pad.
  - Attach the electrodes to the ECG cables before placement and confirm correct location.
  - Turn on the monitor and print a sample strip.

The Leads

- Two main groups:
  - Limb leads
    - I, II, III, aVR, aVL, and aVF
  - Precordial leads (chest leads)
    - V_1 to V_6

The Leads

- Limb leads
  - Einthoven's theory: Every time the heart contracts, electrical energy is emitted.
    - Lead I—attached to right and left arms
    - Lead II—runs between right arm and left leg
    - Lead III—runs between left arm and left leg



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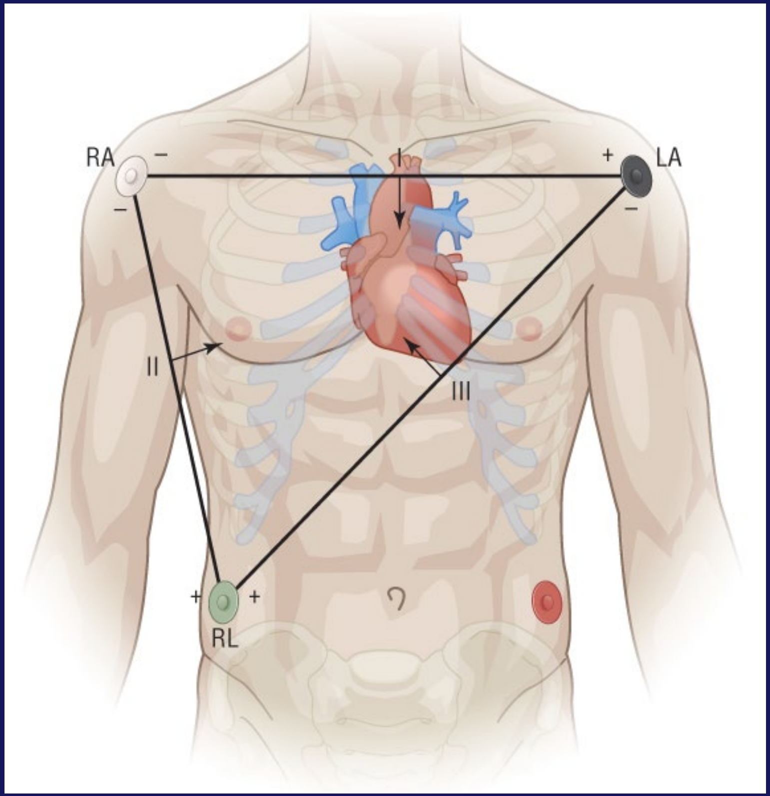
The Leads

- Limb leads (cont'd)
  - Leads I, II, and III are bipolar leads.
    - Contain a positive and negative pole
    - Measure the difference in electrical potential



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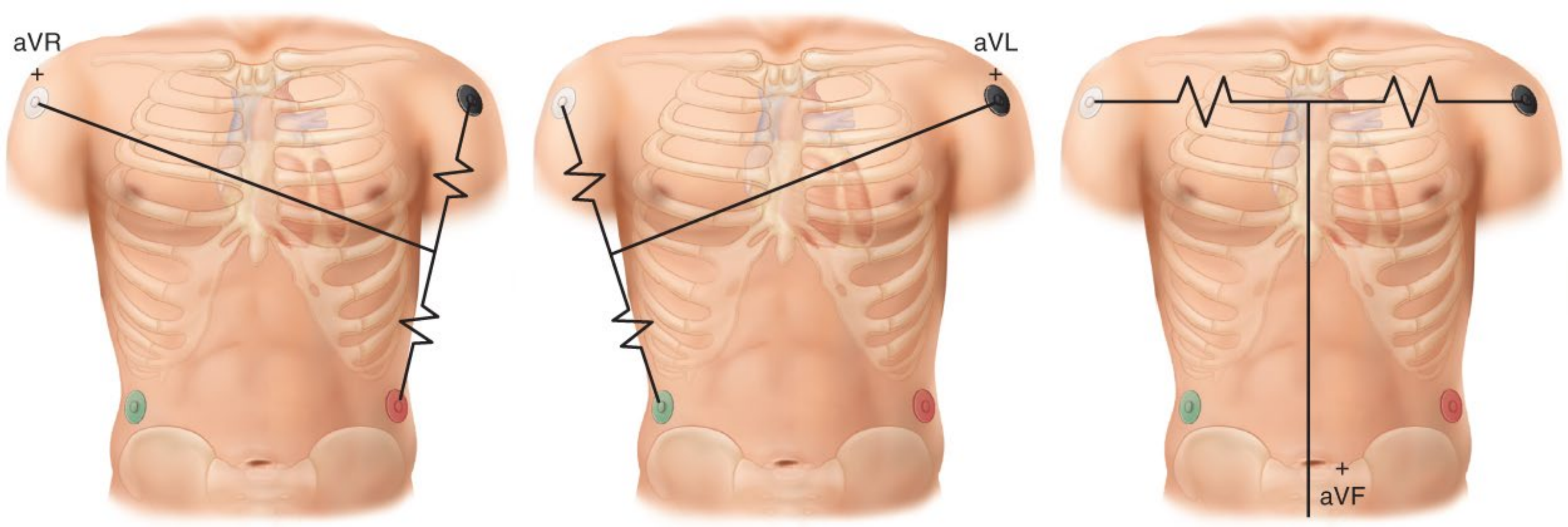
The Leads

- Limb leads (cont'd)
  - Augmented voltage (aV) leads are created using four limb electrodes
    - Leads aVR, aVL, and aVF: combine two limb leads and use the other lead as the other pole.



The Leads

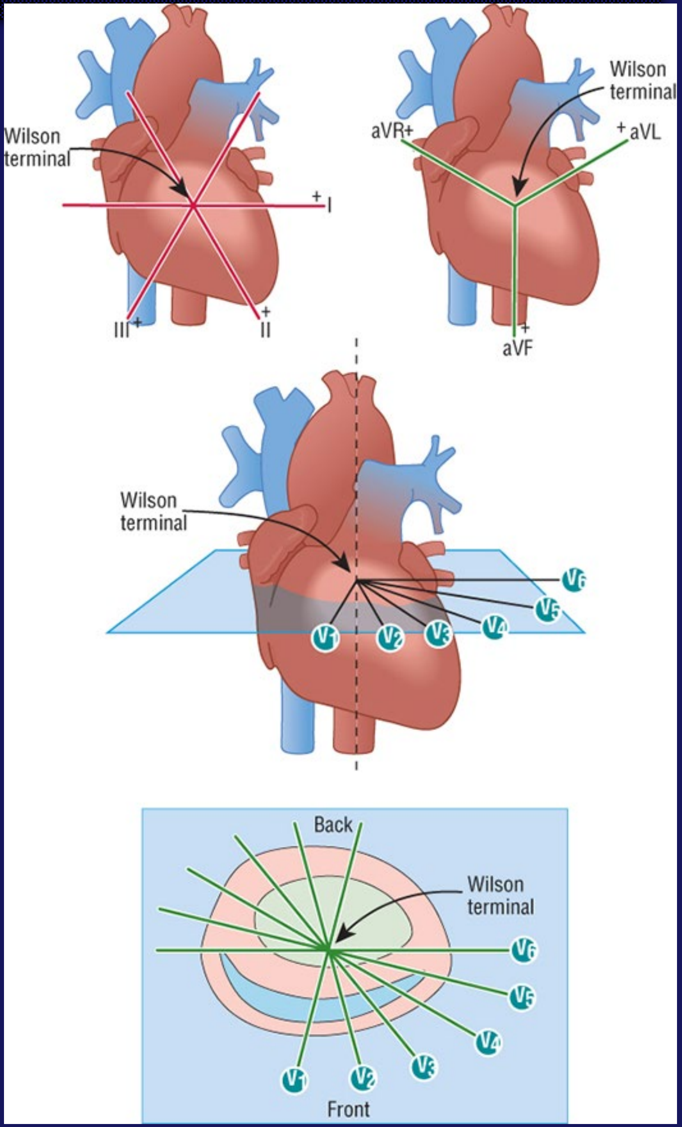
- Limb leads (I, II, III, and aVR, aVL, aVF)
  - For continuous monitoring:
    - White—right upper chest near shoulder
    - Black—left upper chest near shoulder
    - Red—left lower abdomen
    - Green—right lower abdomen

The Leads

- Limb leads (cont'd)
  - For 12-lead ECG:
    - White—right wrist
    - Black—left wrist
    - Red—left ankle
    - Green—right ankle

The Leads

- Precordial leads
  - V1 to V6
  - Unipolar, referenced against a calculated point: the Wilson central terminal



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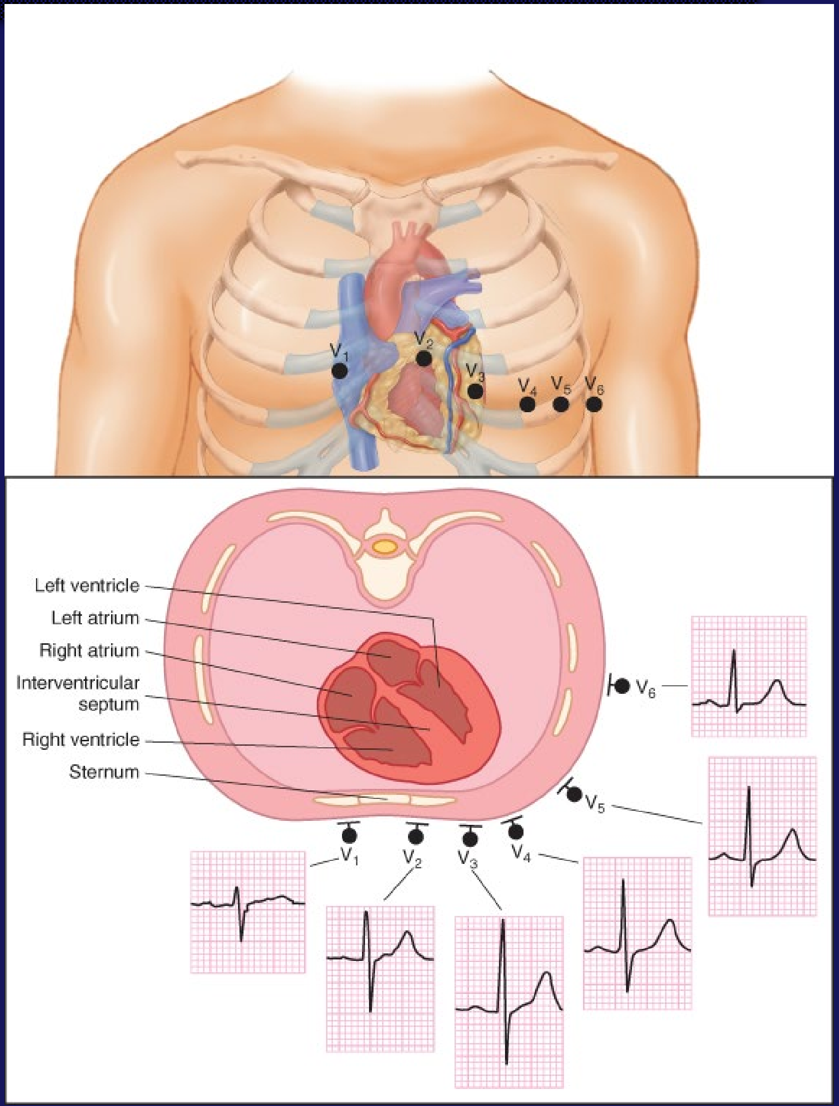
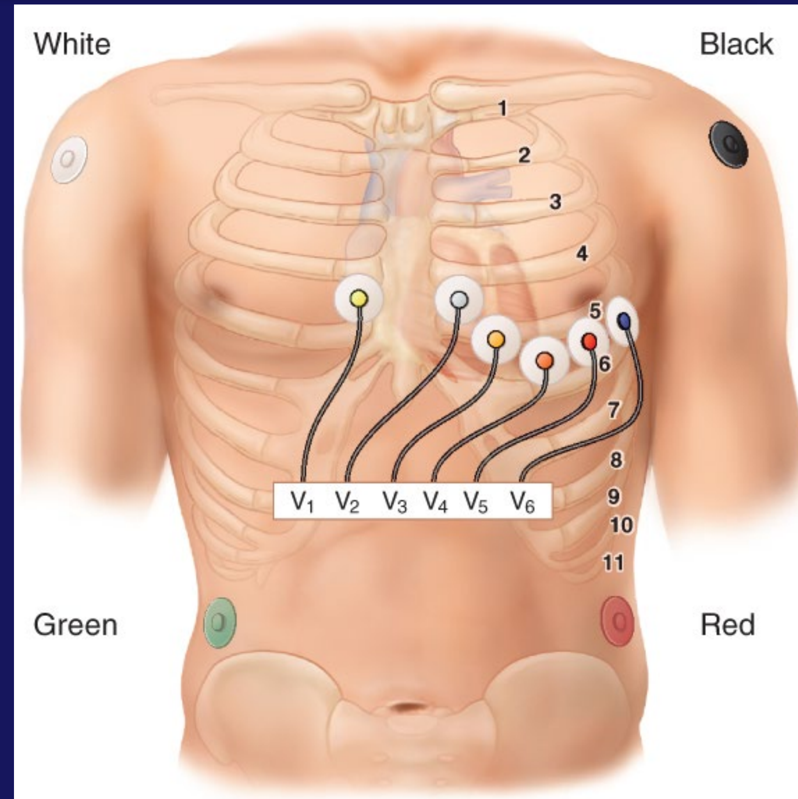
The Leads

- Precordial leads (cont'd)
  - Depict the heart in the horizontal plane



The Leads

- Precordial electrodes must be placed correctly and consistently.



