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Identifying and Interpreting Basic ECG Rhythms: A Bedside Guide for Nurses

Section 1: Introduction 2

Section 2: Review of the Cardiac Conduction System 2

Section 2 Personal Reflection 4

Section 3: ECG Monitoring 4

Section 3 Personal Reflection 7

Section 4: Cardiac Rhythms 7

Normal Sinus Rhythm 10

Premature Atrial Contraction (PAC) 12

Atrial Fibrillation 13

Atrial Flutter 14

Supraventricular Tachycardia (SVT) 15

Premature Ventricular Contractions 17

Ventricular Tachycardia 18

Ventricular Fibrillation 19

Heart Block 20

Bundle Branch Block 22

Long QT syndrome 25

Cardiac Arrest 26

Section 4 Personal Reflection 27

Section 5: Nursing Implications 27

Section 5 Personal Reflection 30

Section 6: Case Studies 30

Section 7: Conclusion 34

References 35

Section 1: Introduction

Since the invention of the ECG, valuable information has been learned and used to identify and treat many cardiac conditions. Access to this monitoring has expanded with advances in technology, making ECG monitoring available to anyone wearing a capable smartwatch (Friedman, 2024). Patients can now obtain their own ECGs, and nurses must be prepared to provide evidence-based education about the information patients obtain from smart devices. Early detection of cardiac arrhythmias is critical for timely treatment and the prevention of morbidity and mortality (Katal et al., 2023). Therefore, nurses must be able to recognize potentially dangerous ECG rhythms and intervene appropriately to facilitate optimal outcomes.

ECG monitoring is the heart of cardiac care and is present in every nursing setting. Nurses must understand the elements of ECG, including how the cardiac conduction system works and the cardiac rhythms they may encounter in practice. In addition to recognizing cardiac rhythms, nurses must respond appropriately when a concerning rhythm is identified and feel confident in knowing when the patient requires emergency services or higher-level care. Nurses should be knowledgeable about evidence-based nursing interventions and treatments to support optimal outcomes in cardiac care.

Section 2: Review of the Cardiac Conduction System

To understand the various cardiac rhythms found on an ECG, nurses must understand cardiac conduction. Essentially, the heart is a pump composed of muscle tissue and nerves, regulated by an electrical conduction system. This electrical regulation ensures the contractions of the heart's various chambers are coordinated to accomplish the heart's vital role of circulating blood, and therefore oxygen, to the entire body (Johns Hopkins Medicine, 2026).

The cardiac conduction system consists of two types of cardiac cells that regulate the heartbeat. These are conducting cells that carry electrical signals through depolarization and repolarization, and muscle cells that respond to these signals by contracting (Cleveland Clinic, 2025b). To initiate a heartbeat, the sinus node, also known as the sinoatrial node or SA node, generates an electrical stimulus. The SA node is a small mass of specialized tissue (Johns Hopkins Medicine, 2026), called pacemaker cells (NHLBI, 2025), located in the upper portion of the right atrium. The sinus node is only a few square millimeters in size, yet it is known as the pacemaker of the heart (Kashou et al., 2022).

The SA node generates a spontaneous electrical stimulus at regular intervals at a rate of 60-100 beats per minute in a healthy adult under normal conditions. This stimulus from the SA node activates the atria and travels through the conduction pathway to the atrioventricular (AV) node (Johns Hopkins Medicine, 2026). The AV node is another area composed of pacemaker cells (NHLBI, 2025). At this point, the electrical signal is slowed for a very short period at the AV node, located between the atria and ventricles (NHLBI, 2025). This slowing is necessary so the atria contract before the ventricles. If they were to contract simultaneously, the heart would not be able to pump blood efficiently. The electrical current then travels down the pathway through the bundle of His (pronounced "hiss"), also known as the atrioventricular bundle. The bundle of His bifurcates into left and right bundle branches that arc throughout the ventricles as Purkinje fibers. Purkinje fibers are extensions of the left and right bundle branches and stimulate the ventricles to contract (Oberman et al., 2023). Each ventricle contraction is considered one heartbeat, with the atria contracting just a fraction of a second before the ventricles, allowing blood to empty from the atria into the ventricles prior to the muscle contraction (Johns Hopkins Medicine, 2026). When the ventricles relax, the process begins again in the SA node (NHLBI, 2025).

Section 2 Personal Reflection

Why do you think it is important for nurses to understand the basics of the cardiac conduction system? Why is the SA node known as the pacemaker of the heart? How can alterations in conduction be problematic?

