Foundations of ECG Interpretation

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INTRODUCTION

The heart is central to the success of all body systems. It has its own unique electrical system to stimulate the heart to contract in an orderly fashion. When there are complications with the electrical conduction system, this can result in an arrhythmia.

There can be many causes for arrhythmias including but not limited to electrolyte imbalances, heart disease, congenital anomalies, and substance abuse. Depending on the type and severity of arrhythmia, it could mean a life or death situation.

Technological advances have made it possible for cardiac monitors to actually identify a cardiac rhythm. However, it is the licensed clinician’s responsibility to confirm that the interpretation is accurate. Therefore, it is imperative for clinicians to understand how to properly interpret a cardiac rhythm with accuracy so appropriate treatment can be administered.

Clinical knowledge of basic rhythm interpretation begins with understanding the basic anatomy and physiology of the heart and the electrical conduction system. Understanding each of the components of a cardiac rhythm and how it corresponds to the mechanisms of the heartbeat is critical to the proper analysis and treatment of an arrhythmia.

PURPOSE/OVERALL GOAL

The purpose of this module is to serve as a review for individuals who have previously completed a formal ECG interpretation course.

This module is not intended to replace any formal training, nor is the primary focus on interventions. Rather, it is to serve as a review of the fundamental components for properly interpreting cardiac rhythms in the provision of safe and effective care.

- To protect content integrity, the learner will be unable to print this module.
- All strips in this module are six seconds in length.

COURSE OBJECTIVES

After completing this module, the learner should be able to:
1. Identify basic components of the electrical conduction system on the ECG
2. Identify and correlate the electrical conduction system to the cardiac cycle
3. Describe two ways to properly measure rhythm
4. Describe the basic steps to rhythm interpretation
OVERVIEW OF HEART FUNCTION

The heart is made up of four chambers: two atria and two ventricles, which are identified by right and left. During one cardiac cycle:

- Blood is emptied from the right atria into the right ventricle and is then pumped into the pulmonary vascular system
- At the same time, blood from the left atria empties into the left ventricle and is then pumped into the peripheral circulatory system

The heart’s ability to pump can only occur with electrical stimulation. This stimulation is the cardiac impulse of the heart through the electrical conduction system.

The cardiac conduction system is part of the complex autonomic nervous system made up of two branches:

- The sympathetic (or adrenergic)
- The parasympathetic (or cholinergic)

The sympathetic or adrenergic system releases two hormones: epinephrine and norepinephrine. These hormones:

- Speed up the heart rate
- Increase the force of the heart’s contraction
- Increase blood pressure

Sympathetic activation is well known for its flight or fight response. Conversely, the parasympathetic or cholinergic response releases acetylcholine and actually decreases the heart rate.
THE CARDIAC ELECTRICAL CONDUCTION SYSTEM

Basic steps to rhythm interpretation start with reviewing each component of the ECG complex.

ECGs (electrocardiograms) are a measure of electricity (voltage on the y-axis) over the time it takes for the impulse to travel through the heart fibers (milliseconds on the x-axis).

- An electrical impulse travels from the SA (sinoatrial node), located in the right atrium, through the walls of the atria, which causes them to contract.
- The impulse travels through the AV node, which is also located between the atria and ventricles, and then travels down through the bundle branches located in the ventricles.
- The contraction of muscles fibers in a normal fashion is called depolarization.
- Repolarization is the resting state, or relaxation phase, of the myocardium.
- Any delays in the electrical activity could indicate the presence of damage to the fibers in the conduction pathway such as in a myocardial Infarction or electrolyte imbalances, for example.
It’s important to understand the relationship between the electrical system of the heart and what we see on the cardiac monitor.

Electrical impulses that begin in the SA node are demonstrated on the ECG as the P-wave.

The P wave represents an atrial depolarization as seen in this illustration:
The electrical impulse then reaches the AV node, which is represented by the PR interval. The PR interval represents the time for the impulse to travel from the SA node, through the atria, and to the AV node. The AV node serves as the “gatekeeper” for all impulses traveling from the atria to the ventricles. The electrical impulses are delayed at the AV node before they are allowed to travel to the ventricles.

The electrical impulse spreads to the ventricles resulting in contraction. This can be visualized as the QRS complex.

The T-wave represents the resting phase or repolarization of the ventricles.

The cardiac cycle is complete via these components.
Here is a quick reference table with highlights of cardiac activity:

<table>
<thead>
<tr>
<th>QUICK TERMINOLOGY REFERENCE TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repolarization</td>
</tr>
<tr>
<td>Depolarization</td>
</tr>
<tr>
<td>P-wave</td>
</tr>
<tr>
<td>QRS complex</td>
</tr>
<tr>
<td>T-wave</td>
</tr>
<tr>
<td>Interval</td>
</tr>
<tr>
<td>ST segment</td>
</tr>
</tbody>
</table>
PUTTING IT ON PAPER

ECG tracings can be visualized and measured on graph paper. The electrical conduction that occurs in one beat are displayed on the grids. To better understand how to measure the different components of an ECG tracing, the following is a breakdown of how each grid is measured:

There are basic steps that a clinician can use when interpreting any cardiac rhythm. These are steps that should always be used when interpreting rhythms, as it can make a difference in arriving at the correct interpretation and applying the appropriate interventions.

