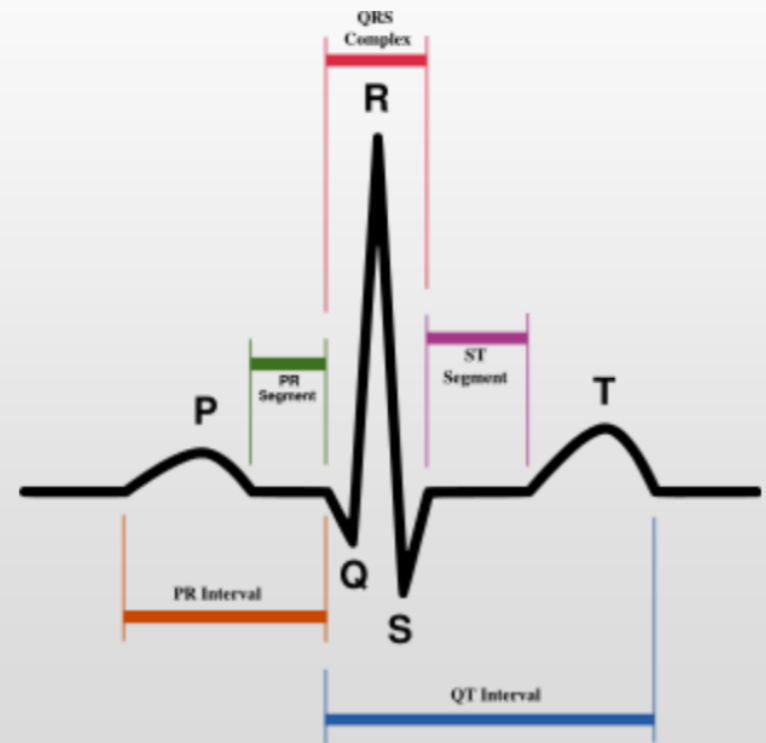


EKG Study Guide

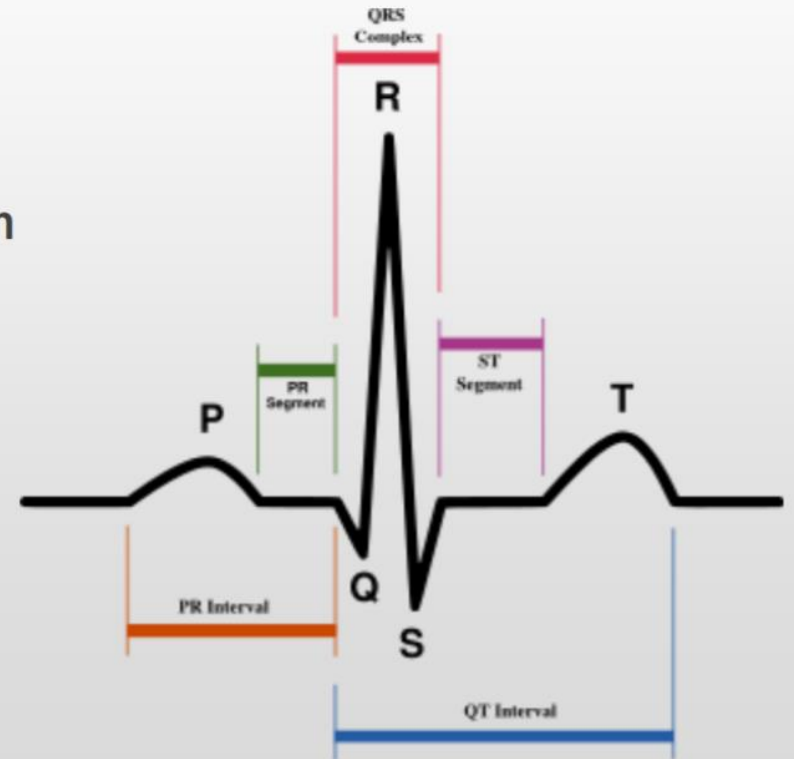
EKG Waveforms

One complete cardiac cycle =

P, Q, R, S, (QRS complex),
and T wave



- **P wave**
 - Atrial depolarization (contraction)
- **QRS Complex**
 - Ventricular depolarization, atrial repolarization
- **T wave**
 - Ventricular repolarization (resting phase)



Sinus Rhythms

Normal Sinus Rhythm

Sinus rhythm means a **normal** heart beat, both with respect to the heart rate and **rhythm**.



- Regular R to R
- 60-100 beats per minute
- Uniform P wave precedes every QRS
- PR interval between .12-.20 seconds
- QRS measures less than .12 seconds

Sinus Tachycardia

Sinus Tachycardia is characterized by a pulse rate of more than 100 beats per minute in adults. The electrical signals originate in the sinoatrial (SA) node. Appropriate sinus tachycardia can result from exercise, alcohol or caffeine, drugs and anxiety.



- Regular R to R
- 100-150 beats per minute
- Uniform P wave precedes every QRS
- PR interval between .12-.20 seconds
- QRS measures less than .12 seconds