Section 3: ECG Monitoring

Electrocardiogram (ECG or EKG) monitoring has been used as a non-invasive diagnostic and monitoring modality for over a century. ECG monitoring was first invented in 1902 by Dutch physician Willem Einthoven. The word electrocardiogram is derived from the German word “elektro-kardiographie”, which is why the abbreviations ECG and EKG are interchangeable. Today, ECG is used globally to improve health outcomes in almost every healthcare setting. Because of its importance for monitoring, screening, diagnosing, and research, there are many indications for using the ECG. ECG is widely accessible and is only contraindicated when the patient refuses or is allergic to the adhesive on the ECG leads (Sattar & Chhabra, 2023).

There are three primary types of ECG. A resting ECG is performed with the patient lying supine. An exercise ECG, also called a stress ECG, is intended to monitor heart conduction during physical activity. An ambulatory ECG, also known as a Holter monitor, records the heart’s electrical activity for 24 hours or more. There are different types of ambulatory ECG monitoring devices, and this technology is especially helpful for patients who experience intermittent adverse cardiac symptoms (InformedHealth.org, 2023).

A 12-lead ECG, the standard for monitoring the heart's electrical activity, records the electrical activity of the heart using two types of adhesive leads. Limb leads view the electrical activity of the heart in a vertical plane, while precordial leads view it in a horizontal plane (InformedHealth.org, 2023). The placement of ECG leads must be correct to provide clinically useful results. The limb leads (I, II, III aVR, and aVF) are labeled RA, LA, RL, and LL and are color-coded to aid in placement. Red corresponds with the right arm, yellow with the left arm, green with the left leg, and black with the right leg. The precordial leads are V1-V6 and are affixed to the chest. The angle of Louis method is most commonly used for precordial lead placement. V1 is placed on the chest to the right of the sternal border, and V2 is placed to the left of the sternal edge. V4 is placed at the fifth intercostal space at the mid-clavicular line and is placed before affixing V3. V3 is placed between V2 and V4. V5 is placed between V4 and V6. V6 is placed at the fifth intercostal space at the mid-axillary line. When correctly placed, V4, V5, and V6 should line up horizontally along the fifth intercostal space (Sattar & Chhabra, 2023).

An ECG test measures both the magnitude and direction of the electromagnetic force and produces a graphic depiction on electrocardiograph paper, which can be interpreted by the healthcare team. An electrocardiograph, the portion of the machine that produces the reading, prints at a speed of 25 mm/second, usually in black. This standardized printing speed is essential for accurate ECG interpretation. The electrocardiograph paper is preprinted, usually in red, with time plotted on the x-axis and voltage plotted on the y-axis. On the time axis, one second is divided into five large squares, with each large square representing 0.2 seconds. Each large square is subdivided into five small squares, each representing 0.04 seconds. On the voltage axis, 1 millivolt is equal to 1 centimeter, or five of the large squares in a vertical row (Sattar & Chhabra, 2023).

The electrocardiograph produces waves that represent the polarization and depolarization of the myocardium over time. This is best understood as waves and intervals. The first wave, called the P wave, represents depolarization of the atrial muscle (Setiawidayat, 2023). A typical P wave should last less than 0.12 seconds and be less than 2.5 mm in amplitude. It should have an upward, rounded, and consistent appearance (Open RN, 2023). Next, the QRS complex represents ventricular depolarization as the electrical current passes down the AV node. The Q waves of the QRS complex represent depolarization of the interventricular septum. The Q wave is not always visible on the ECG (Sattar & Chhabra, 2023), but should have a downward deflection (Open RN, 2023). The R-wave is the tallest of the QRS complex and represents the electrical stimulus traveling through the ventricles during depolarization (Sattar & Chhabra, 2023). The R-wave should be an upward spike (Open RN, 2023). The S-wave represents depolarization of the Purkinje fibers and is visualized as a downward deflection after the R wave (Sattar & Chhabra, 2023). The QRS complex should have a duration of 0.06-0.12 seconds and an amplitude of 1.0-3.0 mm. Finally, the T wave represents ventricular repolarization. Each wave measures the peak amplitude, and the space between points on the wave is called an interval or segment (Setiawidayat, 2023). The PR interval represents the length of time that lapses between the beginning of the P wave (atrial depolarization) and the beginning of the R wave (ventricular depolarization). The ST segment represents the time lapse between the end of ventricular depolarization and the beginning of ventricular repolarization. The QT interval represents the start of depolarization of the ventricles to the end of repolarization of the ventricles (Sattar & Chhabra, 2023). The amplitude and morphology (shape) of the waves, as well as the lengths of the intervals, are important for interpreting ECG results (Setiawidayat, 2023). Other waves may be visible on the ECG and usually indicate an abnormality (Sattar & Chhabra, 2023).