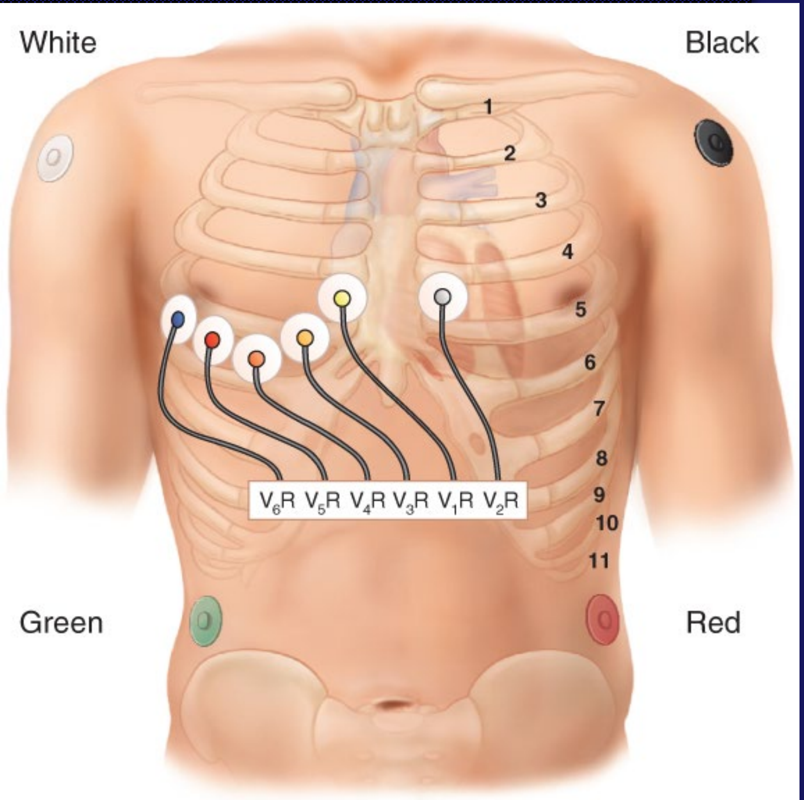
Lead	Location	View
V_1	4th intercostal space, right sternal border	Ventricular septum
V_2	4th intercostal space, left sternal border	Ventricular septum
V_3	Between V_2 and V_4	Anterior wall of left ventricle
V_4	5th intercostal space, midclavicular line	Anterior wall of left ventricle
V_5	Lateral to V_4 at the anterior axillary line	Lateral wall of left ventricle
V_6	Lateral to V_5 at the midaxillary line	Lateral wall of left ventricle

The Leads

- Contiguous leads
  - Leads that view geographically similar areas of the myocardium

The Leads

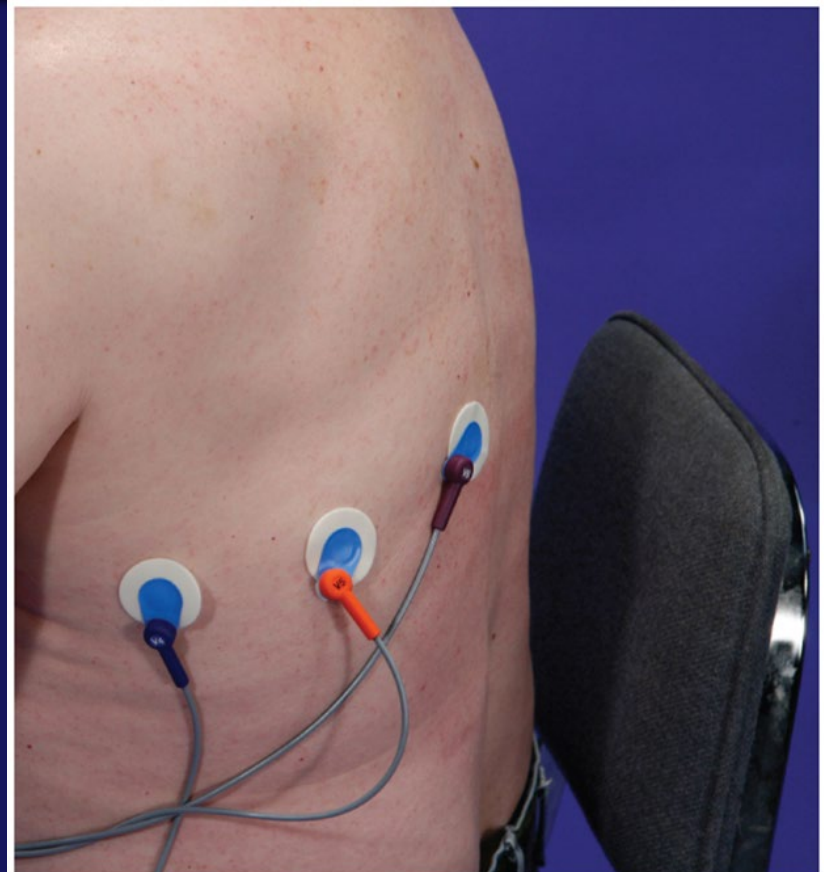
- Right-sided leads
  - Used to evaluate the electrical activity of the right ventricle
  - Precordial leads are placed on the right anterior thorax



Lead	Location	View
V_1R	Left of sternum, 4th intercostal space (ICS)	Ventricular septum
V_2R	Right of sternum, 4th ICS	Ventricular septum
V_3R	Precisely between V_2 and V_4	Right ventricle
V_4R	Right midclavicular, 5th ICS	Right ventricle
V_5R	Precisely between V_4 and V_6	Right ventricle
V_6R	Right midaxillary, 5th ICS	Right ventricle

The Leads

- Posterior leads
  - Evaluate left ventricle posterior wall electrical activity
  - Three precordial leads placed on left posterior thorax



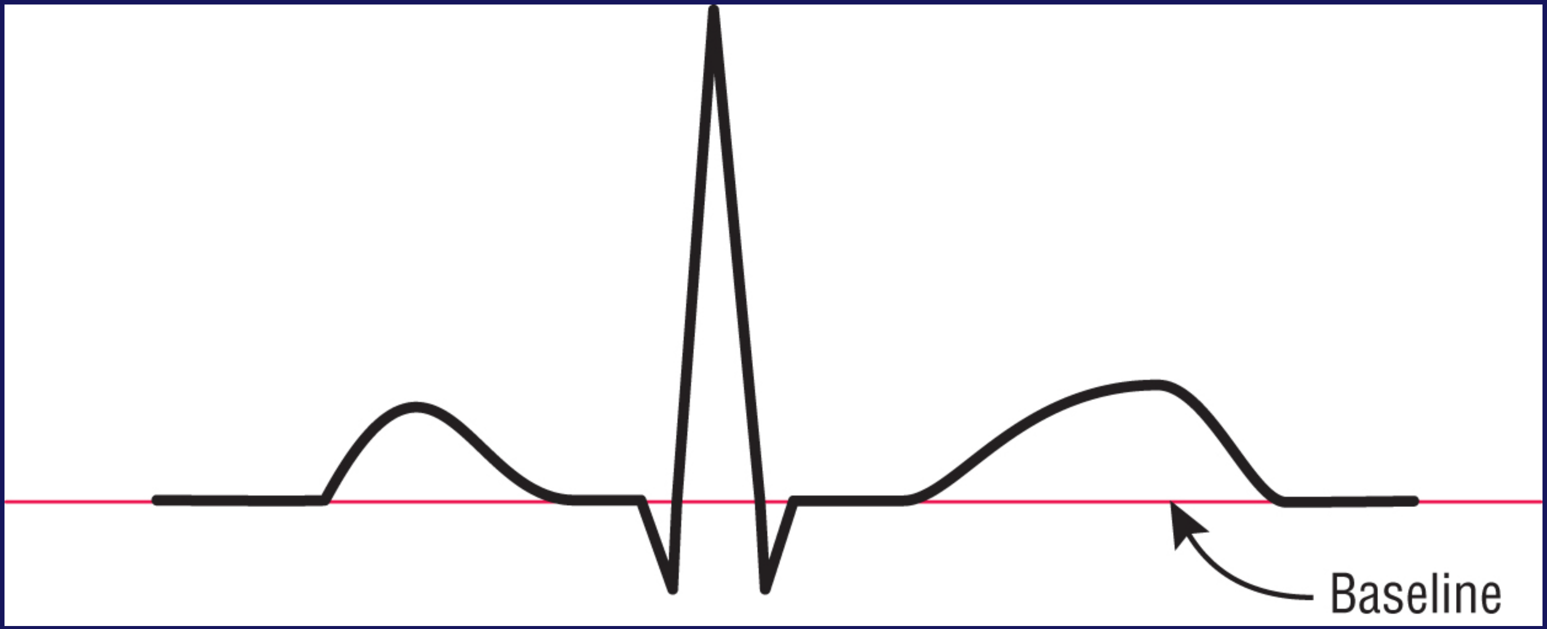
Lead	Location	View
V_7	Between V_6 and V_8, 5th intercostal space	Posterior wall of left ventricle
V_8	Midscapular, 5th intercostal space	Posterior wall of left ventricle
V_9	Just to the left of the spine, 5th intercostal space	Posterior wall of left ventricle

The Leads

- 15-lead ECG: standard 12-lead ECG plus leads V_4R, V_7, and V_8
  - Allows view of right ventricle and posterior wall of left ventricle
- 18-lead ECG: standard tracing plus leads V_4R through V_6R and V_7 through V_9

ECG Concepts

- ECG baseline represents electrical silence in the myocardium.
  - Generally a flat, straight, horizontal line



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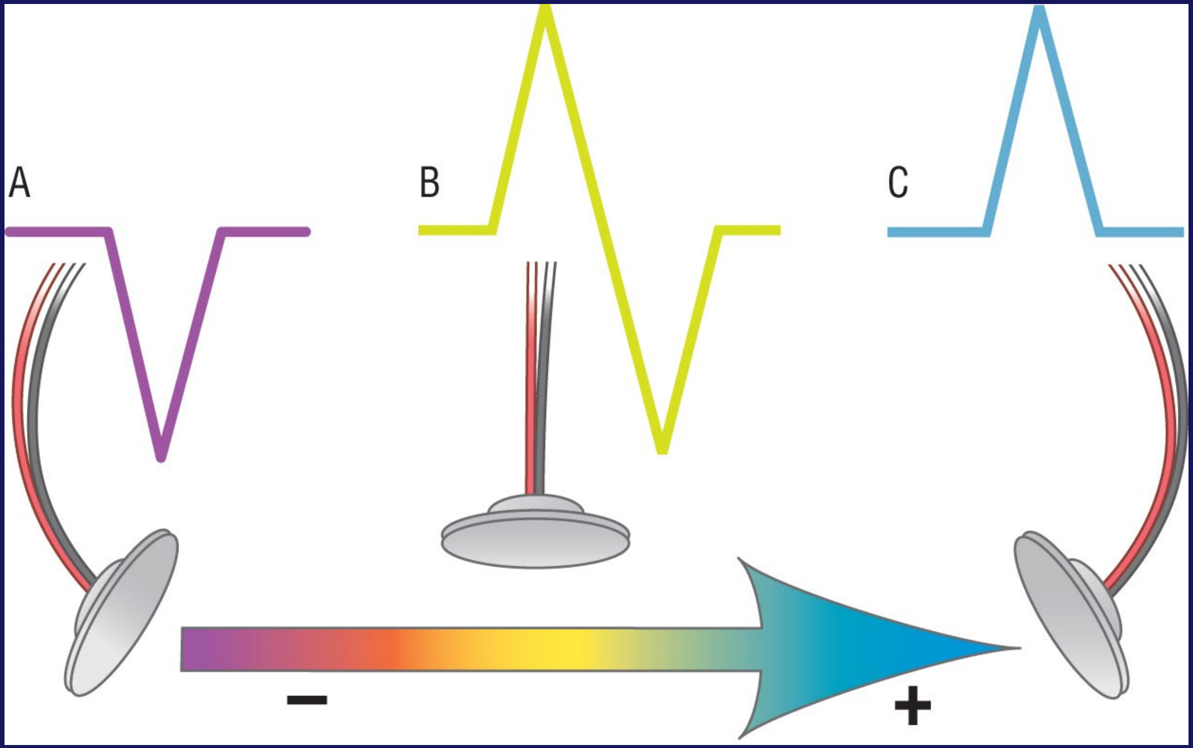
ECG Concepts

- Electrical impulse moving toward a positive electrode produces a deflection above baseline
- Electrical impulse moving toward a negative electrode produces a deflection below baseline

ECG Concepts

- Biphasic waves: waveforms with positive and negative components



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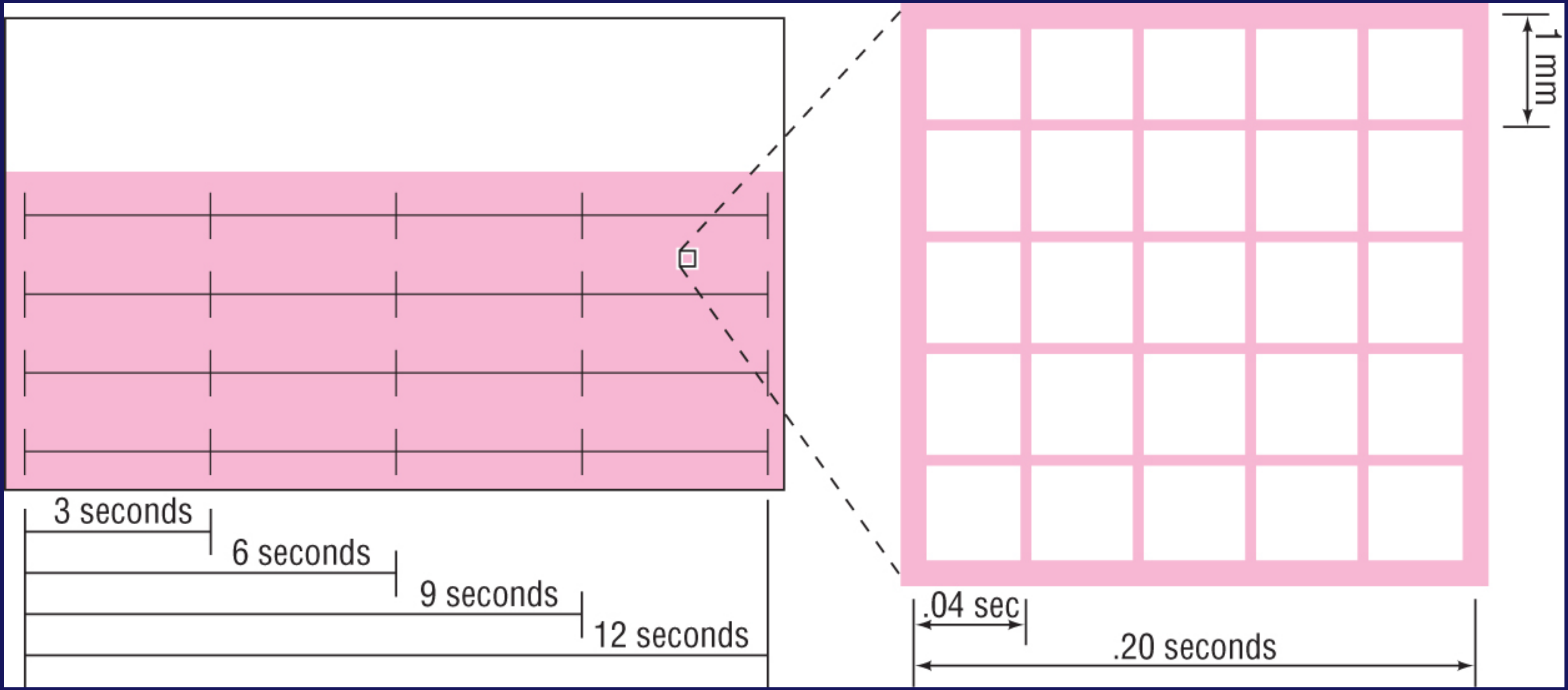
ECG Paper