Sinus Bradycardia

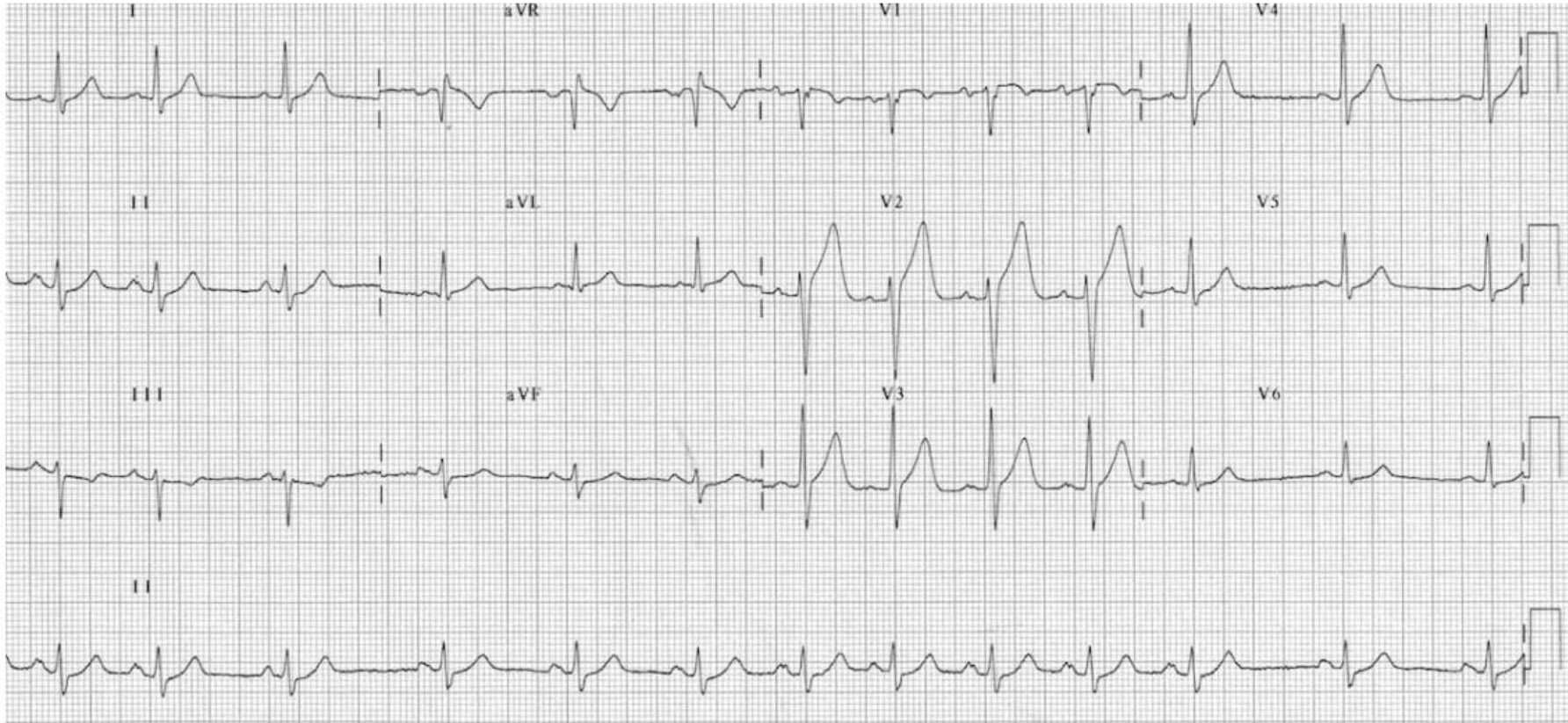
Sinus bradycardia is a heart **rhythm** that originates in the **sinus** node with a rates less than 60 beats per minute. **Sinus bradycardia** is a common condition in both healthy individuals, particularly athletes. It can also occur normally during sleep.



- Regular R to R
- Less than 60 beats per minute
- Uniform P wave precedes every QRS
- PR interval between .12-.20 seconds
- QRS measures less than .12 seconds

Sinus Arrhythmia

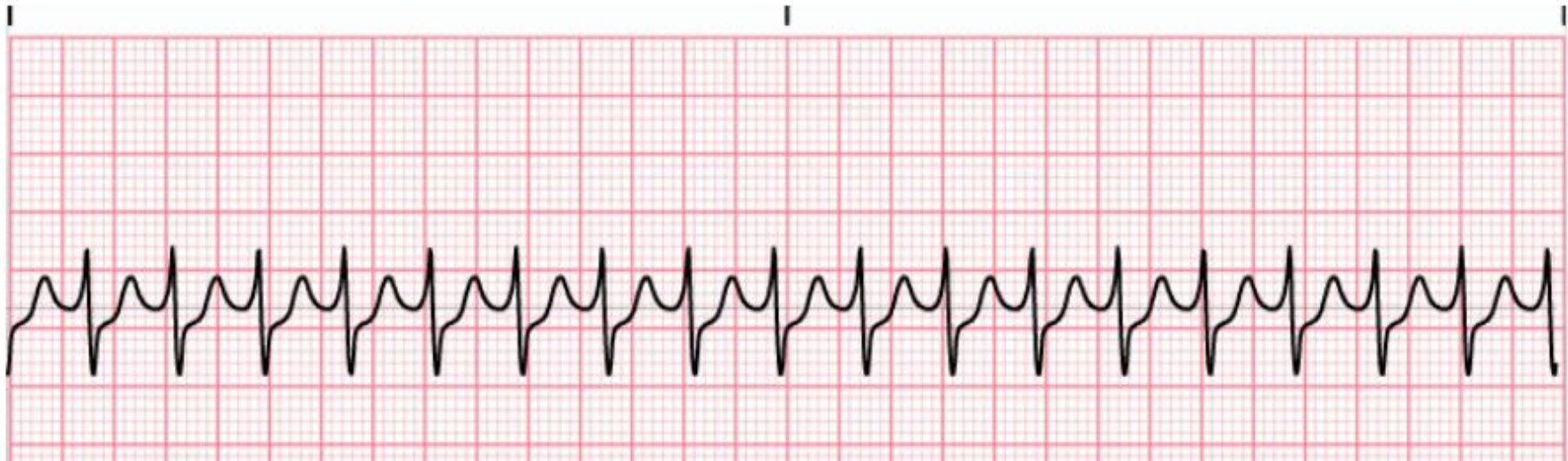
Sinus arrhythmia is a normal physiological phenomenon, most commonly seen in young, healthy people. Examples:



- Varied R to R, may change with patient's respirations
- Usually P wave precedes every QRS
- PR interval between .12-.20 seconds
- QRS measures less than .12 seconds

Paroxysmal Supraventricular Tachycardia

Supraventricular tachycardia (SVT) is a cardiac arrhythmia characterized by very rapid or erratic beating. SVT is also called paroxysmal supraventricular tachycardia (PSVT).



- Regular rhythm with a rate of 160-220 beats per minutes
- May start rapidly and last for only a few minutes but can extend for hours- often referred to as paroxysmal
- QRS complexes are usually narrow- sometimes referred to as PAT
- QRS complexes can be widened, making it difficult to distinguish from ventricular tachycardia- patient assessment is key

Atrial Rhythms

Premature Atrial Contraction- PAC

A premature atrial contraction occurs when a focus in the atrium (not the sinoatrial node) generates an action potential before the next scheduled SA node action potential.