Further, it is essential to understand the criteria each rhythm must meet and to note if the rhythm is regular and whether that rhythm falls within acceptable parameters (60-100 beats/min). For example, it is important to know if:

- A P-wave initiates every QRS complex
- A QRS complex follows every P-wave
- The PR intervals are constant

To get started, here are some helpful tips to follow when properly interpreting the cardiac rhythm:

1. Is the rhythm regular?
2. What is the rate?
3. Is there a P-wave that precedes every QRS complex and a QRS complex for every P-wave?
4. What is the PR interval? Is it consistent?
5. What does the QRS measure? Is it wide or narrow?
CALCULATING THE RATES

There are several methods that can be used to manually calculate rates. These methods may only be used if the rate is regular, such as in sinus rhythms, atrial flutter, and monomorphic ventricular tachycardia.

One simple, quick method provides a rough estimation but is commonly used in the clinical setting. Count the number of large squares between the R-waves using the following rates:

- 1 large square = 300
- 2 large squares = 150
- 3 large squares = 100
- 4 large squares = 75
- 5 large squares = 60

The five smaller boxes within the larger box represent increments of 5 beats.
- Using the method 300 - 150 - 100 - 75 - 60 in the above example, 3 large boxes noted between two R-waves, followed by roughly 2.5 small boxes would represent a ventricular rate of 85/min.
- Another method is to divide 1500 by the number of small squares between two R-waves. In the same example above, there are 17 small squares between the two R waves. Therefore, 1500 divided by 17 = 88.2 beats/min.
NORMAL SINUS RHYTHM (NSR)

The natural pacemaker of the heart is called the sinoatrial (SA) node. The SA node is what determines the normal/regular rhythm of the heart. This can be found in the right atrium where the electrical impulse begins and then travels down to the ventricles.

This rhythm indicates that the electrical conduction system is operating in an orderly fashion. The electrical impulse originates in the SA node (natural pacemaker) and travels through the AV node and to the ventricles to complete the cardiac cycle. Depending on the different nerve impulses it receives, the signals can cause the heart to beat faster or slower.

- The normal sinus rhythm rate for an adult is 60-100 beats/min.
- When there is a disruption or absence of a normal sinus rhythm, this is called an arrhythmia or abnormal heart rhythm.

Rhythm interpretation can be simple if a clinician understands the components of a rhythm strip and the criteria that must be met for a rhythm to be identified.
The criteria for normal sinus rhythm are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>60-100/min</td>
<td>Present/Upright</td>
<td>0.12 – 0.20 msec</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   • This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   • The rate on this rhythm strip is 85 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   • Yes, there is a P-wave for every QRS

4. What is the PR interval? Is it consistent?
   • The PR interval is 0.20 and is consistent

5. What does the QRS measure? Is it wide or narrow?
   • The QRS is less than 0.12 and is normal

Interpretation: This is a normal sinus rhythm
SINUS BRADYCARDIA (SB)

Sinus bradycardia occurs when the sinoatrial (SA) node fires at a rate less than 60 beats/minute. This occurs when the natural pacemaker does not signal the heart to beat faster resulting in a slower heart rate.

Contributing factors to sinus bradycardia include:
- Hypothyroidism
- Vagal stimulation
- Myocardial infarction
- Medications such as beta-blockers
- Hypoxia
- Well-conditioned athletes

Patient presentation:
- Patients may experience fatigue, dizziness, diaphoresis, and pallor.
- Hemodynamically compromised patients can experience syncope and in extreme cases, cardiac arrest.

Nursing considerations:
- Patients who have been physically active frequently have a resting heart rate less than 60 beats/minute. These individuals can maintain adequate perfusion with less exertion and remain asymptomatic.
- Some patients who enter a deep sleep may experience a heart rate below 60 beats/minute.
- Medication dosages such as beta-blockers, inotropes and calcium/sodium channel blockers may need to be adjusted.

A patient who becomes hemodynamically compromised requires immediate intervention. Interventions for SB include:
- Monitoring patient for symptoms of bradycardia such as dizziness and fainting
- Follow ACLS algorithms
- Symptomatic bradycardia can be treated with atropine or temporary pacing (transvenous or transcutaneous)
The criteria for sinus bradycardia are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>&lt;60/min</td>
<td>Present/Upright</td>
<td>0.12 – 0.20 msec</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

**Basic steps to rhythm interpretation:**

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is approximately 50 beats/minute

3. Is there a p-wave that initiates every QRS complex and a QRS complex for every p-wave?
   - Yes, there is a p-wave for every QRS

4. What is the PR interval? Is it consistent?
   - The PR interval is 0.20 and is consistent

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is 0.12 and is wide

**Interpretation:** This is sinus bradycardia
**SINUS TACHYCARDIA (ST)**

Sinus tachycardia occurs when the sinoatrial node fires rapidly at a rate greater than 100 and less than 150 beats/minute. There is usually an underlying cause for this rhythm. Sympathetic activity is usually a contributing factor in a patient presenting with sinus tachycardia.

Contributing factors to sinus tachycardia include:
- Exercise
- Pain
- Dehydration
- Alcohol Abuse
- Respiratory problems
- Pyrexia
- Anxiety
- Hypoxia
- Hypotension
- Stimulants such as caffeine
- Hyperthyroid activity

Patient presentation:
- Patients may experience dizziness, shortness of breath, rapid heart rate, palpitations, chest pain, and/or fatigue

Nursing considerations include:
- Closely monitor patients who have underlying cardiac disease.

Interventions for ST:
- Identify underlying cause and treat
- Follow ACLS algorithms
The criteria for sinus tachycardia are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>100-150/min</td>
<td>Present/Upright</td>
<td>0.12 – 0.20 msec</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is 150 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Yes, there is a P-wave for every QRS

4. What is the PR interval? Is it consistent?
   - The PR interval is 0.08 and is consistent

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is <0.12

Interpretation: This is sinus tachycardia
SINUS ARRHYTHMIA (SA)

Sinus arrhythmia originates from the SA node, but there is a cyclic change in the heart rate. It can occur simply with inspiration and expiration.