- Graph paper moves past stylus at 25 mm/s
  - One 1-mm box — 0.04 second
  - One large box — 0.20 second
  - Vertical axis — amplitude
    - Standard amplitude calibration — 10 mm/mV

ECG Paper



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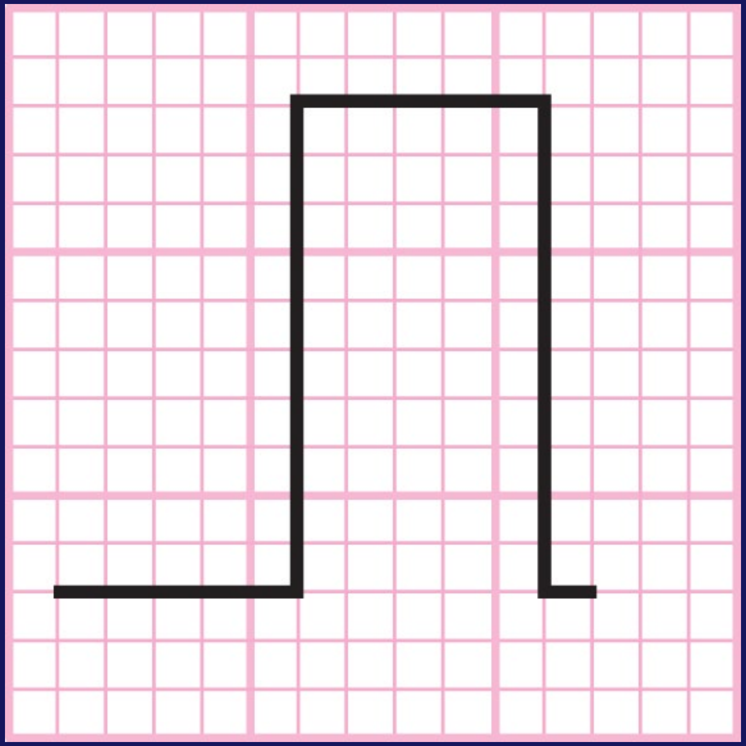
ECG Paper

- A calibration box printed at the beginning of all 12-lead ECGs informs the paramedic about:
  - Paper speed
  - Amplitude



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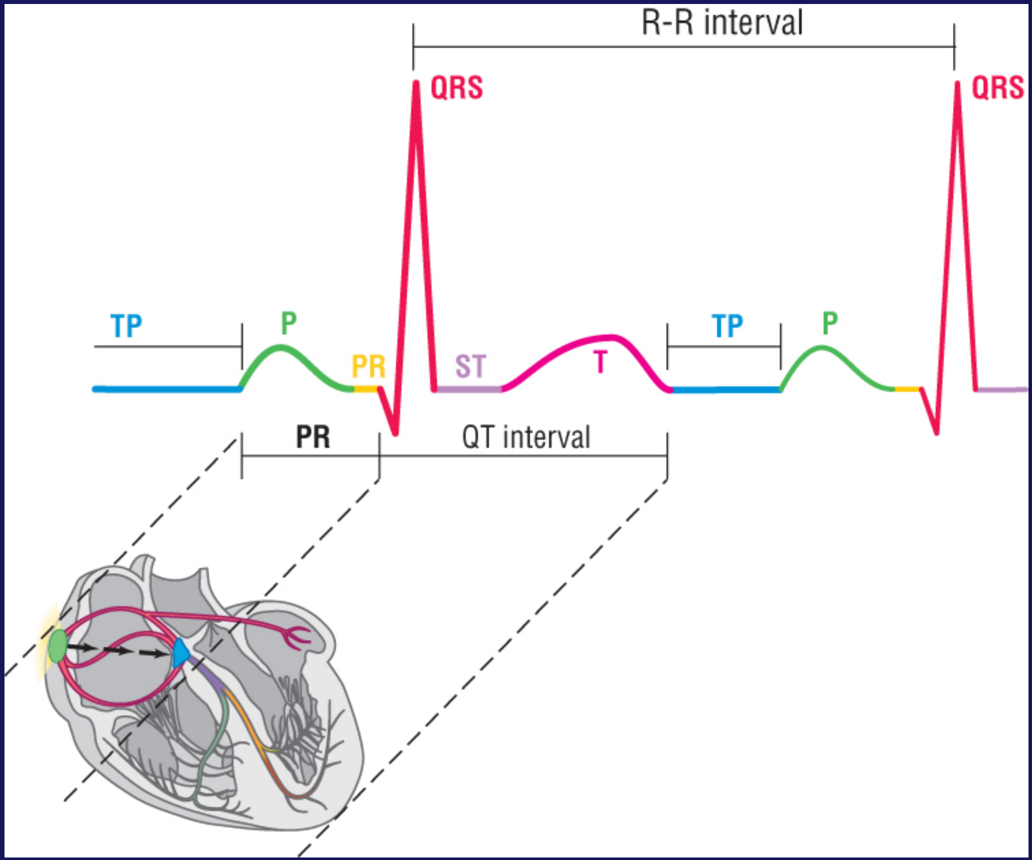
ECG Components

- The ECG components correspond to electrical events in the heart.



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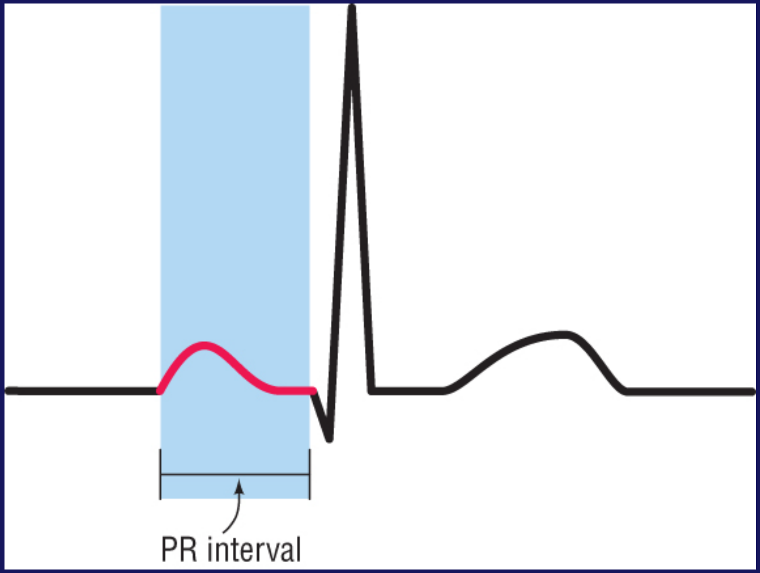
ECG Components

- P wave: represents atrial depolarization
  - Smooth, round, upright shape
  - Normal duration of less than 0.11 seconds
  - Amplitude less than 2.5 mm tall

ECG Components

- PR interval (PRI):
  - Represents the time required for an impulse to traverse the atria and AV junction
  - Normal duration of 0.12 to 0.20 seconds



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ECG Components

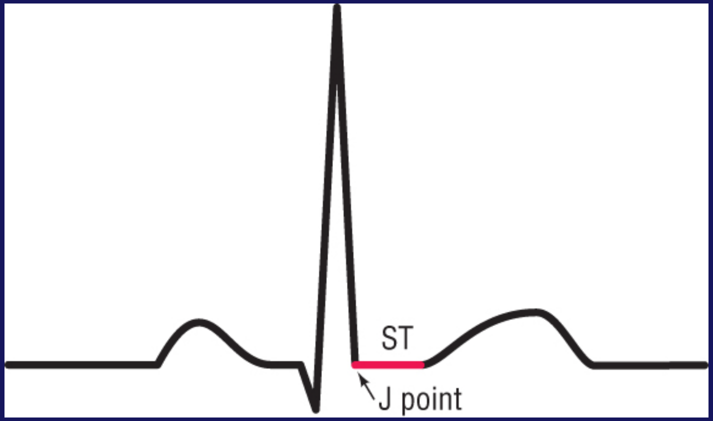
- QRS complex: three waveforms representing ventricular depolarization
  - From beginning of Q wave to end of S wave
  - Narrow in healthy people, less than 0.11 seconds
  - Indicates that impulse has proceeded normally

ECG Components

- QRS complex (cont’d)
  - Q wave: First negative deflection
  - R wave: First upward deflection
  - S wave: Downward deflection after the R wave

ECG Components

- J point: where QRS complex ends and ST segment begins
  - End of depolarization and beginning of repolarization
- ST segment: begins at J point and ends at T wave



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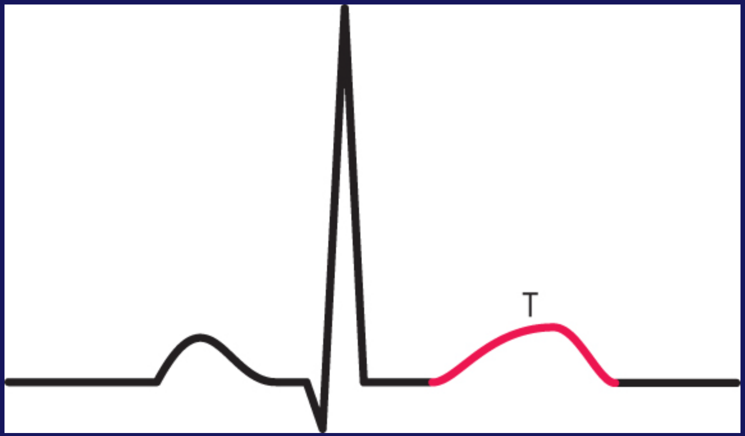
ECG Components

- T wave: represents ventricular repolarization
  - Should be asymmetric
  - Less than half overall QRS complex height
  - Oriented in same direction as QRS complex



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ECG Components

- T wave (cont’d)
  - Very large: may indicate myocardial ischemia, injury, and infarction
  - Tall, pointed (peaked): may indicate hyperkalemia
  - Deeply inverted: acute CNS events

ECG Components

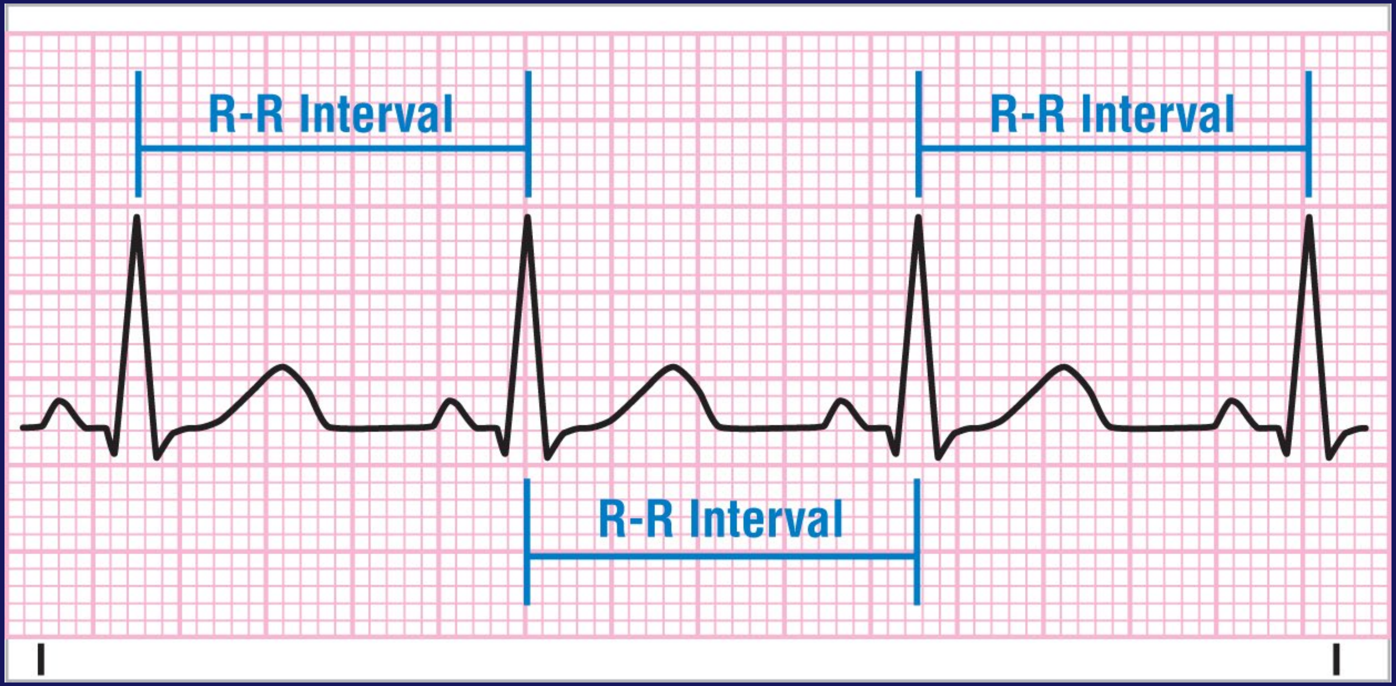
- QT interval: represents all electrical activity of one completed ventricular cycle
  - Begins at the onset of the Q wave.
  - Ends at the T wave.
  - Normally lasts 390 to 460 ms.
  - Long QT intervals can lead to ventricular dysrhythmias and sudden cardiac arrest.