- Premature atrial beat which interrupts the regularity of the underlying rhythm
- Heart rate depend on the underlying rhythm
- P wave of the premature beat has a different morphology than the other P waves in the underlying rhythm. This may be flatted, notched, or hidden within the T wave of the preceding complex
- QRS measures less than .12 seconds

Atrial Tachycardia

Atrial Tachycardia is a type of abnormal heart rhythm, or arrhythmia. It occurs when the electrical signal that controls the heartbeat starts from an unusual location in the upper chambers (**atria**) and rapidly repeats, causing the **atria** to beat too quickly.



- Regular R to R
- 150-250 beats per minute
- Usually one P wave in front of every QRS. This P wave may be flattened, notched or hidden in the T waves
- QRS measures less than .12 seconds

Atrial Flutter

Atrial Flutter is a very rapid pattern of atria contraction. Unlike atrial fibrillation, atrial flutter's electrical activity in the atria is coordinated. This rapid rate (250 to 350 times per minute) is too fast to allow the conduction of each impulse to the ventricles.



- Atrial rhythm is regular
- Ventricular rhythm can be regular or irregular depending on the ratio of impulses conducted through the ventricles
- P waves are well defined with a saw tooth appearance (flutter waves)
- Due to the P wave configuration and proximity of the wave to the QRS, often impossible to determine the PR interval
- QRS measures less than .12 seconds but can be difficult to measure

Atrial Fibrillation

Atrial fibrillation is a condition that disrupts your heartbeat. A glitch in the heart's electrical system makes its upper chambers (the atria) beat so fast they quiver, or fibrillate. This causes the lower chambers (the ventricles) to beat out of sync.

AFib can be dangerous because it raises your risk of stroke and heart failure.

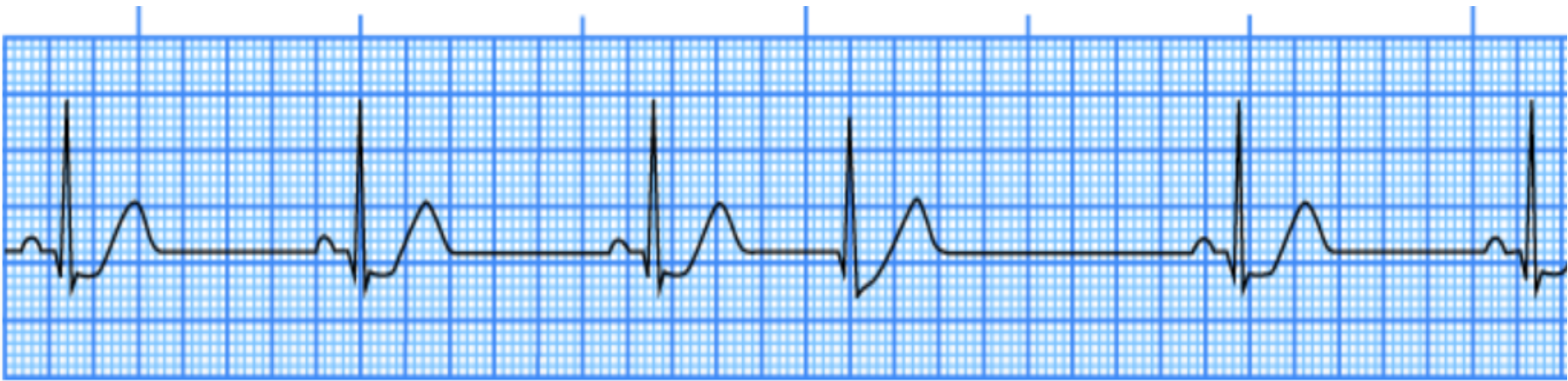


- Atrial activity is chaotic, irregular
- P waves are not discernible- only fibrillatory waves
- Unable to measure PR interval
- While the atrial rate is often fast, the ventricular rate is significantly slower as the AV node blocks most of the atrial impulses
- Ventricular rate is below 100 beats per minute, the rhythm is referred to as controlled
- Ventricular rate greater than 100 beats per minute

Junctional Rhythms

Premature Junctional Contractions

A **premature junctional** complex (PJC) is an abnormality seen in the presence of an underlying sinus rhythm. It is an abnormal impulse that originates in the atrioventricular junction and occurs early before the next expected P wave.



- Premature atrial beat which interrupts the regularity of the underlying rhythm
- Heart rate depend on underlying rhythm
- P wave may come before or after the QRS complex or even within the QRS complex
- If visible, the P wave may be inverted
- PR interval when the P wave precedes the QRS will be less than .12 seconds
- Unable to measure PR interval if the P wave is within or after the QRS

Junctional Rhythm

Junctional rhythm describes an abnormal **heart rhythm** resulting from impulses coming from tissue in the area of the atrioventricular node, the "junction" between atria and ventricles.



- Regular R to R
- Equal atrial and ventricular rates
- 40-60 beats per minute
- P wave may come before or after the QRS complex or even within the QRS complex
- If visible, the P wave may be inverted
- PR interval when the P wave precedes the QRS will be less than .12 seconds

Accelerated Junctional Rhythm

Accelerated junctional rhythm (AJR) occurs when the rate of an AV junctional pacemaker surpasses that of the sinus node.



- Regular R to R
- Equal atrial and ventricular rates
- 60-100 beats per minute
- P wave may come before or after the QRS complex, or even with the QRS complex
- If visible, the P wave may be inverted
- PR interval when the P wave precedes the QRS will be less than .12 seconds
- Unable to measure the PR interval if the P wave is within or after the QRS complex

Junctional Tachycardia

Junctional tachycardia occurs when three or more premature junctional complexes (PJC's) appear in a row. Heart rate will be over 100 bpm.