Section 3 Personal Reflection

Why do you think a 12-lead ECG is the “gold standard” for evaluating conduction? What does an ECG measure exactly? What are the different waves of the ECG? How is it helpful to have standardized terminology for ECGs? What does an alteration in an ECG indicate?

Section 4: Cardiac Rhythms

When discussing cardiac function, it is important to remember that conduction refers to how electrical impulses travel through the heart, while rhythm describes how the heart beats. When conduction disorders occur, arrhythmias can develop (AHA, 2024) because the electrical signals of the heart are not generated properly, do not travel through the cardiac conduction system appropriately, or both (NHLBI, 2025). Arrhythmias can be triggered by alterations in blood glucose, caffeine, illegal drug use, certain medications, dehydration, electrolyte imbalances, physical activity, intense emotional stress, anxiety, anger, pain, startling, vomiting, or coughing (NHLBI, 2022). Symptoms of arrhythmias include shortness of breath, chest pain, heart palpitations, dizziness, fainting, and fatigue (Cleveland Clinic, 2025b).

When reviewing an ECG, leads I, II, aVF, and V1 are used to interpret the cardiac rhythm (Sattar & Chhabra, 2023). An ECG should be interpreted using a systematic approach. First, the atrial and ventricular rates should be calculated. The simplest way of counting a ventricular rate is to identify the number of R waves in a six-second strip and multiply that number by 10. Similarly, atrial rate can be calculated by counting the number of P waves in a six-second strip and multiplying by 10 (Open RN, 2023). A normal heart rate is 60-99 beats per minute. In adults, a heart rate below 60 bpm is considered bradycardia, and above 100 bpm is considered tachycardia (Sattar & Chhabra, 2023).

Next, the regularity of the rhythm is determined. The distance between the beginning of the R waves should be measured with a caliper or ruler for an accurate measurement. The distance should be assessed across the whole strip to ensure there are no abnormalities. The regularity of the heart rhythm can be categorized in four ways. A regular rhythm means that the R-R intervals are consistent. An irregularly irregular rhythm occurs when the R-R intervals are never equal. A regularly irregular rhythm occurs when the R-R intervals are unequal, but there is an identifiable pattern to the irregularity. An occasionally irregular rhythm occurs when the R-R intervals are typically equal, with an occasional sporadic R wave (Open RN, 2023).

Next, the P waves are assessed. If P waves are absent, the heartbeat is not initiated in the SA node. The length of the P wave should be less than 0.12 seconds and have an amplitude of less than 2.5 mm. It should be upward, rounded, and consistent in shape. The P waves should all look the same and occur at a regular rate. If the P wave interval varies, it indicates a conduction issue between the SA and AV nodes. There should be a P wave with every QRS complex, ensuring the atria and ventricles are working together (Open RN, 2023).

The PR interval is assessed next and is measured from the beginning of the P wave to the beginning of the QRS complex. If the PR interval is too long, there is a conduction issue between the SA and AV nodes (Open RN, 2023).

The QRS duration must be measured from the beginning to the end of the QRS complex. The QRS complex should have a duration of 0.04-0.12 seconds with an amplitude of 1.0-3.0 mm. The Q wave should have a downward deflection, the R wave should be represented as an upward spike, and the S wave should have a downward deflection. If the QRS complex is too wide, the heartbeat did not originate in the atria (Open RN, 2023).

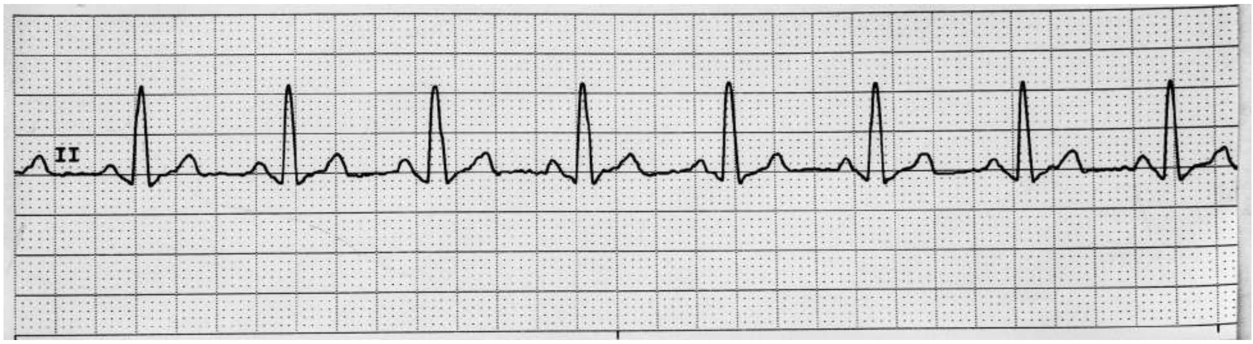
Next, the T waves are assessed. They should follow each QRS complex, be upright, and have a rounded shape. The T wave should be 1/8-2/3 the size of the R wave and should have a height of less than 10mm. If the T wave appears inverted, flat, biphasic, or peaked, it indicates an abnormality, though there are many possible causes for this variation (Open RN, 2023).