Contributing factors:
- Breathing in and out can be a causal factor to sinus arrhythmia. This typically occurs in young, healthy individuals. Due to vagal tone that occurs during inspiration, the heart rate varies.

Patient presentation:
- This is a normal physiologic occurrence.

Nursing considerations:
- Sinus arrhythmia normally occurs in healthy individuals.
- The most common population that experiences sinus arrhythmia is children.

Interventions for sinus arrhythmia:
- None, unless the patient is symptomatic.
The criteria for sinus arrhythmia are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular</td>
<td>60-100/min</td>
<td>Present/Upright</td>
<td>0.12 – 0.20 msec</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

**Basic steps to rhythm interpretation:**

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is irregular as indicated by irregular R-R intervals

2. What is the Rate?
   - The rate on this rhythm strip is approximately 80 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Yes, there is a P-wave for every QRS

4. What is the PR interval? Is it consistent?
   - The PR interval is normal and consistent

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is <0.12

**Interpretation:** This is sinus arrhythmia
PREMATURE ATRIAL CONTRACTION (PAC)

A premature atrial contraction (PAC) represents a contraction that originates in the atria (upper chambers of the heart) and not in the SA node. The cause is usually unknown although factors such as heart disease can be a contributor to PACs.

Patient presentation:
- Patient may complain of palpitations or feeling their heart “skip a beat.”
- Some patients may not feel anything or be aware.

Nursing considerations:
- The majority of PACs are benign and do not require treatment.

Interventions for PAC:
- None, unless cause is identified
The criteria for premature atrial contractions are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular</td>
<td>Defer to underlying rhythm</td>
<td>Present or hidden in T-wave</td>
<td>0.12 – 0.20 msec</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is irregular

2. What is the rate?
   - The rate on this rhythm strip is 70 beats/min, as indicated on the R-R intervals

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Yes, there is a P-wave for every QRS

4. What is the PR interval? Is it consistent?
   - The PR interval is 0.12 and is consistent

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12 and normal

Interpretation: This is normal sinus rhythm with frequent PACs
ATRIAL FIBRILLATION (A-FIB, AF)

Atrial fibrillation (A-fib) results when there are rapid and disorganized electrical signals in the heart’s atria that cause the atria to fibrillate.
- The very rapid and disorganized signals may prompt the ventricles to beat very rapidly with reduced cardiac output due to inadequate filling time.
- The AV node, serving as the “gatekeeper,” is unable to send the signals to the ventricles as fast as they arrive.
- Coordination between the atria and ventricles becomes nonexistent and results in a fast irregular heart rhythm.

Atrial fibrillation A-fib may happen intermittently or it may become long-term and last for years.
- A-fib with rapid ventricular response is when the ventricular rate is 100 to 175 beats per minute.
- Patients can also experience “controlled A-fib,” which means that ventricular response rate is within normal limits of 60-100.
- In paroxysmal atrial fibrillation, the A-fib can begin suddenly and stop on its own.
- In persistent atrial fibrillation, the rhythm continues for more than a week. It may stop on its own or with treatment.
- In permanent atrial fibrillation, the rhythm is nonresponsive to treatment and will not convert to a normal sinus rhythm; however, it may respond in rate reduction.

Contributing factors to A-fib include:
- Heart disease
- Alcohol use
- Obesity
- Hypertension
- Family history of atrial fibrillation

Patient presentation:
Most of the symptoms of A-fib are related to rapid ventricular response. Patients may experience:
- Palpitations
- Shortness of breath
- Weakness
- Chest pain
- Dizziness/fainting
- Fatigue
- Confusion

Nursing considerations:
- The fibrillations that occur in the atria prevent normal atrial contraction, causing poor emptying of the atria and increasing the risk of thrombus formation.
- Patients who experience paroxysmal and persistent A-fib over time may eventually remain in permanent A-fib.
Interventions include:
- Follow ACLS algorithms
- Anticoagulant therapy
- Rate control with medications such as beta blockers (metoprolol, atenolol), calcium channel blockers (diltiazem, verapamil), digitalis (digoxin)
- Rhythm control and/or chemical cardioversion with medications such as amiodarone, sotalol, flecainide, propafenone, dofetilide, ibutilide
- Electrical cardioversion
- Catheter ablation

**The criteria for atrial fibrillation are displayed here:**

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular</td>
<td>Atrial rate = will not be able to measure; Ventricular rate = varies</td>
<td>Fibrillatory waves (no discernable P-waves)</td>
<td>N/A</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

**Basic steps to rhythm interpretation:**

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is irregular, indicated by irregular R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is approximately 80 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - No discernible P-waves noted

4. What is the PR interval? Is it consistent?
   - No PR interval due to absence of P-waves

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

**Interpretation:** This is atrial fibrillation
ATRIAL FLUTTER (A-FLUTTER)

Atrial flutter is easily recognized by classic saw-tooth P-waves. Atrial flutters occur when the atria are beating faster than the ventricles can respond.
- The atrial rate can exceed 250 beats per minute.
- As the flutter waves arrive at the AV node, the AV node blocks some of the impulses.