- Regular R to R
- Equal atrial and ventricular rates
- 100- 180 beats per minute
- P wave may come before, after, or with the QRS complex
- If visible, the P wave may be inverted
- Unable to measure the PR interval if the P wave is within or after the QRS complex

Heart Blocks

First Degree Heart Block

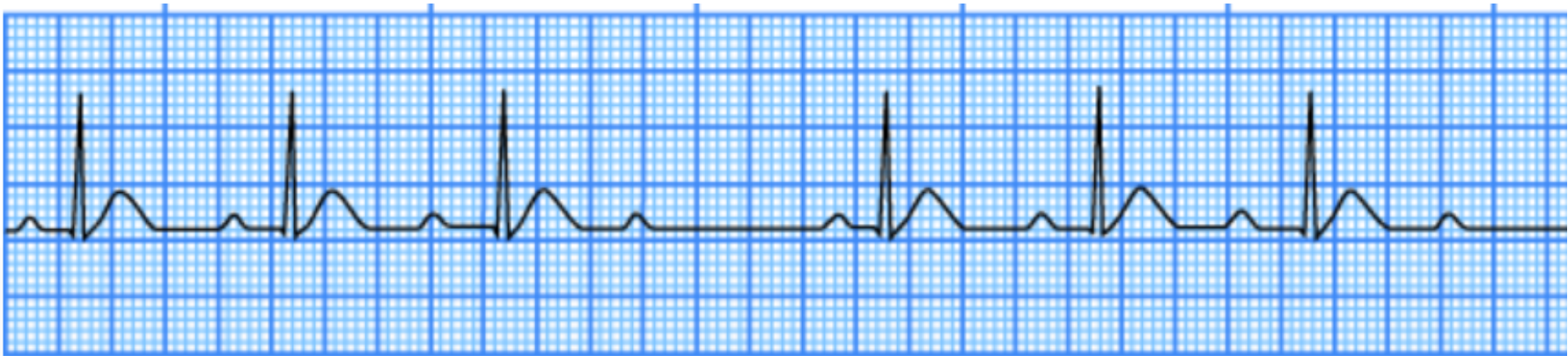
Also called first-degree AV block is a disease of the electrical conduction system of the heart in which the PR interval is lengthened beyond 0.20 seconds. This lengthening of the PR interval is caused by a delay in the electrical impulse from the atria to the ventricles through the AV node.



- Regularity depends on the regularity of the underlying rhythm
- Rate depends on the underlying rhythm
- Uniform P wave precedes every QRS
- PR interval constant and greater than .20 seconds
- QRS measures less than .12 seconds

Second Degree Heart Block Type I / Mobitz I / Wenckebach

Second Degree Type I heart block is the less serious form of second-degree heart block. In this condition, the electrical signal goes slower and slower until the heart actually skips a beat.



- R to R is irregular but demonstrates a pattern of grouped beats
- Atrial rate is normal
- Ventricular rate is usually slightly slower than normal and less than the atrial rate as some beats are not conducted
- P waves are upright and uniform
- Some P waves are not followed by a QRS complex
- The PR interval gets progressively longer until one P wave is not followed by a QRS complex.

Second Degree Heart Block Type II/ Mobitz II

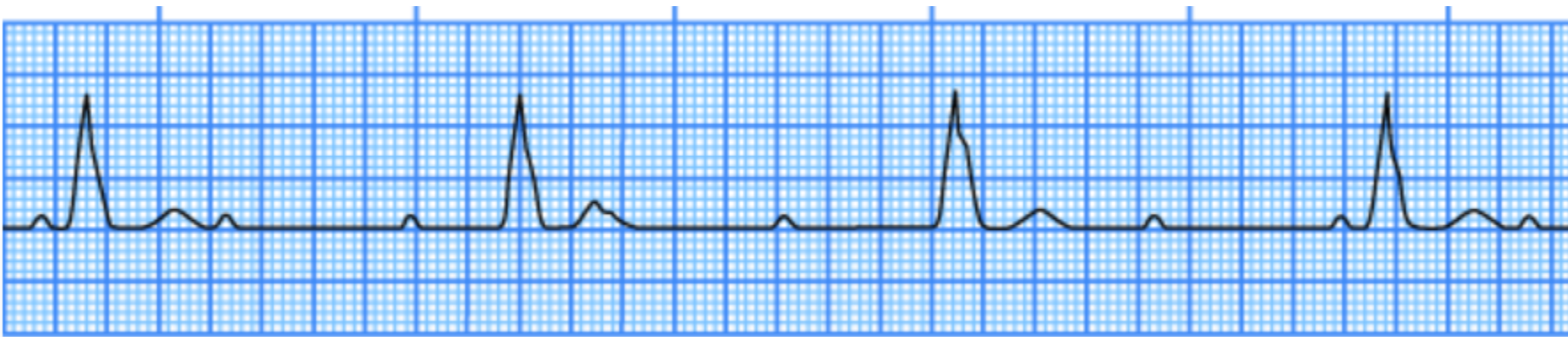
In Second Degree Heart Block Type II some of the electrical signals do not reach the ventricles, and the pattern is irregular.



- R to R may be regular or irregular
- Atrial rate is usually normal
- Since many of the atrial impulses are blocked, the ventricular rates will usually be less than 60 beats per minute
- P waves are upright and uniform
- More P waves than QRS complexes
- The PR interval on conducted beats will be constant across the strip but may be longer than .20 seconds

Third Degree Heart Block, Type II / Complete Heart Block

In third degree heart block, the electrical signal is not sent from the atria to the ventricles. The heart compensates by producing electrical signals from a specialized pacemaker area in the ventricles.