Approach to Dysrhythmia Interpretation

- Method to interpret dysrhythmias:
  - Identify the waves (P-QRS-T).
  - Measure the PRI.
  - Measure the QRS duration.
  - Determine rhythm regularity.
  - Measure the heart rate.

Rhythm Regularity

- Measure the distance between R waves
  - Regular: the distance between R waves is the same



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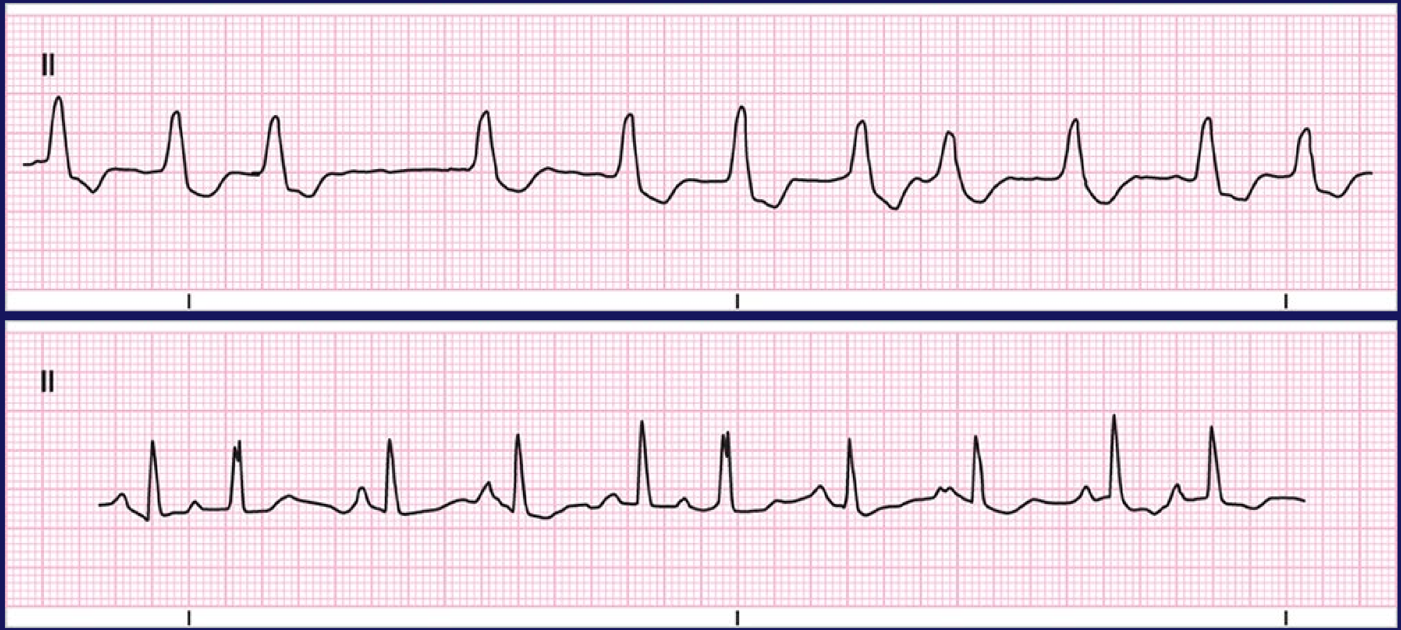
Rhythm Regularity

- Measure distance between R waves (cont'd)
  - Irregularly irregular: no two R waves equal
  - Regularly irregular: R waves irregular but follow a pattern



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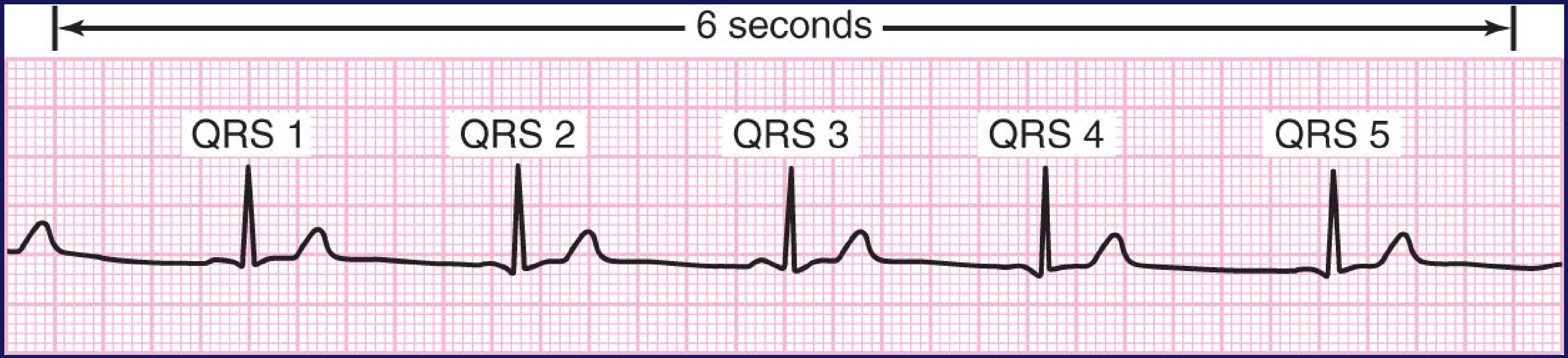
Determining Heart Rate

- 6-second method
  - Count the number of QRS complexes in a 6-second strip and multiply by 10.



Determining Heart Rate

- Sequence method
  - Find R wave; count off above sequence until next R wave.
    - If the interval spans fewer than three boxes, the rate is greater than 100.
    - If it is more than five boxes, the rate is less than 60.

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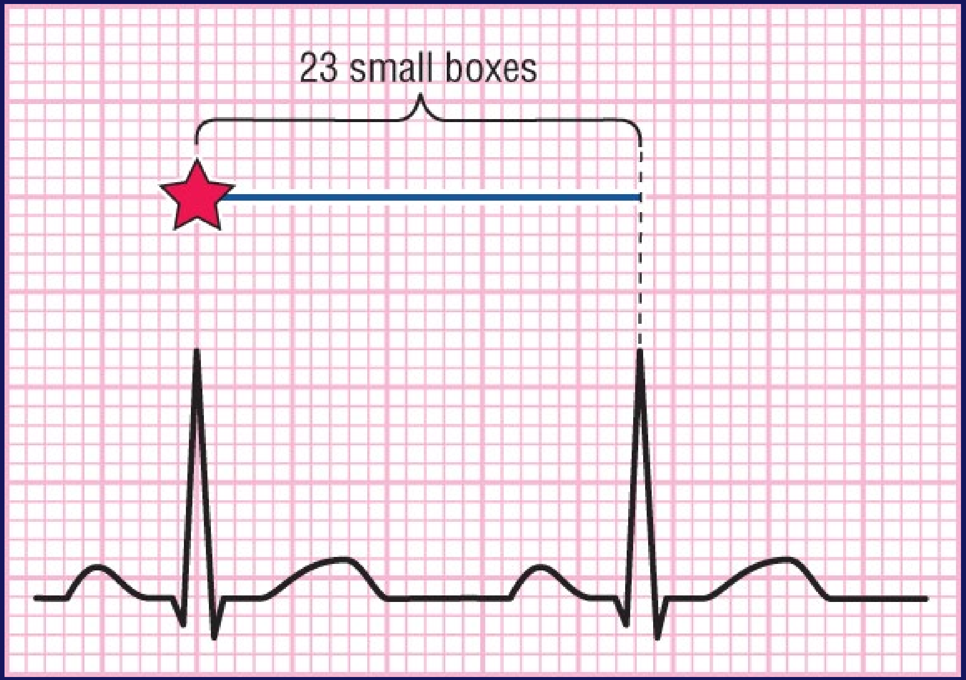
Determining Heart Rate

- 1,500 method
  - Count the number of small boxes between any two QRS complexes.
    - Divide by 1,500



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Specific Cardiac Dysrhythmias

- Dysrhythmia classifications
  - Disturbances of automaticity or conduction
  - Tachydysrhythmias or bradydysrhythmias
  - Life threatening or non–life threatening
  - By site from which they arise

Rhythms Originating in SA Node

- Normal sinus rhythm
  - Intrinsic rate of 60 to 100 beats/min
  - Upright P wave preceding each QRS complex

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Rhythms Originating in SA Node

- Sinus bradycardia
  - Rate of less than 60 beats/min
  - Upright P wave preceding every QRS complex

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Rhythms Originating in SA Node

- Sinus bradycardia (cont'd)
  - Can cause:
    - Altered mental status
    - Ischemic chest discomfort
    - Acute heart failure
    - Hypotension
  - Treatment indicated when signs/symptoms persist despite adequate airway and breathing

Artificial Pacemakers

- TCPs (cont'd)
  - Use in the following situations
    - Patient with a bradydysrhythmia that severely reduces CO and does not respond to atropine
    - Patient who requires interhospital transfer for pacemaker implantation
    - Symptomatic patient with artificial pacemaker failure

Rhythms Originating in SA Node

- Sinus tachycardia
  - The rate is more than 101 to 180 beats/min.
  - Upright P waves precede QRS complexes.

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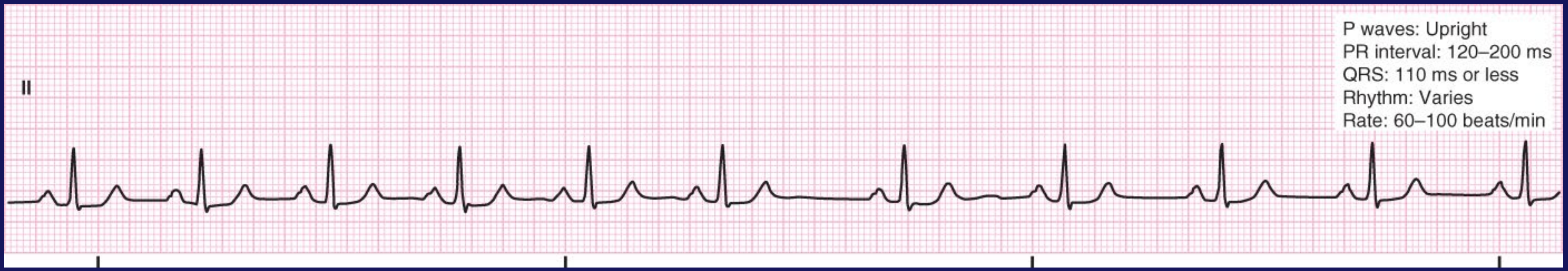
Rhythms Originating in SA Node

- Sinus tachycardia (cont'd)
  - Hypoxia, metabolic alkalosis, hypokalemia, and hypocalcemia can lead to electrical instability.
  - Treatment is related to the underlying cause.

Rhythms Originating in SA Node

- Sinus dysrhythmia
  - There is a slight variation in sinus rhythm cycling.
  - Upright P waves precede the QRS complexes.



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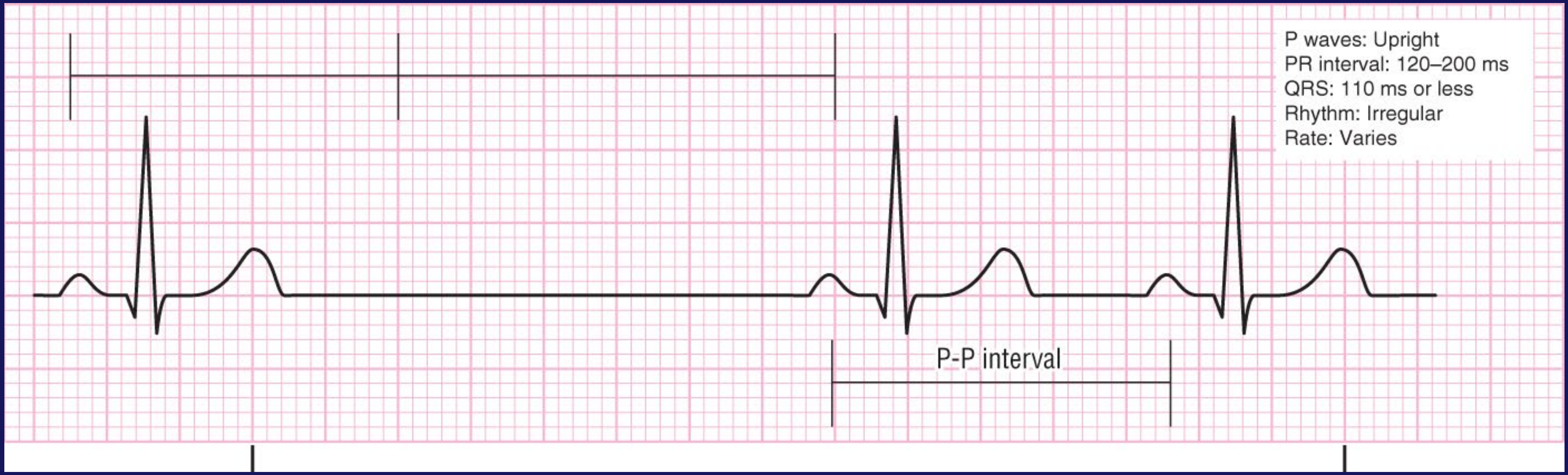
Rhythms Originating in SA Node

- Sinus dysrhythmia (cont'd)
  - More prominent with respiratory cycle fluctuation
  - Increases during inspiration and decreases during expiration
  - Found in children and young adults

Rhythms Originating in SA Node

- Sinus arrest
  - The SA node fails to initiate an impulse.
  - Upright P waves precede QRS complexes.



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Rhythms Originating in SA Node

- Sinus arrest (cont'd)
  - Common causes:
    - Ischemia of the SA node
    - Increased vagal tone
    - Carotid sinus massage
    - Use of certain drugs
  - Treatment may include a pacemaker.