Contributing factors to atrial flutter include:
- Underlying cardiac disease
- Hypertension
- Hyperthyroidism
- COPD (chronic obstructive pulmonary disease)
- History of cardiac surgery causing scarring
- History of atrial fibrillation

Patient presentation:
- Palpitations
- Increased heart rate
- Dizziness
- Hypotension
- Difficulty breathing
- Chest pain

Nursing considerations:
- A heart rate that is too slow or too fast can impact cardiac output; therefore, it is essential to monitor the patient’s ongoing response to rhythm and therapies.
- An increased risk for thrombus formation is present in patients who have been in atrial flutter for a prolonged period of time; however, it is less common than for patients in A-fib.

Interventions including, but not limited to:
- Follow ACLS algorithm
- Address underlying cause
- Pharmacologic therapy
- Synchronized cardioversion
The criteria for atrial flutter are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usually regular, can be irregular</td>
<td>Atrial rate = 250-350/min&lt;br&gt;Ventricular rate = varies</td>
<td>Flutter/saw-toothed waves</td>
<td>N/A</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular with flutter waves present

2. What is the rate?
   - Ventricular rate is approximately 70 beats/min, as indicated by R-R waves

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - No, only flutter waves

4. What is the PR interval? Is it consistent?
   - Unable to measure

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This is atrial flutter
ATRIAL TACHYCARDIA (SVT)

Atrial tachycardia is a supraventricular tachycardia (SVT) where there are episodes of rapid firing originating in the atria.

Contributing factors to atrial tachycardia include:
- Digoxin toxicity
- Wolf-Parkinson-White Syndrome
- PE (pulmonary embolus)
- Congenital/genetic predisposition

Individuals are at a higher risk if they engage in the following:
- Alcohol use
- Caffeine use
- Smoking
- Illicit drug use

Patient presentation:
- Cardiac output that is compromised due to rapid heart rate could cause patients to experience dizziness that could result in syncope.
- Symptoms may be brief or they could last for several hours and may stop and start suddenly.

Patients may also experience:
- Chest tightness
- Palpitations
- Shortness of breath
- Anxiety

Nursing considerations:
- Patients who experience atrial tachycardia may have this rhythm intermittently or it may last for hours.

Interventions include:
- Follow ACLS algorithms
- Perform a Valsalva maneuver (attempt to exhale with the nostrils and mouth closed, which increases pressure in the middle ear and the chest)
- Sit up with the upper body in a forward position and cough
- Synchronized cardioversion
- Pharmacologic intervention
- Cardiac ablation
- Pacemaker to override rapid heart rate
- Surgical intervention
The criteria for atrial tachycardia/SVT are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>150-350/min</td>
<td>? Hidden in QRS or T-wave</td>
<td>?</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular, as indicated by regular R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is 190 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Not evident

4. What is the PR interval? Is it consistent?
   - Unable to determine

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is <0.12

Interpretation: This is atrial tachycardia
JUNCTIONAL RHYTHMS OVERVIEW

Junctional rhythms occur when the AV node takes the primary role as the pacemaker. A junctional rhythm can be seen on the ECG when:

- There is a failure of the SA node
- There is an automatic tachycardia of the AV node

The junctional rhythm can be seen on the ECG as an escape rhythm that occurs during periods of significant bradycardia. This happens when:

- There is a failure of the SA node to fire
- The SA node becomes slower than the junctional pacemaker and the junctional pacemaker takes on this role

Junctional rhythms can be classified as:

- Junctional rhythm or junctional escape rhythm
- Accelerated junctional rhythm
- Junctional tachycardia

The primary distinguishing characteristics among the three has to do with the ventricular rates:

- Junctional rhythm or junctional escape rhythm = 40-60 beats/min
- Accelerated junctional rhythm = 60-100 beats/min
- Junctional tachycardia = >100 beats/min
JUNCTIONAL RHYTHM/JUNCTIONAL ESCAPE RHYTHM

Contributing factors to junctional rhythm/junctional escape rhythm:
- Digoxin toxicity
- Parasympathetic stimulation
- Myocardial infarction
- Drug use
- Cardiovascular surgery

Patient presentation:
- Palpitations
- Fatigue
- Dyspnea
- Lightheadedness
- Syncope

Nursing considerations:
- Close monitoring is essential in patients with underlying cardiac disease or in elderly patients who may have a low tolerance for decreased cardiac output.

Interventions include:
- Treat underlying cause
- Follow ACLS algorithms
- Pacemaker may be indicated in cases of severe bradycardia
The criteria for junctional rhythm/junctional escape rhythm are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>40-60/min</td>
<td>May appear inverted or absent</td>
<td>&lt;0.12, if present</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular, as indicated by regular R-R intervals

2. What is the rate?
   - The ventricular rate is approximately 52 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - The p-waves are absent

4. What is the PR interval? Is it consistent?
   - No p-waves; therefore, no PR interval

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This is junctional rhythm/junctional escape rhythm
PREMATURE JUNCTIONAL COMPLEX (PJC)

Premature junctional complex is a single premature impulse that originates in the AV node.

Contributing factors:
- Underlying heart disease
- Digoxin toxicity

Patient presentation:
- Patients may complain of palpitations, feeling dizzy or tired, but are usually asymptomatic.

Nursing considerations:
- Monitor patients for symptoms
- Identify and address underlying cause

Interventions:
- Most patients do not require treatment.
- If patient becomes symptomatic, treat symptoms and underlying cause.
The criteria for premature junctional contractions are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular</td>
<td>See underlying rhythm</td>
<td>May appear inverted or absent</td>
<td>&lt;0.12, if present</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   • This rhythm is irregular due to presence of PJC

2. What is the rate?
   • The rate is approximately 80 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   • There is a normal p-wave before every QRS complex, except with PJC

4. What is the PR interval? Is it consistent?
   • The PR interval is consistent where normal p-wave present

5. What does the QRS measure? Is it wide or narrow?
   • The QRS is < 0.12

Interpretation: This is normal sinus rhythm with PJC
ACCELERATED JUNCTIONAL RHYTHM

Accelerated junctional rhythm originates from the AV junction at a rate greater than the junctional pacemaker rate of 40-60 beats/minute. The rate for accelerated junctional rhythm occurs at 60-100 beats/minute.