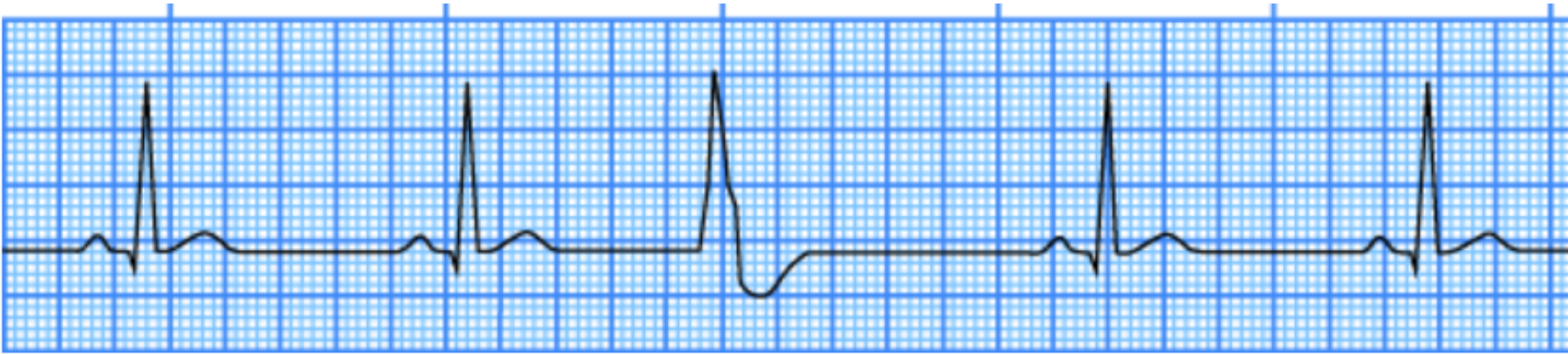


- Rhythm: Atrial: regular, Ventricular: regular- No ratio can be determined since the atrial rhythm is independent of the ventricular rhythm
- Rate: Atrial: usually normal (60-99 bpm) Ventricular: slow < 60 bpm
- P waves: Present, Normal in size, shape. > 1:1, more P waves than QRS complexes
- No relationship between the P waves and QRS complexes
- No PR interval
- QRS complex: Normal (0.04-0.10 seconds), or abnormally wide (> 0.10 seconds)

Ventricular Rhythms

PVC- Premature Ventricular Contraction

A premature ventricular complex (PVC) is an abnormality seen in the presence of an underlying rhythm. It originates in the ventricle and occurs *early* or *prematurely* before the next expected P-QRS-T sequence.



- Underlying rhythm may be regular or irregular
- The premature beat interrupts the regularity of the the underlying rhythm
- Rate is determined by underlying rhythm
- PVC's are usually not included in the rate determination as they do not produce a pulse
- P waves: Absent
- QRS complex: Abnormally wide (> 0.10 seconds)
- No PR interval
- PVC's may occur as a single beat

Bigeminy

Bigeminy is a heart rhythm in which there are repeated rhythms heart beats, one long and one shorter.



- Every other beat is an ectopic ventricular beat

Multifocal Ventricular Rhythm

A multifocal rhythm stems from two or more different spots on the ventricle wall. Multifocal indicates the irritability of the myocardium and the possibility of even more dangerous heart arrhythmia.



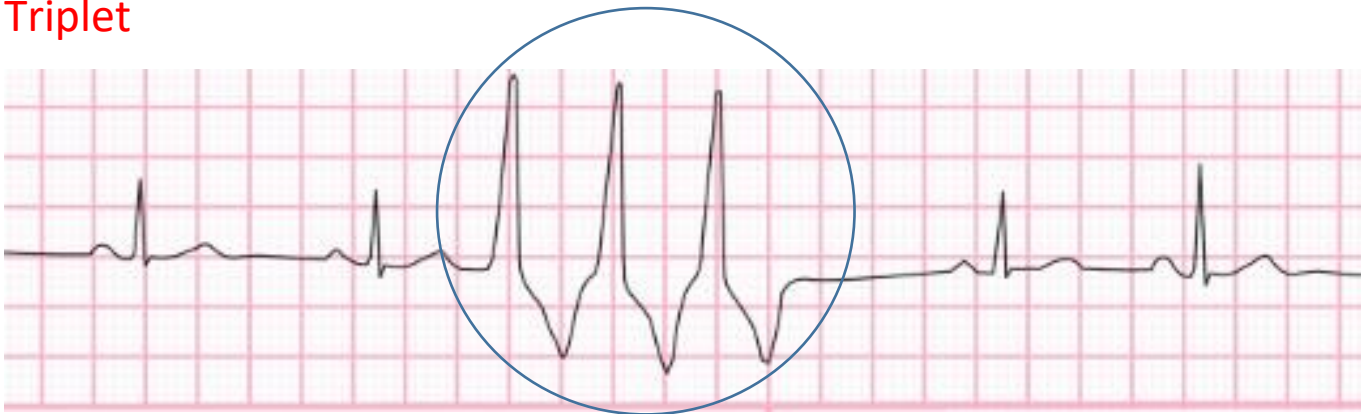
- The ectopic ventricular beats show different morphology and reflect ventricular irritability from more than one site

Couplets



- Two ectopic ventricular beats in a row

Triplet



- Three ectopic ventricular beats in a row
- Some may refer to this as a short run of ventricular tachycardia

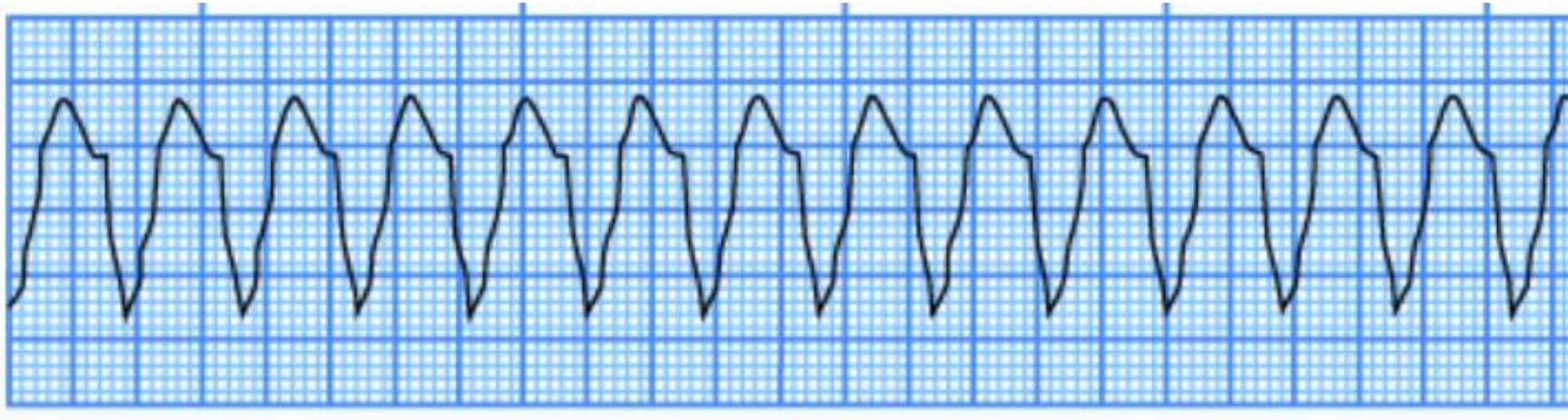
Idioventricular Rhythm IVR



- Rhythm: Ventricular usually regular
- Rate less than 40 bpm
- P waves: Absent
- No PR interval
- QRS complex is abnormally wide at least greater than .10 seconds