The ST segment is evaluated next. It should be isoelectric, meaning it is at the same level in the ECG as the PR segment. If there is a difference of 1 mm or more between the ST and PR segment heights, it is indicative of an abnormality, which could have multiple causes (Open RN, 2023).

Next, the QT interval duration is determined. This is measured from the Q wave to the end of the T wave. A normal QT interval is 0.4 to 0.44 seconds, though women often have a slightly longer QT interval than men. Heart rate can also impact this interval. The corrected QT interval (QTc) accounts for heart rate variations and is used to monitor the QT interval. A shortened QTc may indicate hypercalcemia, acidosis, hyperkalemia, hyperthermia, or short QT syndrome (Open RN, 2023).

Other components of the ECG must also be evaluated. There should not be any extra beats on the waveform. There should not be any identifiable U waves or J waves. Finally, the patient must be observed for any signs or symptoms indicating the significance of the dysrhythmia, as this will guide clinical practice (Open RN, 2023).

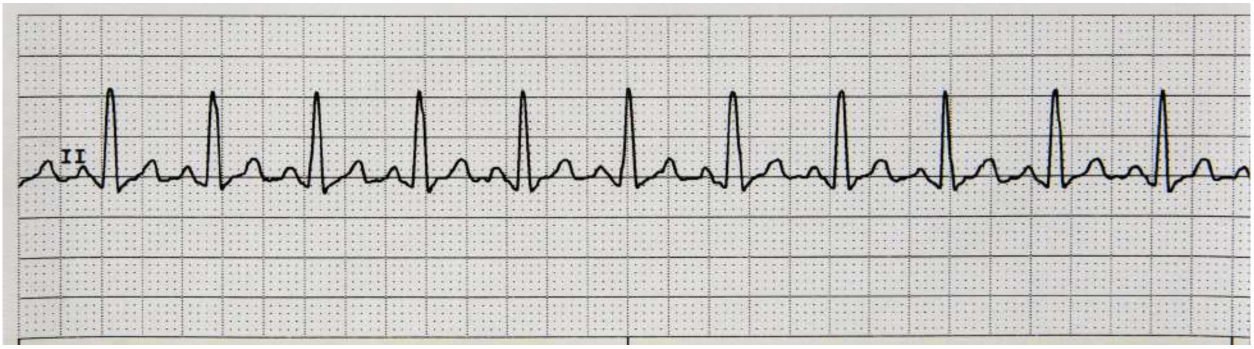
Normal Sinus Rhythm



Normal Sinus Rhythm. Image credit: (Hoyord, 2023)

Normal sinus rhythm reflects normal electrical conduction in the heart and allows for optimal cardiac output. It is characterized by a heart rate of 60-100 bpm. For the rhythm to be considered a normal sinus rhythm, the P waves in leads I and II must be upright, indicating the rhythm is initiated in the sinus node. The PR interval should be 0.12-0.20 seconds, be consistent within a six-second ECG strip, and there cannot be any dropped or ectopic beats (Open RN, 2023).

Sinus tachycardia describes a normal heart rhythm, though at a rate of greater than 100 beats per minute in an adult (Sattar & Chhabra, 2023). Sinus tachycardia is most often caused by stress, exercise, alcohol, caffeine, tobacco, hypovolemia, anemia, fever, infection, decreased oxygenation, cardiac conditions, and some medications. While some patients may be asymptomatic, others may experience palpitations or symptoms of decreased cardiac output (Open RN, 2023).



Sinus Tachycardia. Image credit: (Hoyord, 2023)

Sinus bradycardia occurs when a normal sinus rhythm occurs at a rate of 60 beats per minute or less (Sattar & Chhabra, 2023). Sinus bradycardia may be found in well-conditioned athletes, but it can also be a side effect of certain cardiac medications. Most patients with sinus bradycardia are asymptomatic, but some have symptoms due to decreased cardiac output (Open RN, 2023).

Sinus bradycardia. Image credit: (Hoyord, 2023)

Respiratory sinus arrhythmia is a benign condition that is very common in young healthy adults. This occurs when the cardiac rhythm correlates with the respiratory cycle, with an increase in heart rate during inspiration and a decrease during expiration. If the patient holds their breath, the rhythm reverts to normal sinus rhythm. Respiratory sinus arrhythmia is rarely symptomatic and is considered a normal, functioning rhythm (Open RN, 2023).