Contributing factors:
- Digoxin toxicity
- History of cardiac surgery
- History of myocardial infarction
- Myocarditis
- Beta blockers
- Calcium channel blockers

Patient presentation:
- Palpitations
- Fatigue
- Dyspnea
- Lightheadedness
- Syncope

Nursing considerations:
- Close monitoring is essential in patients with underlying cardiac disease or in elderly patients who may have a low tolerance.

Interventions:
- Treat underlying cause
- Follow ACLS algorithms
The criteria for accelerated junctional rhythm are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>60-100/min</td>
<td>May appear inverted or absent</td>
<td>&lt;0.12, if present</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   - The ventricular rate is 90 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - No. The P-wave is absent.

4. What is the PR interval? Is it consistent?
   - N/A

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This is accelerated junctional rhythm
JUNCTIONAL TACHYCARDIA

Junctional tachycardia originates in the AV node with a heart rate greater than 100 beats/min.

Contributing factors:
- Myocardial Infarction
- Digoxin toxicity

Patient presentation:
- Palpitations
- Fatigue
- Dyspnea
- Lightheadedness
- Syncope

Nursing considerations:
- Close monitoring is essential in patients with underlying cardiac disease or in elderly patients who may have a low tolerance.

Interventions:
- Treat underlying cause
- Follow ACLS algorithms
The criteria for junctional tachycardia are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>&gt;100</td>
<td>May appear inverted or absent</td>
<td>&lt;0.12, if present</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the Rhythm Regular?
   - This rhythm is regular as indicated by the R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is 140 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - No P-waves are visible

4. What is the PR interval? Is it consistent?
   - N/A

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This is junctional tachycardia
PREMATURE VENTRICULAR COMPLEX (PVC)

Premature ventricular contractions are wide, bizarre complexes that originate in the lower portion of the ventricles. They are usually followed by a compensatory pause where the distance from the R wave of the preceding complex and the R wave of the complex following the PVC is exactly twice the R-R intervals of the underlying rhythm.

- PVCs can occur as a singular beat or in patterns such as bigeminal (every other beat) or trigeminal (every third beat).
- PVCs that occur together in pairs are called “couplets.”
- PVCs that occur with at least three beats in row would be classified as ventricular tachycardia.

Contributing factors:
- Myocardial infarction
- Electrolyte imbalance
- Hypoxia
- Underlying heart disease

Patient presentation:
- Patients may complain of palpitations with PVCs.
- It is rare that patients complain of dizziness or weakness.
- However, if a patient experiences frequent PVCs, couplets, or triplets, they may experience symptoms associated with a decreased cardiac output.

Nursing considerations:
- Depending on PVC frequency and the hemodynamic response, patients can become unstable very quickly. PVCs that are infrequent or isolated usually will not pose a threat. However, if PVCs become frequent, this could precipitate more serious ventricular arrhythmias.
- Cardiac output can be impacted in the event of frequent PVCs.
- Patients who experience three or more consecutive PVCs (a triplet) in a row are considered to have a three-beat run of ventricular tachycardia.
- Patients with underlying cardiac disease could be at increased risk for developing ventricular tachycardia, which is a life-threatening or lethal arrhythmia.

Interventions:
- Follow ACLS algorithms
- There may not be a need for intervention, if the patient is asymptomatic.
- If the patient becomes symptomatic, then intervention is required and would require treating underlying condition. Underlying causes may include electrolyte imbalance.
- Other interventions may include the use of lidocaine or amiodarone.
The criteria for premature ventricular complex (PVC) are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular</td>
<td>See underlying rhythm</td>
<td>Absent</td>
<td>N/A</td>
<td>&gt; 0.12 &amp; bizarre</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is irregular due to presence of PVC

2. What is the rate?
   - The rate on this rhythm strip is approximately 100 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - A P-wave is present before every QRS except for PVC

4. What is the PR interval? Is it consistent?
   - The PR interval is 0.16 and consistent when present.

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This is sinus tachycardia with rare PVC
VENTRICULAR TACHYCARDIA (V-TACH)

Ventricular tachycardia is when there is a sustained rhythm of three or more PVCs in a row.

Contributing factors:
- Myocardial infarction
- Electrolyte imbalance
- Hypoxia
- Cardiomyopathy (ischemic and non-ischemic)
- Pulmonary embolism

Patient presentation:
- Palpitations
- Dizziness
- Syncope
- Weakness
- Shortness of breath
- Chest pain
- Anxiety/sense of impending doom

Nursing considerations:
- Ventricular tachycardia is a life-threatening arrhythmia
- Cardiac output can be impacted due to lack of filling time and organized contraction of the ventricles
- Ventricular tachycardia that is sustained will usually deteriorate into ventricular fibrillation

Interventions include:
- Follow ACLS algorithms
- If patient has no pulse, begin CPR and defibrillate immediately
- If patient has a pulse, is symptomatic and unstable then prepare to perform synchronized cardioversion immediately
- If patient has a pulse but stable then monitor closely for deterioration in condition
- Pharmacotherapy
- Continue to monitor and assess for underlying causes such as low magnesium or myocardial ischemia
The criteria for ventricular tachycardia are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usually regular</td>
<td>&gt;100</td>
<td>N/A</td>
<td>N/A</td>
<td>&gt; 0.12 &amp; bizarre</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular

2. What is the rate?
   - The ventricular rate on this rhythm strip is approximately 160 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - N/A

4. What is the PR interval? Is it consistent?
   - N/A

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is > 0.12, wide and bizarre

Interpretation: This is ventricular tachycardia
VENTRICULAR FIBRILLATION (V-FIB)

Ventricular fibrillation is a rapid, uncontrolled twitching or quivering of the lower chambers of the heart.