Ventricular Tachycardia

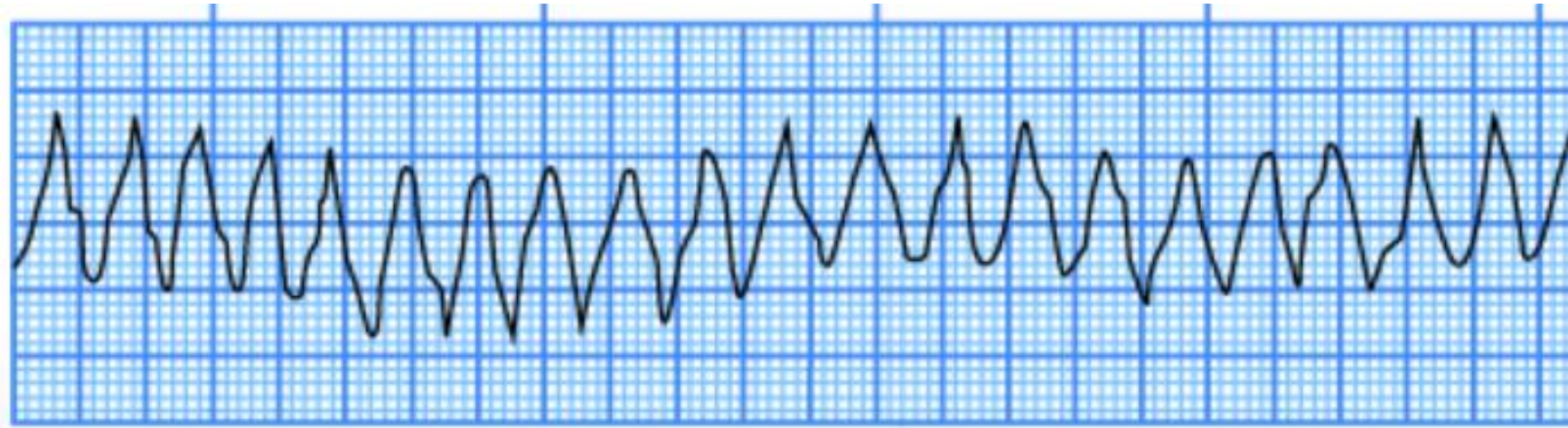
Ventricular tachycardia is a heart arrhythmia caused by abnormal electrical signals in the lower chambers of the heart.



- Rhythm is usually regular
- Atrial rate cannot be determined
- Ventricular range is usually between 150-250 beats per minute
- None of the QRS complexes are preceded by P waves
- This rhythm originates in the ventricles so there is no PR interval
- QRS complex wide, bizarre and measures at least .12 seconds

Torsades de Pointes

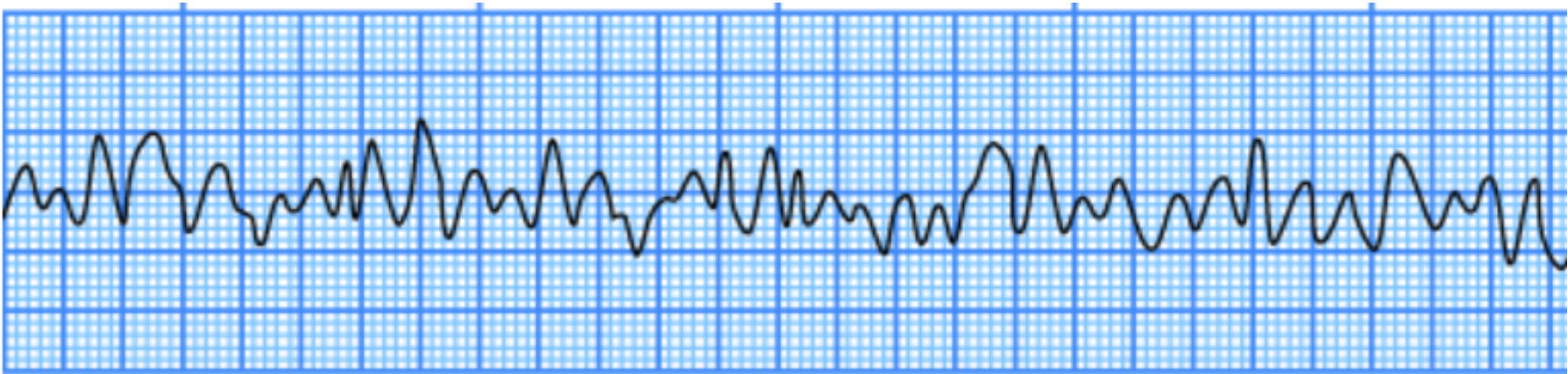
Torsades de Pointes means "twisting around the points" in French. It is an uncommon type of ventricular tachycardia.



- Hallmark appearance with both upward and downward deflection of the QRS complex about the baseline
- Rhythm is irregular
- Rate: 150-250 bpm
- No P waves
- QRS complex is abnormally wide (> 0.10 seconds) ,inconsistent size, shape or direction

Ventricular Fibrillation

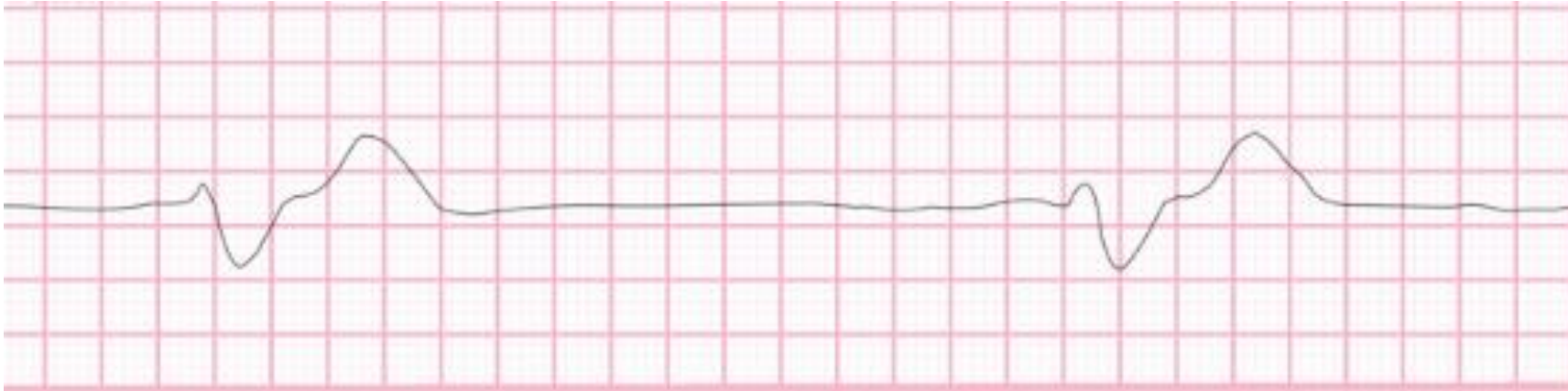
Ventricular fibrillation occurs in those with an underlying heart disease or from irritation to ventricular tissue.