Premature Atrial Contraction (PAC)

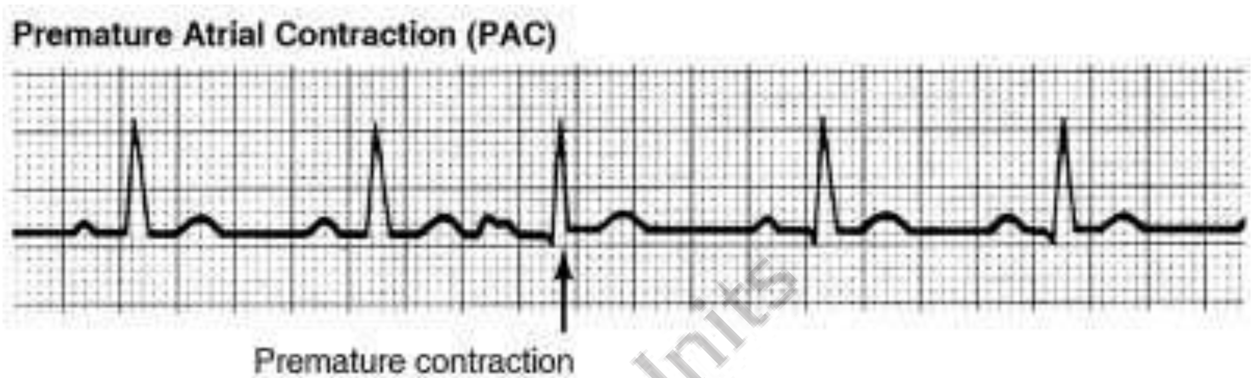
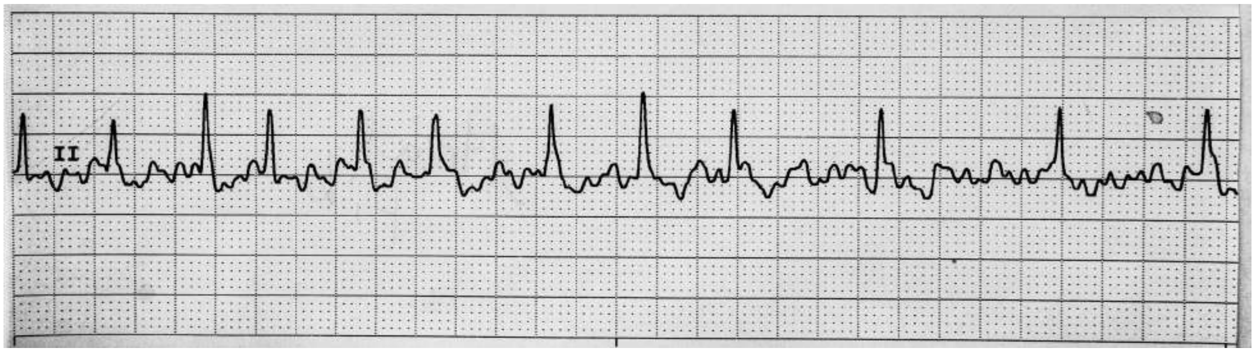


Image credit: (Valley Healthy System, 2026)

A premature atrial contraction (PAC) is a common ECG finding that occurs when an ectopic focus within the atrium initiates an electrical impulse earlier than the sinus node. The P wave typically appears different than the normal sinus P wave. The R-R interval between the last normal beat and the PAC beat is usually shortened, and the R-R intervals of the beats before and after the PAC are shorter than two normal R-R intervals. This is because the PAC depolarizes the SA node (Rogoff & Pride, 2022). PACs are common in older adults (Open RN, 2023).