Contributing factors:
- Underlying cardiac disease
- History of cardiac surgery
- Accidental electrical shock injuries
- Drug toxicity
- Cardiomyopathy
- Ventricular tachycardia
- Pulmonary embolism

Patient presentation:
- Unconscious
- No pulse

Nursing considerations:
- Patients who experience ventricular fibrillation will collapse or become unconscious immediately. Cardiac output will be impacted and the patient will lose perfusion to vital organs including the brain.
- ALWAYS check the patient first with this rhythm.
- If a patient remains in V-fib, the rhythm will eventually deteriorate to asystole.
- Ventricular fibrillation will lead to death within a few minutes unless treated with appropriate interventions.

Interventions:
- Follow ACLS algorithms
- Ventricular fibrillation requires IMMEDIATE intervention
- CPR and defibrillate; defibrillation is the only effective treatment and must be performed immediately.
- If patient is unresponsive and a defibrillator is unavailable, call for help and begin CPR
- Pharmacotherapy
The criteria for ventricular fibrillation are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaotic</td>
<td>Unable to measure</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is chaotic

2. What is the rate?
   - N/A

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - N/A

4. What is the PR interval? Is it consistent?
   - N/A

5. What does the QRS measure? Is it wide or narrow?
   - N/A

Interpretation: This is ventricular fibrillation
IDIOVENTRICULAR RHYTHM

An idioventricular rhythm occurs when the ventricular conduction system takes over and becomes the dominant rhythm when all other intrinsic pacemakers have failed. The ventricular rate occurs at 20-50 beats/minute and can be seen on the ECG as a wide QRS. This rhythm may also be called ventricular escape rhythm.

Contributing factors:
- Digoxin toxicity
- Myocardial infarction
- Electrolyte imbalance
- Drug use

Patient presentation:
Cardiac output can be compromised due to lack of the SA node firing and loss of atrial kick; patients may experience:
- Dizziness
- Shortness of breath
- Hypotension leading to syncope

Nursing considerations:
The patient in an idioventricular rhythm is at high risk for ventricular standstill. Patient should be monitored closely for significant hemodynamic compromise.

Interventions:
The goal in idioventricular rhythms is to increase heart rate and cardiac output.
- Follow ACLS algorithm
- Apply external pacemaker
- Pharmacotherapy may include medications to increase heart rate and blood pressure in the hemodynamically unstable patient
The criteria for idioventricular rhythms are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>20-50/min</td>
<td>Absent</td>
<td>Absent</td>
<td>&gt;0.12</td>
</tr>
</tbody>
</table>

**Basic steps to rhythm interpretation:**

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   - The ventricular rate on this rhythm strip is approximately 45 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - There are no P-waves present

4. What is the PR interval? Is it consistent?
   - N/A

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is > 0.12 and is wide

**Interpretation:** This is idioventricular rhythm
ACCELERATED IDIOVENTRICULAR RHYTHM

An important distinction to note in the criteria for accelerated idioventricular rhythm is the rate.

The criteria for accelerated idioventricular rhythms are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>50-100/min</td>
<td>Absent</td>
<td>Absent</td>
<td>&gt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   - The ventricular rate on this rhythm strip is approximately 70 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - There are no P-waves present

4. What is the PR interval? Is it consistent?
   - N/A

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12 and is wide

Interpretation: This is accelerated idioventricular rhythm
ASYSTOLE

Asystole is an absence of electrical activity and, therefore, no cardiac contraction occurs. This is a terminal rhythm.

Contributing factors:
- Massive pulmonary embolus
- Myocardial infarction
- Cardiac tamponade
- Hyperkalemia
- Hypoxemia
- Drug overdose
- Respiratory failure

Patient presentation:
- Patients who are in true asystole for more than several seconds will be unresponsive.
- Due to the absence of ventricular depolarization, patients in asystole will have no pulse.

Nursing considerations:
- ALWAYS check patient first and confirm in TWO Leads.
- Loose or disconnected ECG leads and low gain are common findings and can appear to be asystole on the cardiac monitor in an alert patient.

Interventions:
- Once a patient is confirmed unresponsive and pulseless, initiate CPR immediately.
- Follow ACLS guidelines
- Pharmacotherapy
The criteria for asystole are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>No activity</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
</tbody>
</table>

**Basic steps to rhythm interpretation:**

1. In the above rhythm strip, is the rhythm regular?
   - No activity present

2. What is the rate?
   - Absent

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Absent

4. What is the PR interval? Is it consistent?
   - Absent

5. What does the QRS measure? Is it wide or narrow?
   - Absent

**Interpretation:** This is asystole
1ST DEGREE HEART BLOCK

1st degree heart block is when the electrical impulses are slowed longer than normal at the AV node when they move from the atria to the ventricles.

- This can be seen on the ECG as a longer PR interval.
- Patients are usually asymptomatic and do not require any treatment.