- No waves or complexes can be analyzed
- Totally chaotic baseline
- No discernible P waves
- No PR intervals
- No discernible QRS complexes

Agonal Rhythm

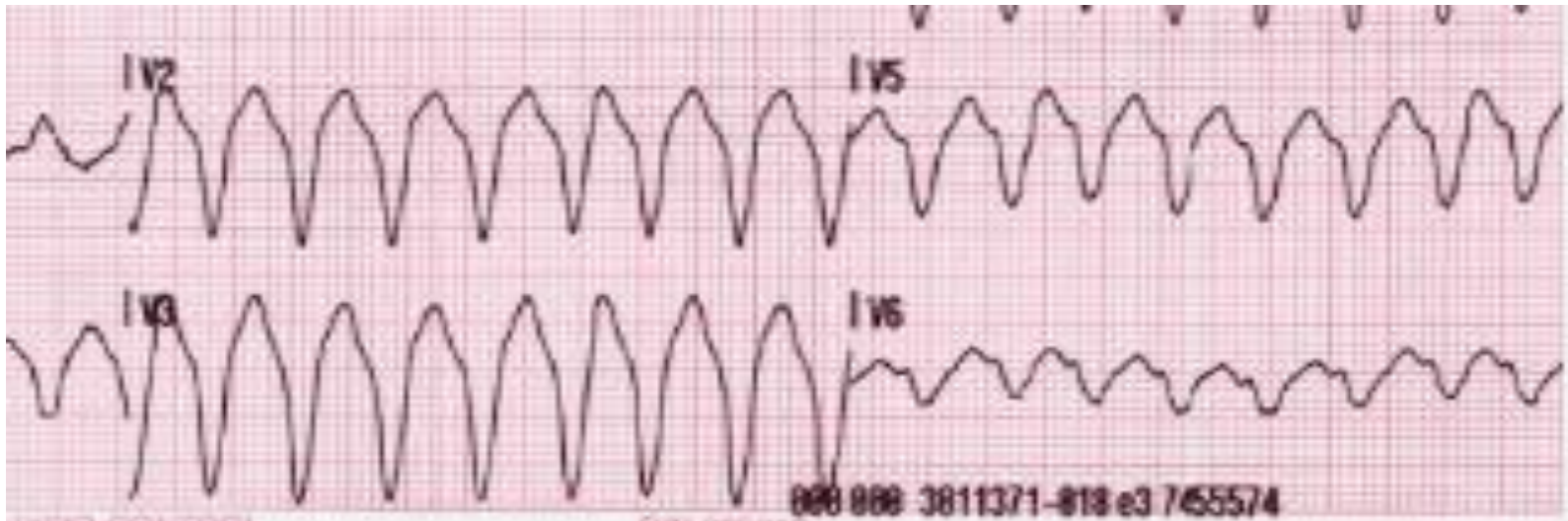
An agonal rhythm is a life-threatening dysrhythmia. It is often the last systematic appearance of organized electrical activity in the heart prior to death.



- Indicates progressive death of the myocardium
- Some refer to as dying heart pattern
- Ventricular Fibrillation or slow idioventricular rhythm
- QRS complexes become progressively wider while the amplitude decreases
- Untreated will terminate into asystole

Ventricular Tachycardia to Ventricular Fibrillation

Untreated or unresponsive ventricular tachycardia can lead to ventricular fibrillation.



Miscellaneous Rhythms

Asystole

Asystole is a cardiac arrest rhythm with no discernible electrical activity. The heart is not functioning.



- No electrical activity
- No rate
- No P waves
- No PR interval
- No QRS

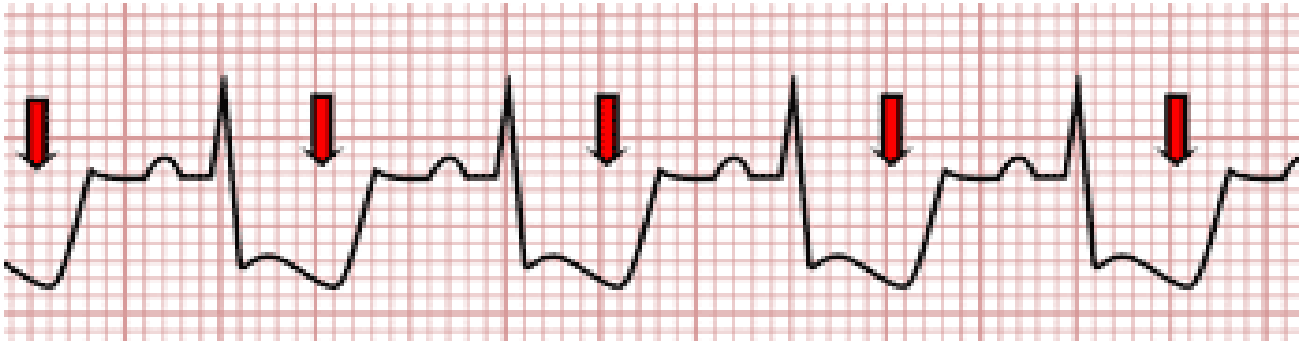
Artifact

Artifact can result from a variety of internal and external causes from muscle tremors to dry electrode gel to loose leads. Troubleshoot to make sure external causes are resolved.