Atrial Fibrillation

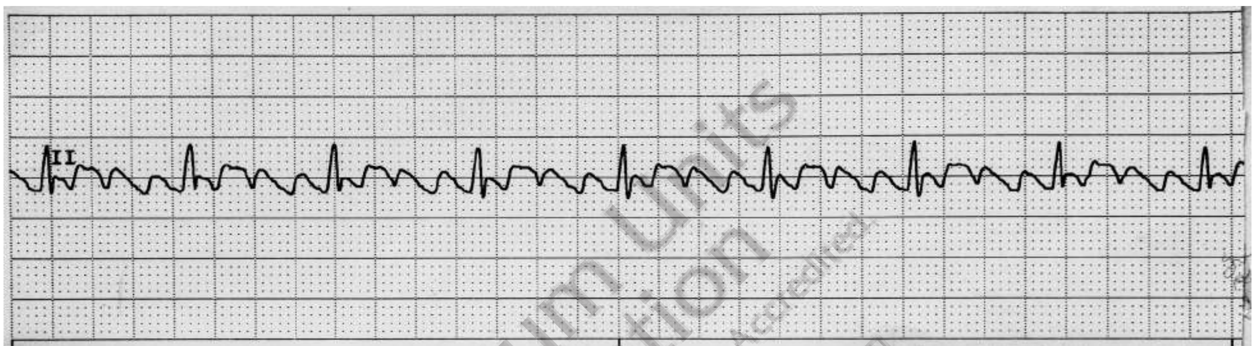


Atrial Fibrillation. Image credit: (Hoyord, 2023)

Atrial fibrillation is the most common arrhythmia and is triggered by premature atrial beats due to ectopic triggers, usually originating in the pulmonary veins (Leventopoulos et al., 2023). This rhythm is considered irregularly irregular. It is characterized by the absence of an organized rhythm and by unsynchronized depolarization and repolarization. Electricity is passed from one myocyte to any surrounding repolarized myocyte, causing the atria to quiver rather than contract (Rogoff & Pride, 2022).

On an ECG, atrial fibrillation lacks a discrete P wave, with fibrillatory waves present that vary in amplitude, morphology, and rate. The R-R intervals are irregular, and the atrial heart rate may be 350-600 beats per minute (Leventopoulos et al., 2023). No isoelectric line is present (Rogoff & Pride, 2022). Atrial fibrillation is usually caused by structural and conduction changes in the tissue of the atria. While atrial fibrillation can occur in the absence of underlying cardiac disease, it most often occurs with mitral valve disease, heart failure, ischemic heart disease, and hypertension (Kingma et al., 2023). Other risk factors include obstructive sleep apnea, advanced age, and hyperthyroidism (Rogoff & Pride, 2022). Symptoms of atrial fibrillation include palpitations, chest pain, dyspnea, presyncope, exertional intolerance, and fatigue, though 10-40% of individuals with atrial fibrillation are asymptomatic. Approximately 10.55 million adults in the United States have atrial fibrillation (Ko et al., 2025), and it primarily affects older adults (Leventopoulos et al., 2023). The condition is associated with increased risk of stroke, heart failure, myocardial infarction, dementia, chronic kidney disease, and death (Ko et al., 2025).

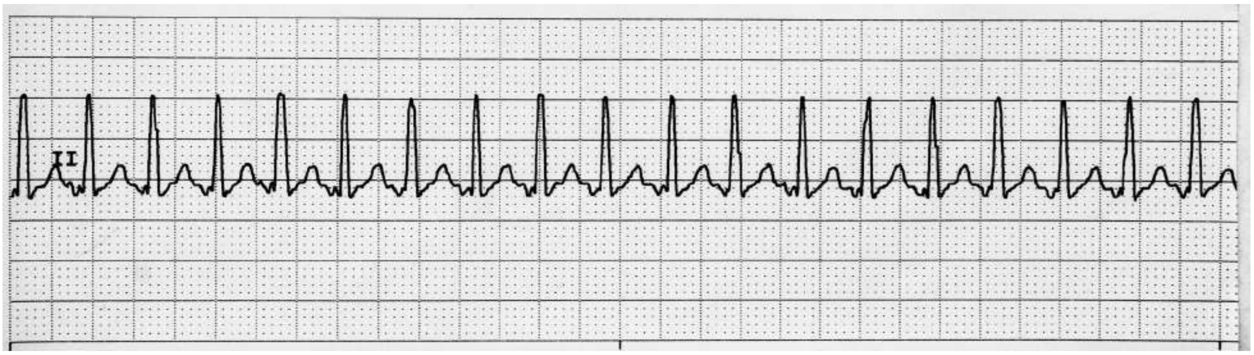
Atrial Flutter



Atrial Flutter. Image credit: (Hoyord, 2023)

Atrial flutter is very similar to atrial fibrillation. However, the heartbeat is more organized (Mayo Clinic, 2023). On an ECG, atrial flutter is visualized as rapid, though regular, F (fibrillatory) waves, in a sawtooth pattern. The F waves can be positive or negative (Liwanag & Willoughby, 2023), with rates between 250 and 300 bpm (Open RN, 2023). It is difficult to identify the isoelectric baseline PR segment (Liwanag & Willoughby, 2023). This is usually accompanied by narrow QRS complexes, though they may be wide in the presence of bundle branch block (Rogoff & Pride, 2022). Atrial flutter increases the risk of stroke (Mayo Clinic, 2023).