Contributing factors:

- Medications such as beta blockers or calcium channel blockers
- History of myocardial infarction
- Rheumatic fever
- Cardiomyopathy
- Myocarditis
- Chronic heart failure
- Congenital heart disease

Patient presentation:

- May not cause symptoms or require any interventions

Nursing considerations:

- 1st degree heart block may occur in healthy persons
- 1st degree heart block could progress into 2nd degree heart block or 3rd degree heart block

Interventions:

- Requires no interventions but ongoing monitoring is necessary
The criteria for 1st degree heart block (AVHB) are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>60-100/min</td>
<td>Present/Upright</td>
<td>&gt;0.20 msec</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is regular as indicated with regular R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is 80 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - A P-wave is present for every QRS

4. What is the PR interval? Is it consistent?
   - The PR interval is 0.32 and consistent

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This is normal sinus rhythm with 1st degree heart block (AVHB)
2ND DEGREE HEART BLOCK TYPE I (MOBITZ I/WENCKEGBACH)

In 2nd degree heart block type I, the AV node progressively delays the conduction, which can be seen with a progressively increasing PR interval.

- This progresses until the QRS is dropped and then the cycle repeats.
- The PR interval is longer immediately prior to the dropped beat and shorter immediately after the dropped beat.

Contributing factors:
- Medications such as beta blockers or calcium channel blockers
- History of myocardial infarction
- Rheumatic fever
- Cardiomyopathy
- Myocarditis
- Chronic heart failure
- Congenital

Patient presentation:
- Fainting
- Dizziness/light headedness
- Fatigue
- Dyspnea
- Chest pain

Nursing considerations:
- 2nd degree heart block type I is less serious than type II; however, patients should be monitored for response

Interventions:
- Treatment of underlying cause
- Follow ACLS Algorithm
- If symptomatic bradycardia, treatment will include pacing or chronotropic drugs
The criteria for 2nd degree heart block type I are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular</td>
<td>60-100/min</td>
<td>Present/Upright</td>
<td>Progressively longer until a QRS drop</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is irregular as indicated by irregular R-R intervals

2. What is the rate?
   - The rate on this rhythm strip is approximately 60 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Yes, there is a P-wave for every QRS

4. What is the PR interval? Is it consistent?
   - The PR interval lengthens and is not consistent

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This rhythm is 2nd degree heart block type I
2ND DEGREE HEART BLOCK TYPE II (MOBITZ TYPE II)

2nd degree heart block type II (Mobitz type II) is when the sinus impulses are intermittently blocked when they reach the AV node. This is represented by non-conducted P-waves without an accompanying QRS.

A 2:1 AV heart block can also occur in a type II. This is when a QRS complex does not follow every other P-wave so that there is 2:1 conduction, or 2 P-waves for every QRS complex.

Contributing factors:
- History of myocardial infarction
- Severe coronary artery disease
- Digoxin toxicity

Patient presentation:
- Fainting
- Dizziness/light-headedness
- Fatigue
- Dyspnea
- Chest pain

Nursing considerations:
- 2nd degree heart block type II is less common than type I; however, it is usually more severe and more likely to progress to 3rd degree heart block.

Interventions:
- Treatment is determined by patient’s signs and symptoms
- Follow ACLS algorithms
- Pacemaker, if indicated
The criteria for 2nd degree heart block type II (Mobitz type II) are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular (could be regular intermittently)</td>
<td>&lt;60/min</td>
<td>Present/Upright</td>
<td>Consistent or fixed, but will be prolonged when followed by QRS</td>
<td>&lt;0.12 msec</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is irregular due to dropped QRS

2. What is the rate?
   - The rate is approximately 70 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - Yes, there is a P-wave for every QRS that is present

4. What is the PR interval? Is it consistent?
   - The PR intervals are consistent and do not lengthen

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12; there is a noted dropped QRS

Interpretation: This rhythm is 2nd degree heart block type II (Mobitz type II)
3RD DEGREE HEART BLOCK

A 3rd degree heart block is also known as complete heart block or AV dissociation. This occurs when the AV node is nonfunctional.

- The SA node continues to cause atrial contractions, but electrical impulses from the atrium do not reach the ventricles.
- Ventricular or Junctional escape rhythms lead to ventricular contractions.
- There is no coordination between the P-waves and the QRS complexes.

Contributing factors:
- History of infections such as rheumatic fever, myocarditis
- Medications such as beta blockers and calcium channel blockers
- Digoxin toxicity
- Myocardial infarction
- History of cardiac surgery

Patient presentation:
- This patient can be hemodynamically unstable and may experience severe hypotension, syncope and death.
- Some patients can experience minimal symptoms such as dizziness or weakness.

Nursing considerations:
- 3rd degree Heart Block can result in sudden cardiac arrest and death.

Interventions:
- Follow ACLS algorithm
- Treatment is almost always required
- If a cause is identified such as medications, the cause will need to be removed
- If the cause such as cardiac disease is identified, it will need to be addressed
- Temporary pacemaker
- Permanent pacemaker
The criteria for 3rd degree heart block are displayed here:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Rate</th>
<th>Presence of P-wave</th>
<th>PR Interval</th>
<th>QRS Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial rates and ventricular ratios</td>
<td>Regular</td>
<td>Present/Upright</td>
<td>No relationship between P-waves and QRS</td>
<td>Varies, depending on if junctional or ventricular escape beat</td>
</tr>
</tbody>
</table>

Basic steps to rhythm interpretation:

1. In the above rhythm strip, is the rhythm regular?
   - This rhythm is slightly irregular

2. What is the rate?
   - The rate on this rhythm strip is 50 beats/minute

3. Is there a P-wave that initiates every QRS complex and a QRS complex for every P-wave?
   - There is no relationship between the P-wave or the QRS, they are dysfunctional

4. What is the PR interval? Is it consistent?
   - Since there is no relationship between the P-wave and QRS, no measurements of PR intervals can be determined

5. What does the QRS measure? Is it wide or narrow?
   - The QRS is < 0.12

Interpretation: This rhythm is 3rd degree heart block
PACED RHYTHMS OVERVIEW

A pacemaker is a device that can be implanted in the chest or in the abdomen and is used to help control the heart rate when it becomes too fast or too slow. A pacemaker:

- Can be temporary or permanent
- Can be transthoracic, transvenous, or epicardial

When the heart’s intrinsic conduction system is defective, a pacemaker uses low-energy impulses to overcome this malfunction.