Rhythms Originating in SA Node

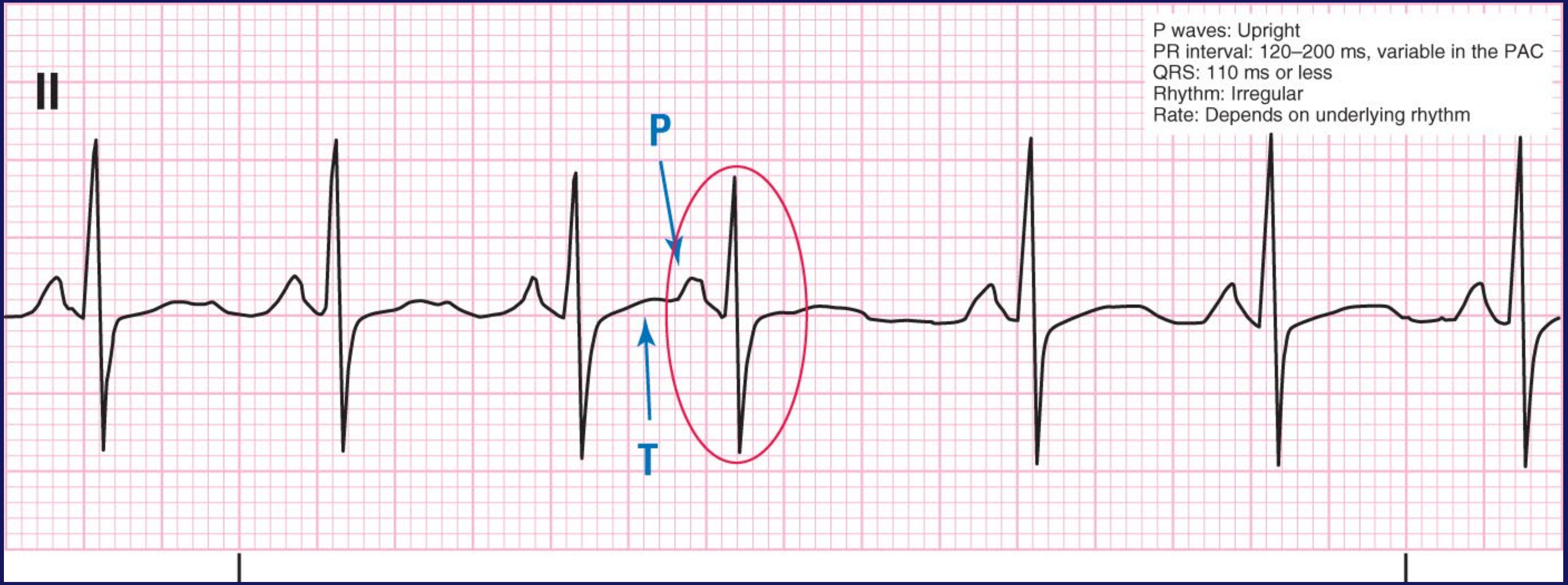
- Sick sinus syndrome
  - A variety of rhythms involving a poorly functioning SA.
  - It shows on an ECG as:
    - Sinus bradycardia
    - Sinus arrest
    - SA block
    - Alternating patterns of bradycardia and tachycardia

Rhythms Originating in the Atria

- Any atrial area may originate an impulse.
- Rhythms have upright P waves preceding each QRS complex.
  - Not as well rounded

Rhythms Originating in the Atria

- Premature atrial complex (PAC)
  - PAC is an ectopic complex within another rhythm.
  - An upright P wave precedes each QRS complex.



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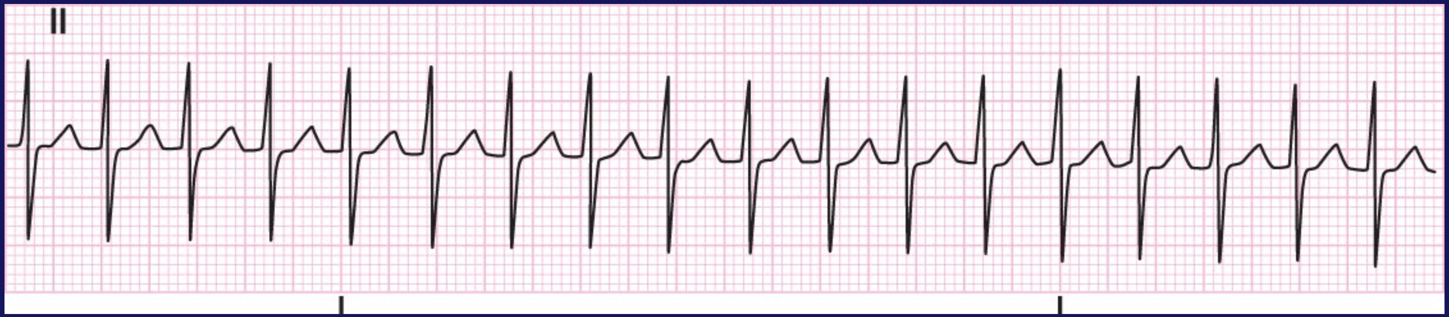
Rhythms Originating in the Atria

- Premature atrial complex (cont'd)
  - Nonconducted PAC: A P wave occurs early on the ECG and is not followed by a QRS complex.
  - It can result from stress, stimulants, or conditions.
  - Treatment is focused on the underlying cause.

Rhythms Originating in the Atria

- Supraventricular tachycardia (SVT)
  - Originates from a site above the ventricles.
  - Regular rhythm at a rate exceeding 100 beats/min at rest.
  - QRS complexes measure 0.11 seconds or less.
  - At a rate of 150 to 180 beats/min, P waves are obscured by the T wave of the preceding beat.



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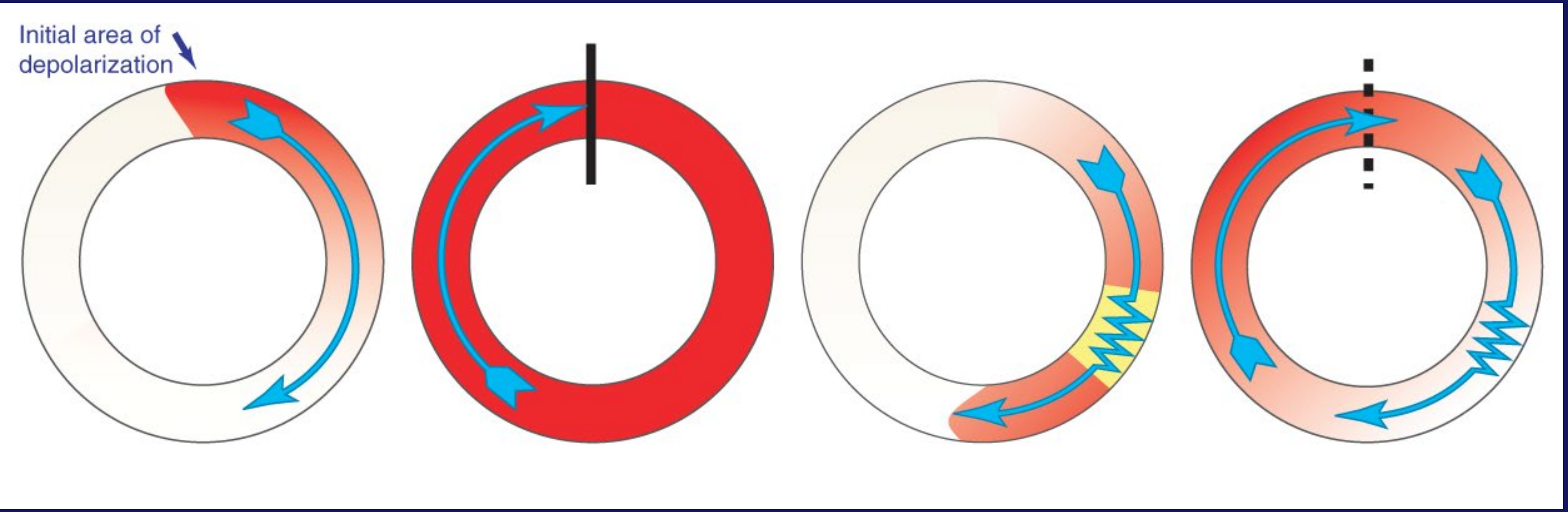
Rhythms Originating in the Atria

- AV nodal reentrant tachycardia
  - The most common type of SVT.
  - Treatment depends on the severity of symptoms and may include medication or electrical therapy.

Rhythms Originating in the Atria



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Rhythms Originating in the Atria

- Atrial fibrillation (AF)
  - Atria fibrillate or quiver
  - Random depolarization from atria cells depolarizing independently

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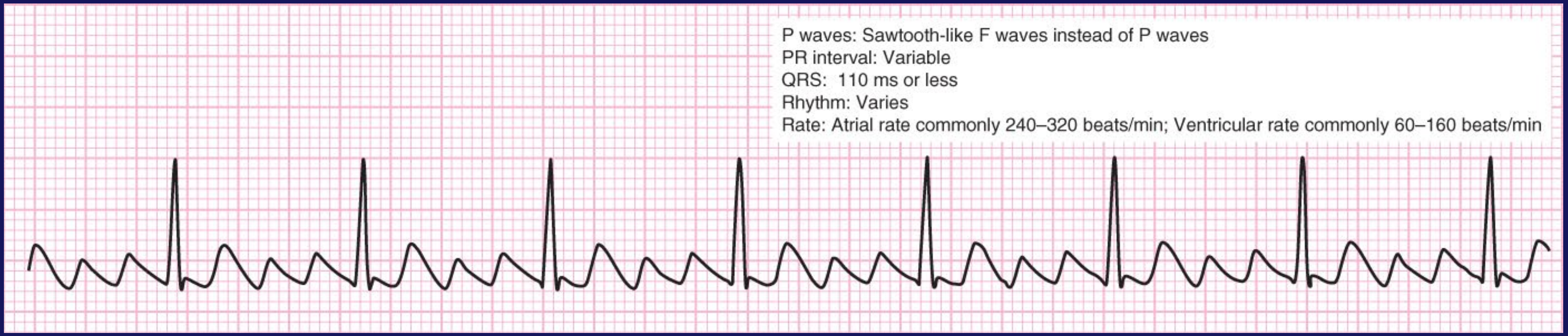
Rhythms Originating in the Atria

- Atrial fibrillation (cont'd)
  - Irregularly irregular appearance
  - Tendency to cause clots
  - Rare prehospital treatment

Rhythms Originating in the Atria

- Atrial flutter
  - Atria contract too fast for the ventricles to match.
  - F waves resemble a sawtooth or picket fence.
  - F waves get blocked by the AV node, creating several F waves before each QRS complex.



Rhythms Originating in the Atria

- Atrial flutter (cont'd)
  - Atrial flutter can degenerate into AF.
  - Treatment is usually medication or electrical cardioversion.
    - Only done in the field if condition is critical

Rhythms Originating in the Atria

- Wandering atrial pacemaker
  - The pacemaker moves from the SA node to other areas within the atria or AV junction.
  - An upright P wave precedes each QRS (at least three shapes of P waves within a strip).

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Rhythms Originating in the Atria

- Wandering atrial pacemaker (cont’d)
  - Treatment in prehospital setting only if:
    - The dysrhythmia is associated with a slow rate.
    - The patient is symptomatic.

Rhythms Originating in the Atria

- Multifocal atrial tachycardia (MAT)
  - The pacemaker moves within various atrial areas.
  - MAT is characterized by a rate of more than 100 beats/min.
  - There is an upright P wave preceding each QRS complex.
    - P waves vary.

Rhythms Originating in the Atria

- Multifocal atrial tachycardia (cont'd)
  - PRI: 0.12 to 0.20 seconds; varies slightly
  - Most common with significant lung disease
  - Generally ineffective therapies for SVT

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Rhythms Originating at the AV Junction

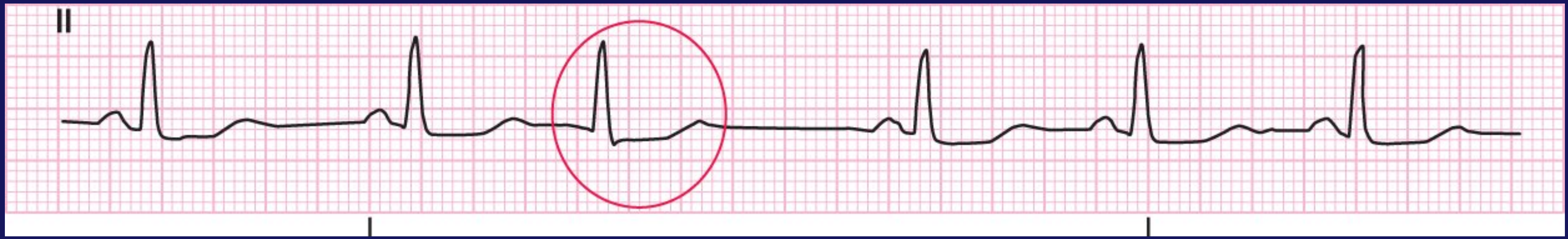
- The AV junction will take over if the SA node fails.
  - Rhythms of AV junction origin are known as junctional rhythms.
    - Have inverted or missing P waves
- An impulse generated in the AV junction travels down into the ventricles and up toward the SA node.