Supraventricular Tachycardia (SVT)



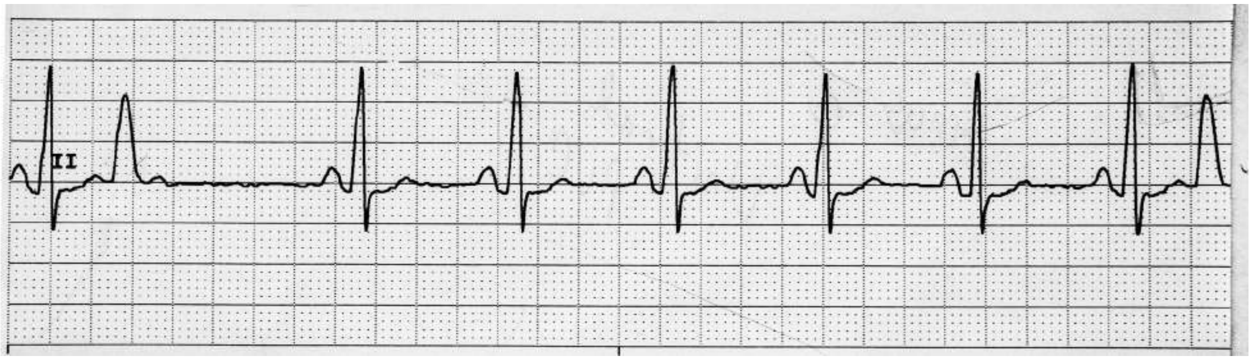
Supraventricular Tachycardia. Image credit: (Hoyord, 2023)

Supraventricular tachycardia (SVT) includes any irregular heartbeats that are initiated above the ventricles. This causes the heart to beat approximately 150-220 times per minute (Mayo Clinic, 2024). On ECG, the QRS is narrow with an interval of less than 0.1 seconds. P waves cannot be identified due to the rapid ventricular rate (Open RN, 2023). When someone experiences SVT, they may report feeling a pounding heartbeat that starts and stops suddenly (Mayo Clinic, 2023). SVT most commonly occurs due to stress on the body, caffeine, alcohol, infection, or sepsis (Open RN, 2023). Symptoms may also include a pounding sensation in the neck, chest pain, fainting, lightheadedness, dizziness, shortness of breath, sweating, weakness, or fatigue. Individuals may also be asymptomatic. In infants and young children, symptoms may include sweating, poor feeding, changes in skin color, and a rapid pulse. There are three primary types of SVT. These are atrioventricular nodal reentrant tachycardia (AVNRT), atrioventricular reciprocating tachycardia (AVRT), and atrial tachycardia (Mayo Clinic, 2024).

AVNRT occurs when two pathways within the AV node have different conduction and repolarization rates, and a premature atrial complex (PAC) occurs when one pathway has been repolarized and is again stimulated while the other pathway has not yet completed repolarization. When the slower pathway reaches the ventricle, the QRS is seen, while the fast pathway conducts back up to the atrium, creating re-entry in the AV node. AVRT involves an accessory pathway between the atria and ventricles that creates a reentry circuit (Rogoff & Pride, 2022).

Atrial tachycardia is a type of SVT that originates in the atria, which can cause the heart to beat 100-250 times per minute (Cleveland Clinic, 2025a). On an ECG, the ventricular conduction can be variable, depending on the presence of an AV block. The P wave appears unifocal, may be inverted, and is different in appearance from a normal sinus P wave. There may be prolonged RP intervals or shortened PR intervals. This rhythm may be paroxysmal, meaning it comes and goes suddenly, or sustained (Liwanag & Willoughby, 2023). Reentrant atrial tachycardia occurs when conduction in the heart is redirected, usually due to scar tissue. Focal atrial tachycardia is initiated by a specific, single focal point on the atrium. Multifocal atrial tachycardia occurs when there is more than one focal point trigger contributing to the atrial tachycardia. Focal and multifocal atrial tachycardia can be caused by automaticity, meaning that another cell or group of cells is taking over the pacemaker role of the heart. This is usually due to an imbalance of sodium, potassium, or calcium (Cleveland Clinic, 2025a). Focal atrial tachycardia is often due to increased metabolic demands and stress, such as infection or hypoxia. Atrial tachycardia is usually a benign arrhythmia that is managed by treating the underlying cause, though if it persists, it can lead to cardiomyopathy (Liwanag & Willoughby, 2023). Atrial tachycardia can also be triggered by a chemical imbalance. Symptoms of atrial tachycardia include heart palpitations, dizziness, fainting, chest pain, and shortness of breath. Risk factors for atrial tachycardia include cardiac and pulmonary disease, myocardial infarction, electrolyte imbalances, excessive alcohol consumption, infection, hypoxia, digoxin toxicity, or caffeine and other stimulants (Cleveland Clinic, 2025a).