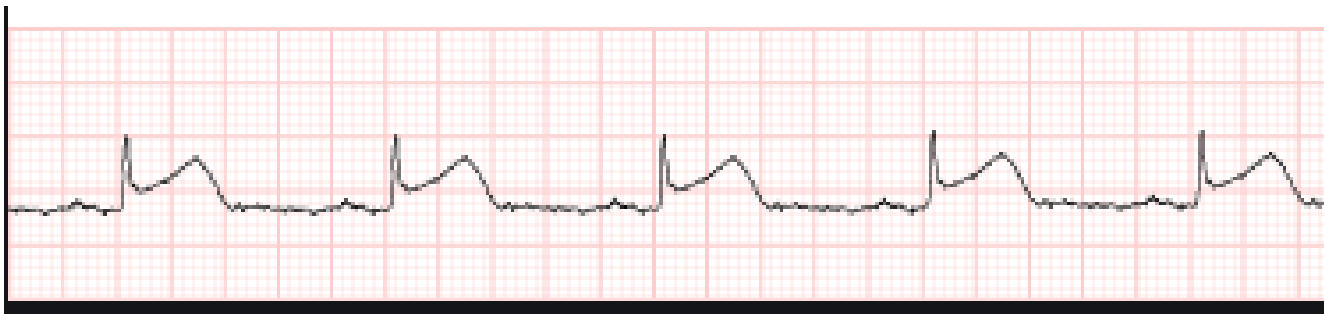
ST Segment Depression

Causes of ST depression are varied- hypothermia, hypokalemia, tachycardia, ischemia, drug related are examples of causes.



ST Segment Elevation

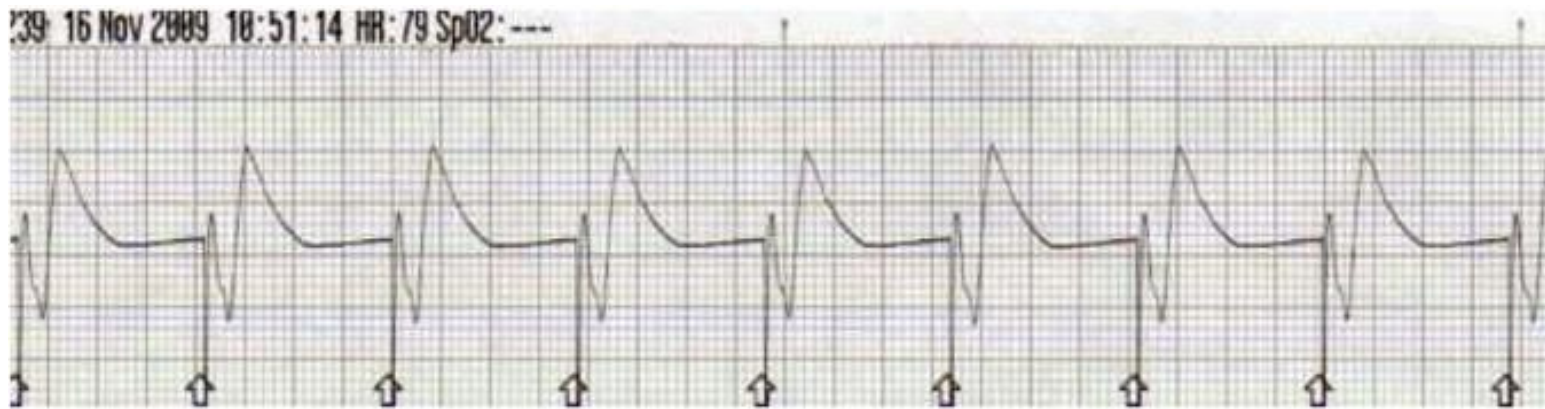
Causes of ST Elevation are varied and may include acute myocardial infarction, pericarditis, left bundle branch block, left ventricular hypertrophy, hyperkalemia, etc.



Pacemaker Rhythms

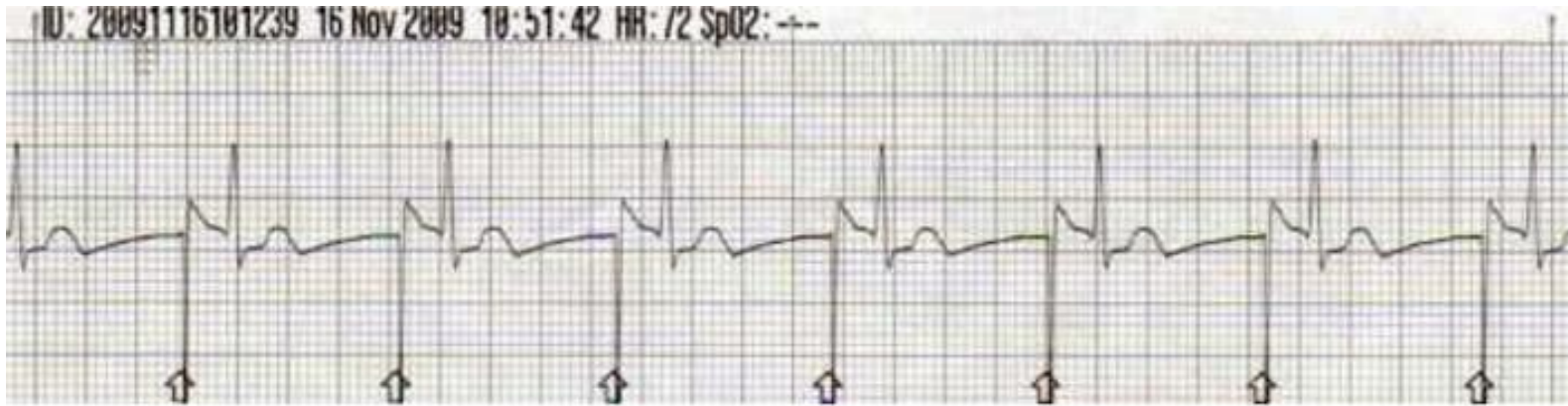
Ventricular Pacing

The ventricles are paced.



Atrial Pacing

The atria are paced.



AV Sequential Pacing

Both the atria and the ventricles are paced.



Failure to Sense

The strip shows the pacemaker competing with the patient's own rhythm and fails to sense the patient's natural pacemaker and corresponding contraction.



Failure to Capture

The pacemaker is firing but is failing to capture/generate a corresponding contraction.