Rhythms Originating at the AV Junction

- Three possibilities:
  - Upside-down P wave immediately followed by QRS complex
  - Smaller inverted P wave hidden within QRS complex
  - Inverted P wave after the QRS complex
- Rates of 40 to 60 beats/min

Rhythms Originating at the AV Junction

- Premature junctional complex
  - Particular complex within another rhythm
  - Inverted P wave that precedes or follows the QRS complex
    - PR interval: less than 0.12 seconds
    - QRS complex: 0.11 seconds or less
  - Rarely treated in the prehospital setting



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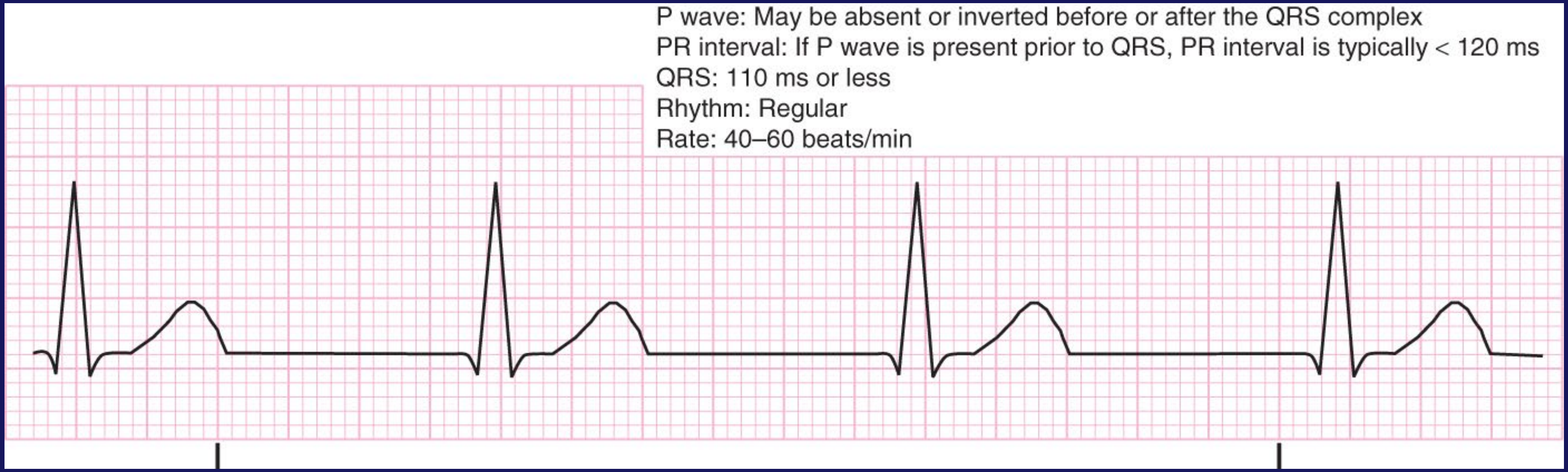
Rhythms Originating at the AV Junction

- Junctional escape rhythm
  - Occurs when the SA node does not function
    - The AV node becomes the pacemaker
  - Most common with significant SA node problems
  - Treatment usually an implanted pacemaker



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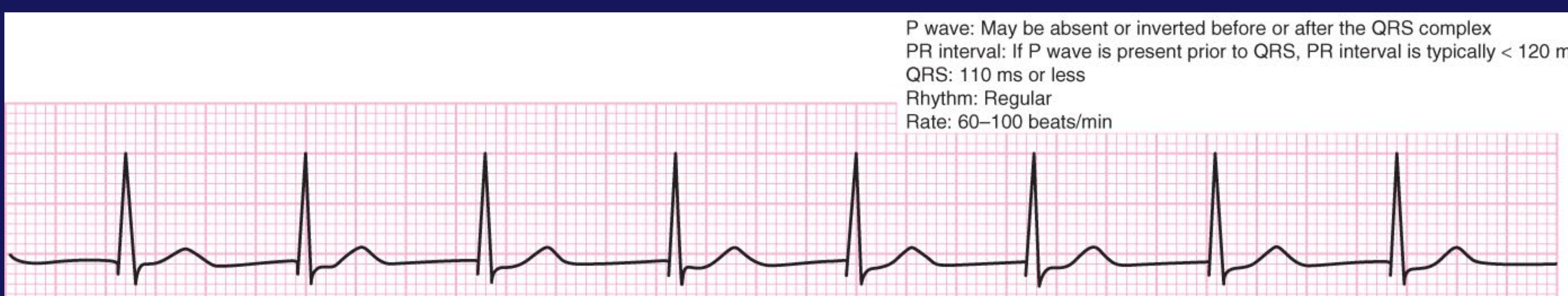
Rhythms Originating at the AV Junction

- Accelerated junction rhythm
  - Present with a rate exceeding 60 beats/min but less than 100 beats/min
  - Regular rhythm, little variation between R-R intervals
  - Seldom treated in the prehospital setting



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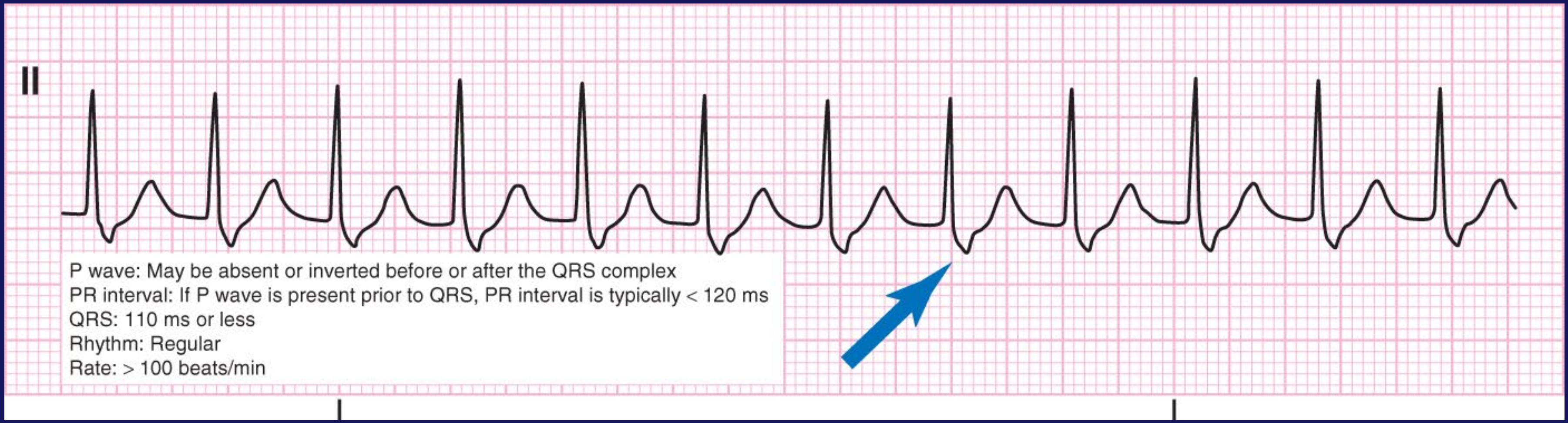
Rhythms Originating at the AV Junction

- Junctional tachycardia
  - Junctional rhythm rate higher than 100 beats/min
  - Regular rhythm, little variation between R-R intervals
  - Seldom requires prehospital treatment



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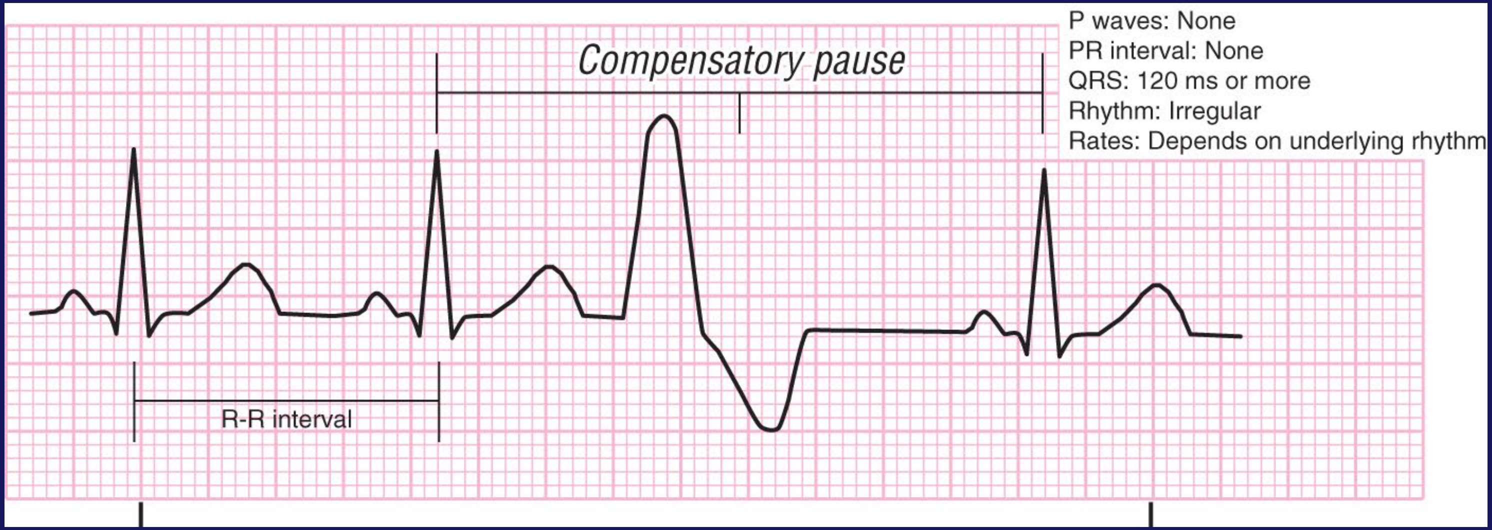
Rhythms Originating in the Ventricles

- Ventricles may become the pacemaker if the AV junction does not take over after the SA node fails.
  - Wide QRS complexes and missing P waves

Rhythms Originating in the Ventricles

- Premature ventricular complex (PVC)
- Particular complex within another rhythm
  - Occurs earlier than expected, causing an R-R interval between it and the previous complex



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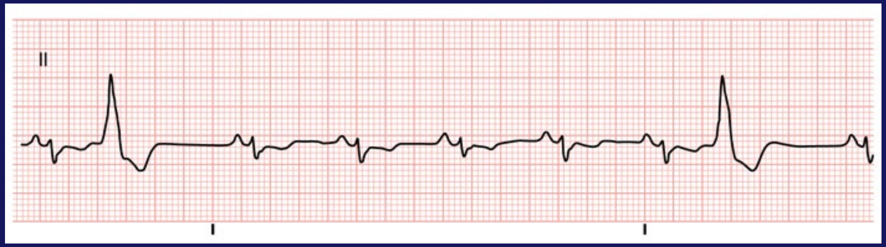
Rhythms Originating in the Ventricles

- Premature ventricular complex (cont'd)
  - Unifocal: from the same spot within the ventricle
  - Multifocal: two premature complexes with different appearances



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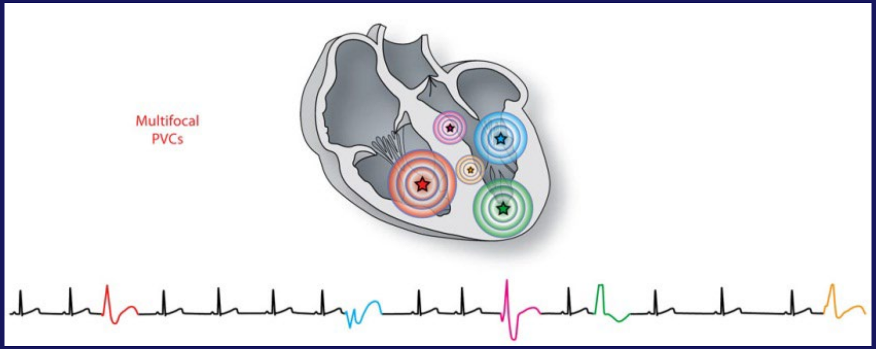

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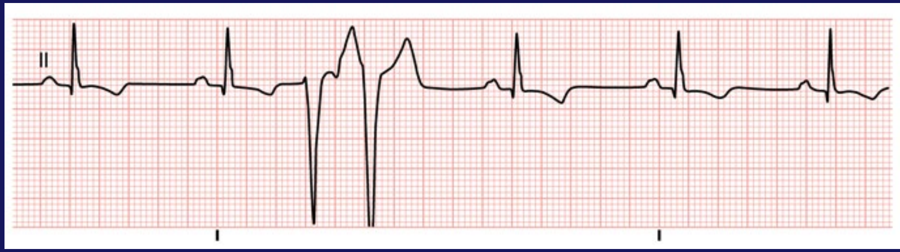
Rhythms Originating in the Ventricles

- Premature ventricular complex (cont'd)
  - Couplet: Two PVCs occur together.
  - Salvos: Three or more PVCs occur in a row.
  - Bigeminy: PCVs alternate with normal complexes.
  - Trigeminy: The third beat is a PVC.