- Temporary pacemakers are used to treat short-term arrhythmias such as after a myocardial infarction or cardiac surgery, or until rate-limiting medications wear off.
- Permanent pacemakers are used to treat long-term arrhythmias.

The newer pacemaker models can measure core temperature, respirations and other physiologic components. They can even adjust the heart rate according to a patient’s activity level.

Indications for pacemakers include:

- Sinus bradycardia
- Sick sinus syndrome
- Atrial fibrillation for rate control
- Heart blocks
- Long QT syndrome

Patient presentation:

- Patients whose pacemaker is functioning properly can experience relief from the symptoms of their underlying arrhythmia.
- A pacemaker can enable patients to resume a more active lifestyle.

Nursing considerations:

- Patients who have a permanent pacemaker will require periodic monitoring after discharge to ensure their pacemaker is functioning properly
- Always know the type of pacemaker your patient has and how that pacemaker is expected to function (i.e., is it a demand pacemaker or rate-controlled?)

Interventions:

- None unless there is a malfunctioning pacemaker

NOTE: It is essential for the clinician to know what type of pacemaker a patient in order to interpret the rhythm properly. For the purpose of this module, we will look at atrial-ventricular and ventricular paced rhythms.
ATRIAL-VENTRICULAR PACING (DUAL CHAMBER PACING)

In atrial-ventricular pacing, there should be a spike before a P-wave and a spike for every QRS.
VENTRICULAR PACING (SINGLE CHAMBER PACING)

In ventricular paced rhythms, a spike will only appear before the QRS.
PACEMAKER MALFUNCTION

The two main types of programming for pacemakers are demand pacing and rate-responsive pacing.
- A demand pacing pacemaker will monitor the heart rhythm and only send electrical impulse when the rhythm is too slow or too fast.
- Rate-responsive pacing is dependent on level of activity and will speed up or slow down depending on activity levels. It monitors the sinus node rate, breathing, body temperature and other factors to determine activity level.

Pacemaker malfunction can cause various symptoms such as syncope, dizziness, palpitations and a slow or fast heart rate.
- Malfunctioning pacemakers can over-sense a patient’s rhythm by recognizing cardiac activity inappropriately and, therefore, an electrical impulse will not be sent.
- Under-sensing occurs when the pacemaker fails to recognize cardiac activity and sends electrical impulses inappropriately.
- Failure to capture occurs when the pacemaker fires an electrical impulse and there is no subsequent cardiac activity (i.e., depolarization).
- Output failure occurs when there should be pacemaker activity and it is absent.

Causes of pacemaker malfunction include:
- Improper positioning of lead
- Improper programming
- Lead breaking, dislodging, or perforating
- Depletion of battery
- Electromagnetic interference
- Pulse generator failure

It is important to identify and address the underlying cause of pacemaker malfunctions as soon as possible.
**SOUNDING THE ALARM!**

We have heard a lot recently about alarm fatigue and the devastating impact it can have on patient outcomes. Hospital environments are inundated with alarms – bed alarms, IV pumps, ventilators, call lights to heart monitors.

Health care providers can become overwhelmed with alarm activity. Desensitization can occur and unfortunately, patient harm can result. In fact, The Joint Commission has included Clinical Alarm Safety as one the National Patient Safety Goals (NPSG).

NPSG.06.01.01 included requiring hospitals to establish alarms as a priority for organizations. This goal also includes incorporating specific components around alarm system management into policies and procedures which will include education.

Alarms that are not managed properly can cause unintended consequences on patient safety. It is important for the clinician to understand their organization’s policy regarding alarm system management such as:

- Points when alarm signals can be disabled
- Who has the authority to set alarm parameters
- Who can change alarm parameters
- Process for monitoring and responding to alarms
- Assessing individual alarm signals for accuracy and detecting

Healthcare providers who are responsible for monitoring cardiac rhythms should be aware of their unit’s policies regarding alarm system management and ensure they respond to the sound of an alarm. There is a reason the alarms are set – and they do require an appropriate response.
CONCLUSION

The ability to properly interpret a cardiac rhythm begins with an understanding of the electrical conduction system and the physiologic components to the cardiac cycle. This module has identified basic components of the electrical conduction system and the cardiac cycle, measured and interpreted cardiac rhythms, and looked at critical implications for interpretation.

Properly analyzing and interpreting cardiac rhythms is a key component to providing safe and effective patient care. By reviewing the basic steps of interpretation and understanding the criteria for each rhythm contained in this module, the clinician can better identify lethal arrhythmias and respond appropriately.

REFERENCES:

- Heart Rhythm Society, Atrial Flutter. Available at http://www.hrsonline.org/Patient-Resources/Heart-Diseases-Disorders/Atrial-Flutter#axzz3cZg012lH. Accessed June 8, 2015.