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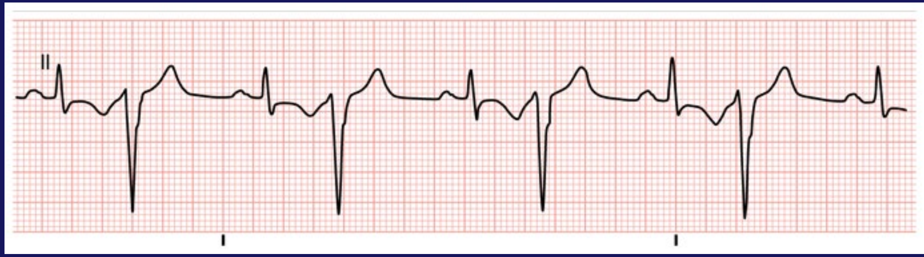

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Rhythms Originating in the Ventricles

- Idioventricular rhythm
  - Occurs when SA and VA nodes fail
  - May or may not result in a palpable pulse
  - Treatment: improving the CO

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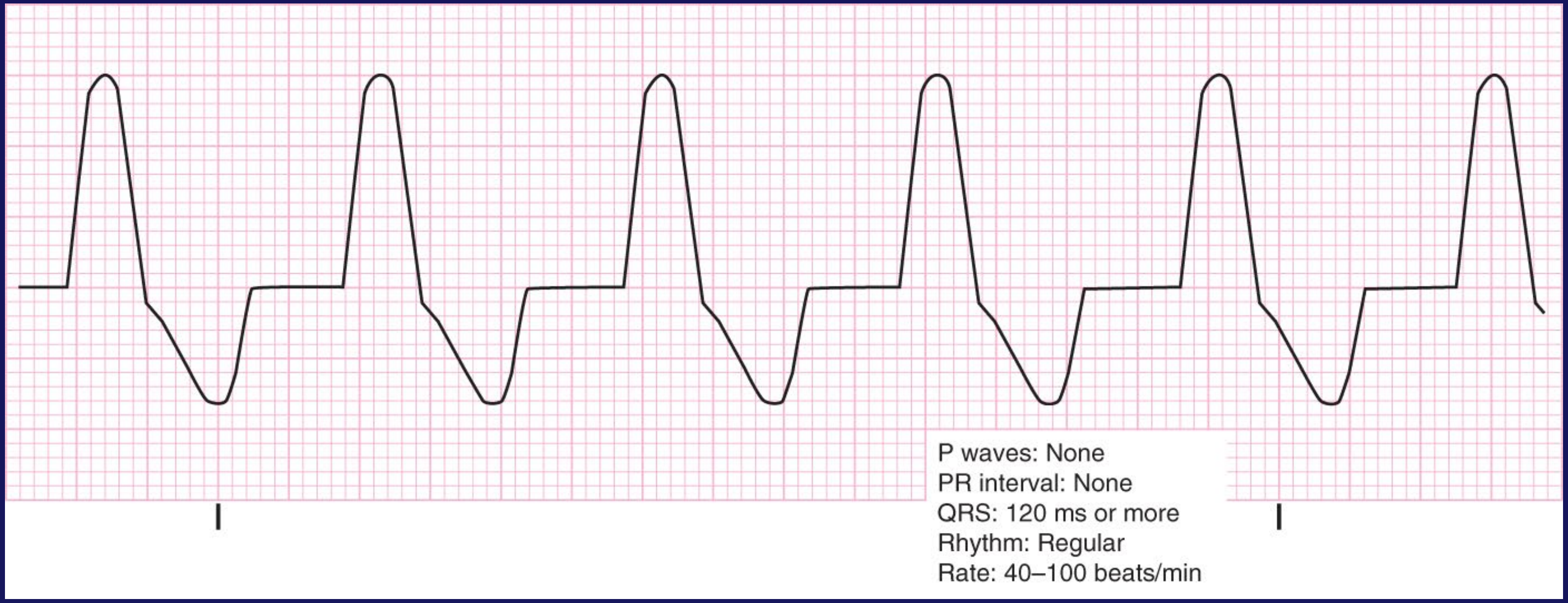
Rhythms Originating in the Ventricles

- Accelerated idioventricular rhythm (AIVR)
  - Occurs when an IVR exceeds 40 beats/min but less than 100 beats/min
  - Rarely treated in the prehospital setting



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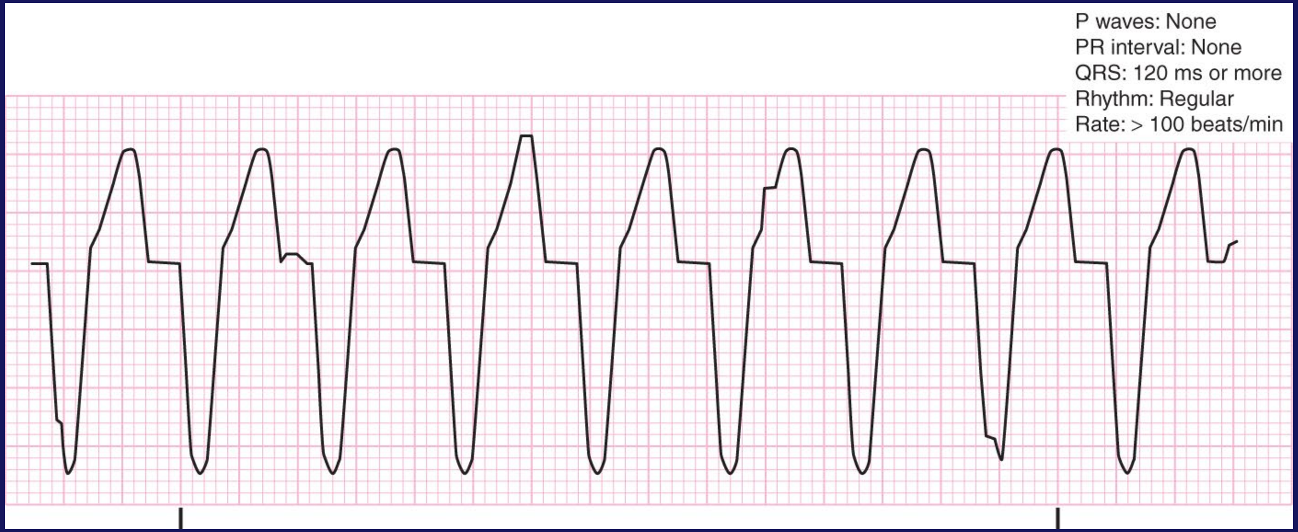
Rhythms Originating in the Ventricles

- Ventricular tachycardia (VT)
  - Occurs when SA and AV nodes fail, and the rate exceeds 100 beats/min
  - QRS complexes usually have uniform tops and bottoms (monomorphic).



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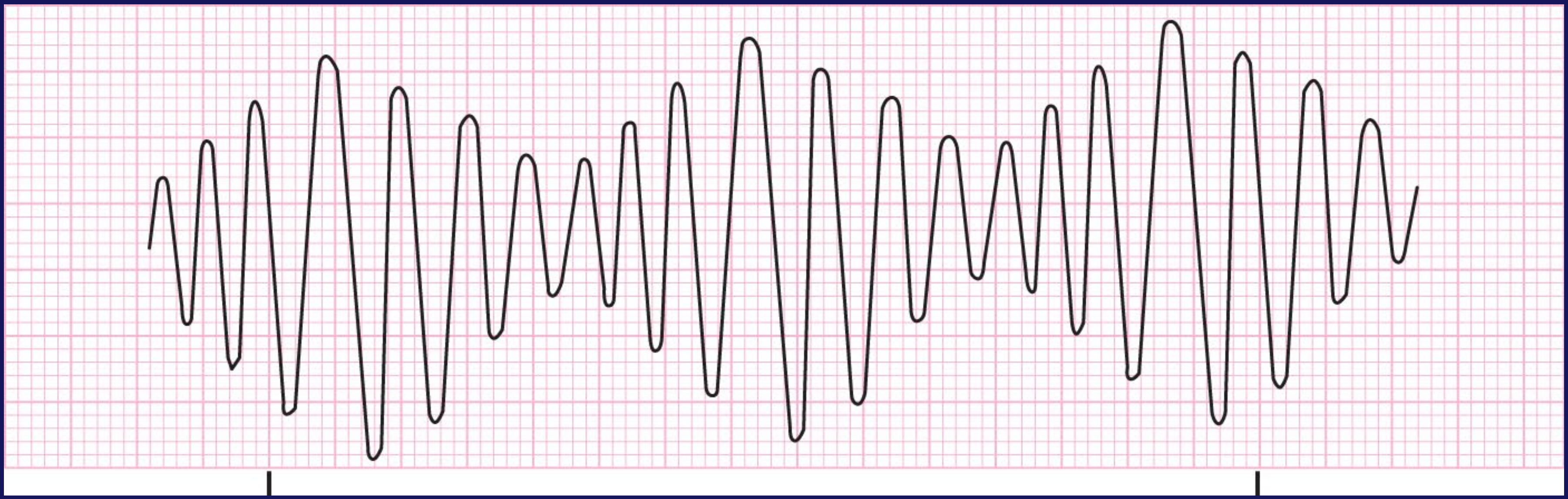
Rhythms Originating in the Ventricles

- Ventricular tachycardia (cont'd)
  - Occasionally the QRS complex will vary in height.
    - Torsades de pointes
  - Requires treatment to maintain adequate CO



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Rhythms Originating in the Ventricles

- Ventricular fibrillation (VF)
  - Rhythm in which the entire heart is fibrillating without a discernable pattern
  - Occurs when many different heart cells become depolarized independently

Rhythms Originating in the Ventricles

- Ventricular fibrillation (cont'd)
  - Coarse (early stages): waves are greater than 3 mm in amplitude
  - Fine: waves are less than 3 mm in amplitude

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Rhythms Originating in the Ventricles

- Asystole (flat line)
  - Entire heart no longer contracting.
  - Heart cells no longer have energy.
  - There is a complete absence of electrical activity.
  - Generally considered a nonshockable cardiac arrest rhythm.

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Pulseless Electrical Activity

- Organized cardiac rhythm not accompanied by a detectable pulse
  - Heartbeat weak from:
    - Cardiogenic or hypovolemic shock
    - Cardiac tamponade
    - Massive pulmonary embolism
    - Electrolyte imbalance disturbances
    - Drug overdose

Pulseless Electrical Activity

- The key to treatment is identifying the cause.
- A nonshockable cardiac arrest rhythm.

Atrioventricular Blocks

- The SA node initiates impulses resulting in heart contractions.
  - Occasionally impulses are delayed longer than usual, causing AV blocks.

Atrioventricular Blocks

- First-degree AV block
  - Occurs when each impulse is delayed slightly longer than normal
  - Least serious type of block
  - Rarely treated in a prehospital setting

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Atrioventricular Blocks

- Second-degree AV block I: Mobitz type I (Wenckebach)
  - Occurs when an interruption in impulse conduction occurs within the AV node, bundle of His, or His-Purkinje system
  - Not treated in the prehospital setting

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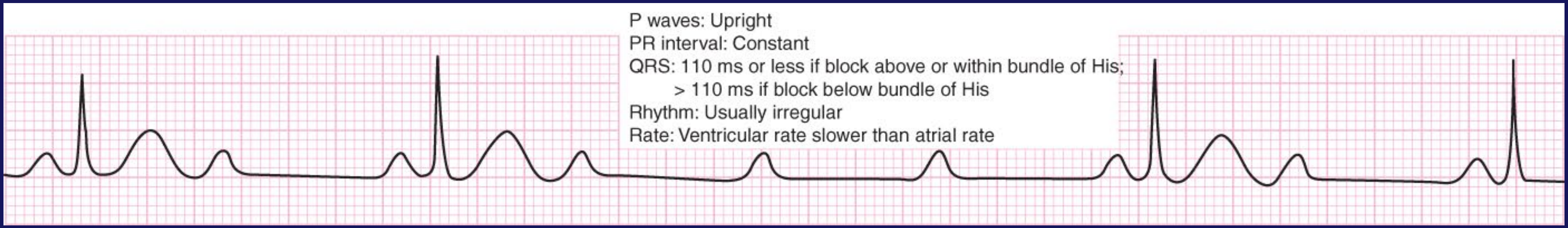
Atrioventricular Blocks

- Second-degree AV block II (Mobitz type II)
  - Occurs when several impulses cannot continue
  - An intermittent block characterized by regularly occurring P waves and the abrupt appearance of at least one P wave that is not followed by a QRS complex



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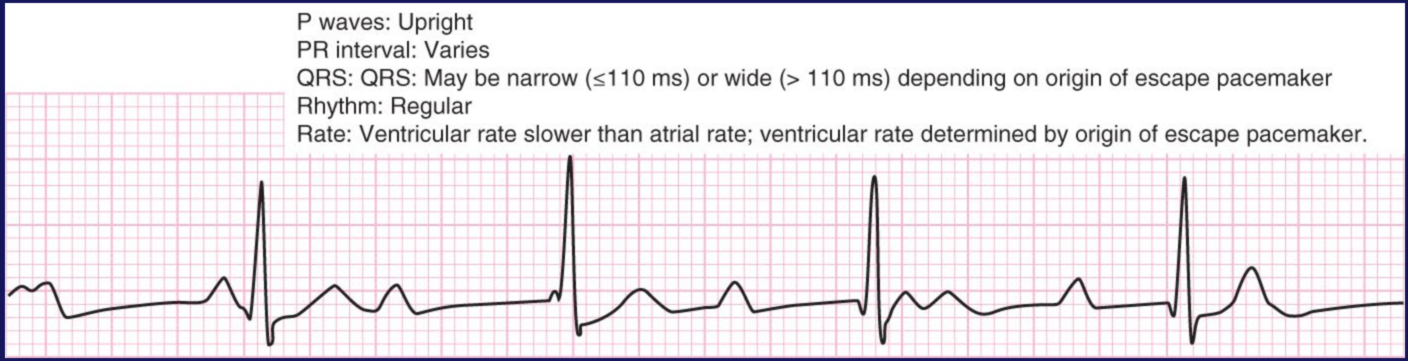
Atrioventricular Blocks

- Third-degree AV block
  - Occurs when all impulses are prevented from proceeding to the ventricles and generating a QRS complex.
  - The secondary pacemaker assumes responsibility.
  - It is identified by nonconducted P waves.
  - It is treated in the field only if it occurs with bradycardia.



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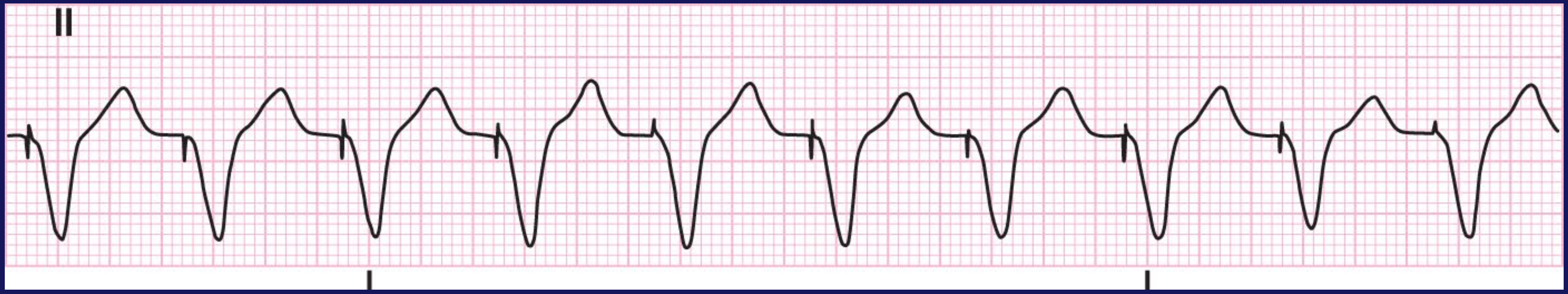
Artificial Pacemaker Rhythms

- Artificial pacemakers
  - Contain programmable hardware
  - Implanted below right or left clavicle
  - Generate unique vertical spike



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Artificial Pacemaker Rhythms

- Single-chamber pacemaker
- Dual-chamber (AV sequential) pacemaker
- Biventricular pacemaker

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Artificial Pacemaker Rhythms

- Demand pacemakers
  - Generate impulses when patient's heart rate has dropped below a predetermined rate (usually 60 beats/min)

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Artificial Pacemaker Rhythms

- If malfunction occurs, the patient's heart will depend on its natural pacemaker, greatly reducing CO.
  - Failure to capture, pace, or sense
  - Oversensing
  - "Runaway" pacemaker

12-Lead ECGs

- Used to localize the cardiac muscle injury site and identify cardiac abnormalities.
- Each lead looks at the heart from a different angle.

12-Lead ECGs

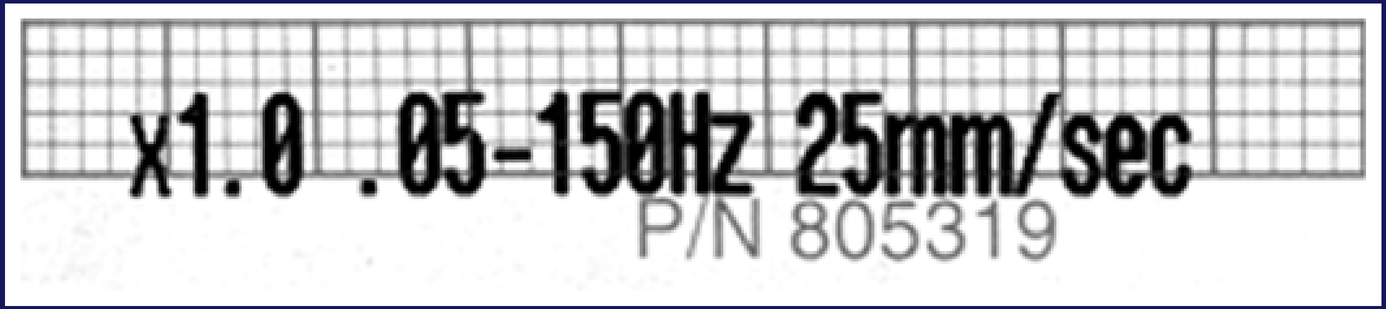
- Indications
  - Chest pain
  - Right or left ventricular heart failure
  - Electrolyte imbalance
  - Medication overdose
  - Syncope or near-syncope
  - Stroke
  - Hemodynamic instability

Acquisition Modes

- Monitor mode is used for rhythm interpretation.
  - Electronic filters to remove artifact
  - Skews shape/location of ST segment, T wave
  - Captures range of 1 to 30, 40, 100, or 150 Hz

Acquisition Modes

- Diagnostic mode filters out very little electrical information.
  - It is used to record 12-lead ECG by default.
  - Many allow recording of three-lead ECGs.
  - This mode captures information in the range of 0.05 to 150 Hz.
  - The frequency range is printed near the bottom.



Lead Placement

- The best way to learn is to practice with the equipment.
  - Make sure the patient does not get chilled.
  - Twelve-lead ECGs are more sensitive to artifact than three-lead monitoring ECGs.

The Snapshot

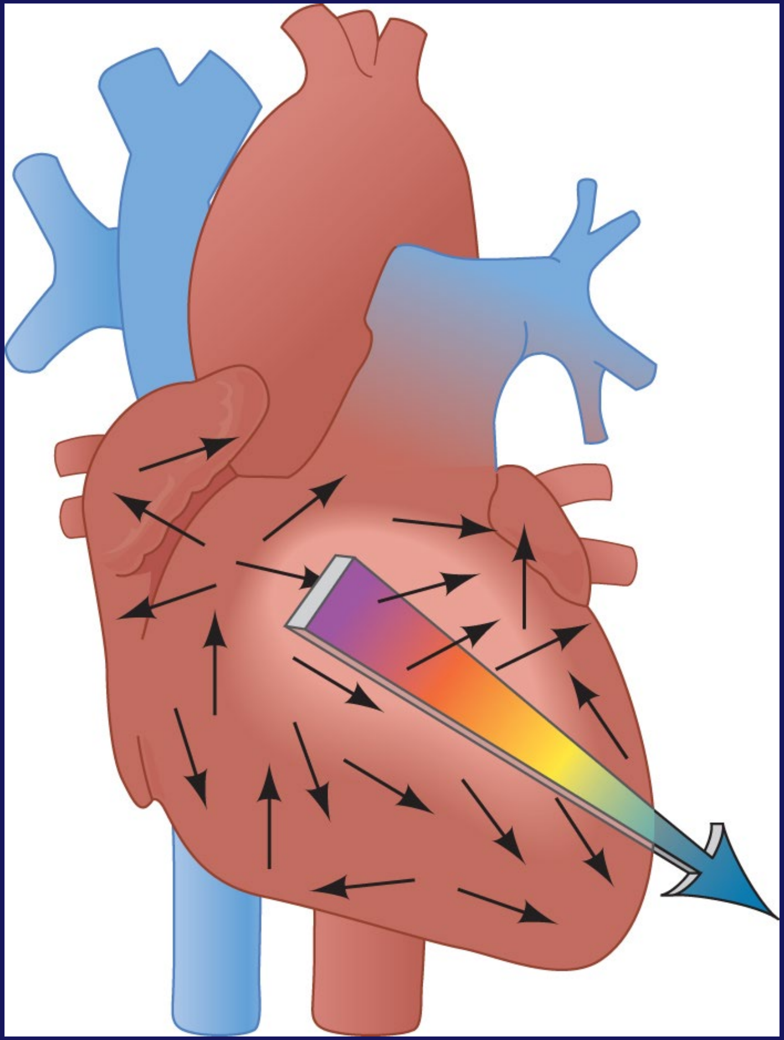
- Look at the tracings.
  - Did all the leads print?
  - Is an artifact present?
  - Is the rate at one of the extremes?

Dysrhythmia Interpretation

- Process to identify underlying rhythm
  - Identify the waves (P-QRS-T).
  - Measure the PRI.
  - Measure the QRS duration.
  - Determine rhythm regularity.
  - Measure the heart rate.

The Axis

- Vector: quantity that has magnitude and direction
- QRS axis: a single vector that represents the average of all vectors created by the ventricles during depolarization



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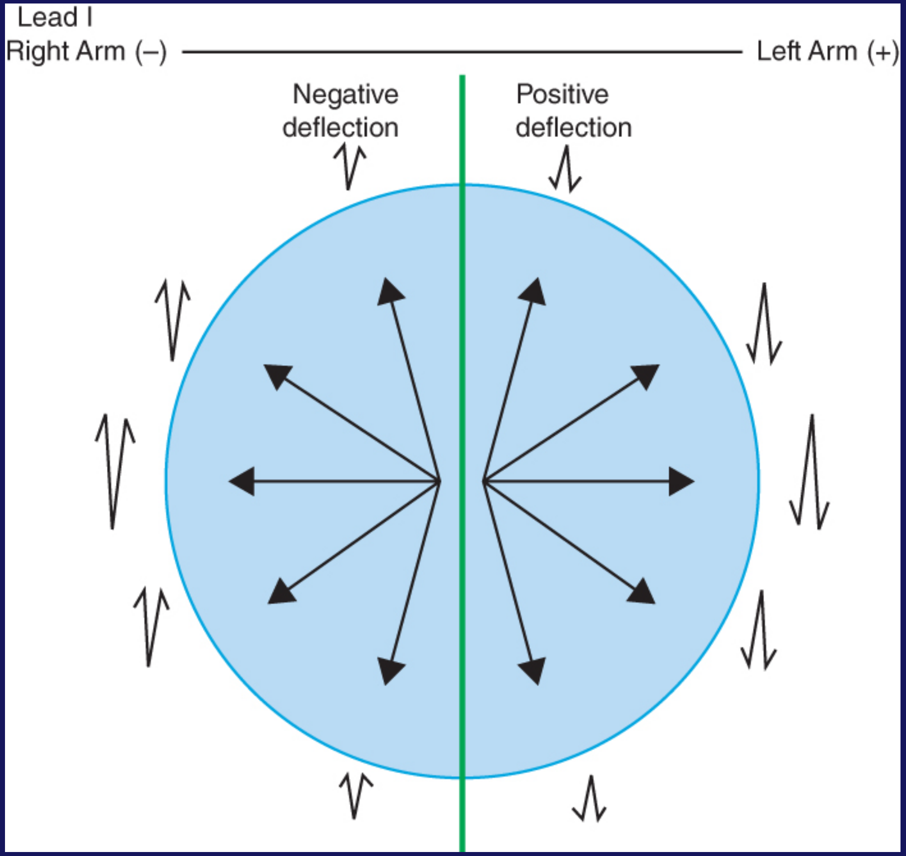
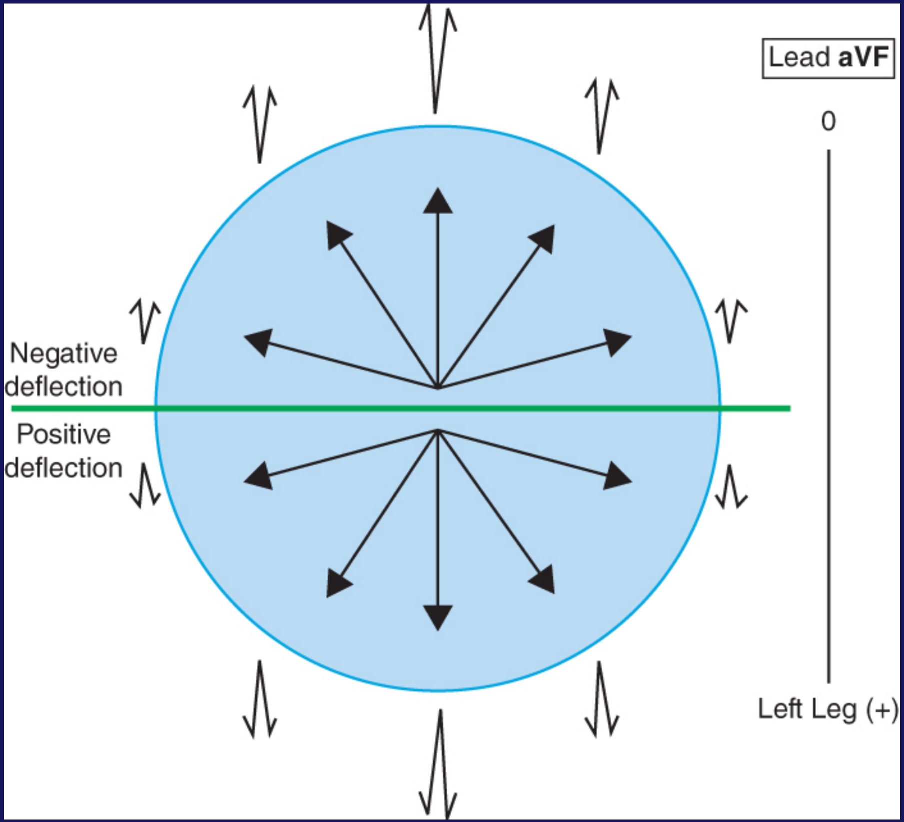
The Axis

- Viewed from lead I, QRS wave will be:
  - Positive if heading toward the left arm
  - Negative if heading toward the right arm



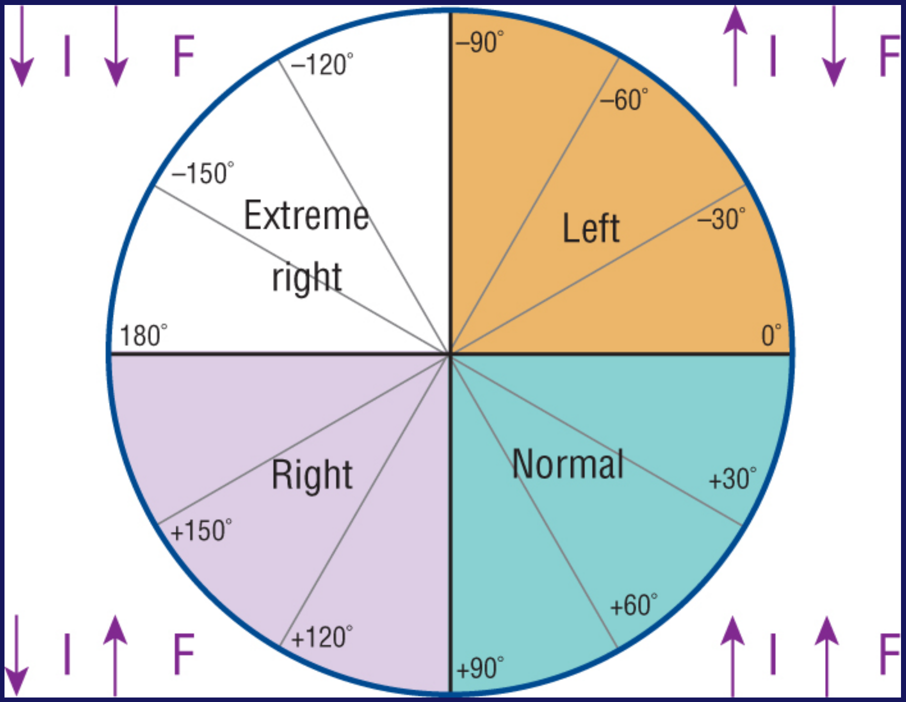
The Axis

- Viewed from lead aVF, the QRS wave will be:
  - Positive if heading toward the feet
  - Negative if heading toward the head



The Axis

- To determine the QRS axis, use the quadrant system.
- The intersection represents the impulse origin.



The Axis

Table 17-7 Determining the QRS Axis Using Leads I and aVF

	Lead I		Lead aVF		Position of QRS Axis
If	Positive	*and*	Positive	*then*	Normal axis
If	Positive	*and*	Negative	*then*	Left axis deviation
If	Negative	*and*	Positive	*then*	Right axis deviation
If	Negative	*and*	Negative	*then*	Extreme right axis deviation

The Axis

- The QRS axis will always move toward hypertrophy and away from infarction.
  - Enlarged ventricle: more electrical energy
  - Infarcted ventricle: no electrical energy

Thank You

Please move to the next section