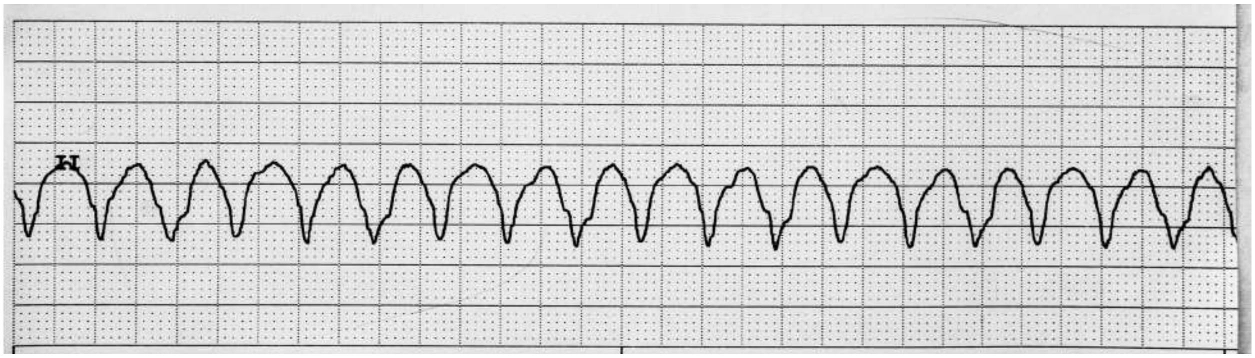
Premature Ventricular Contractions



Premature Ventricular Contractions. Image credit: (Hoyord, 2023)

Premature ventricular contractions (PVCs) occur when an ectopic beat originates in the ventricle. Since the electrical impulse is generated in the ventricle, it travels slowly, resulting in a wide, bizarre-looking QRS complex (Open RN, 2023). PVCs occur during other rhythms, such as a normal sinus rhythm. Since the PVC does not depolarize the SA node, the SA node continues to trigger at regular intervals, so the underlying R-R intervals stay consistent. Usually, PVCs are benign and can occur in healthy individuals. When PVCs have a pattern, they are referred to as either ventricular bigeminy or ventricular trigeminy. Ventricular bigeminy occurs when a PVC occurs with every other normal heartbeat. Ventricular trigeminy occurs when a PVC occurs every third heartbeat (Rogoff & Pride, 2022). When a PVC occurs on a T wave, known as the R-on-T phenomenon, it can trigger ventricular tachycardia (Open RN, 2023).

Ventricular Tachycardia

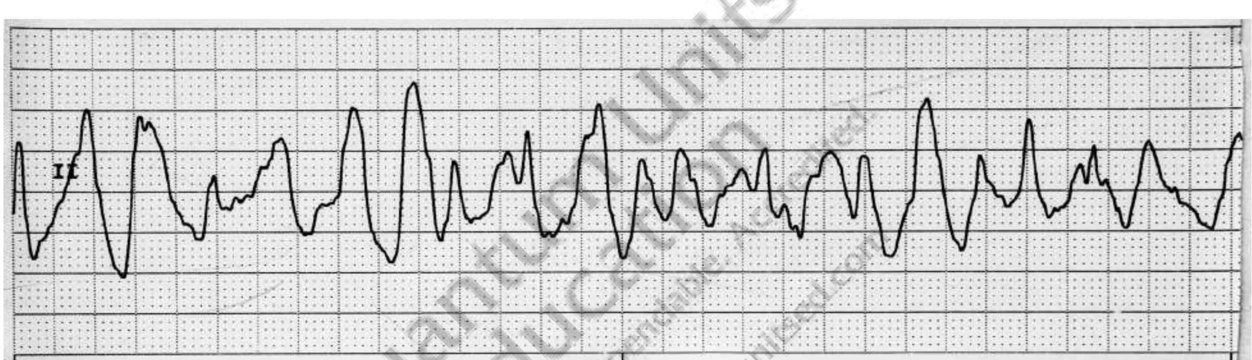


Ventricular Tachycardia. Image credit: (Hoyord, 2023)

Ventricular tachycardia (VT), often called V-tach, occurs as a rapid, irregular heartbeat and is caused by a conduction problem in the ventricles (Mayo Clinic, 2023). On ECG, a wide QRS complex is seen without visible P or T waves, with a ventricular rate often exceeding 120 bpm (Open RN, 2023). When ventricular tachycardia occurs, the ventricles are unable to fill adequately, leading to decreased cardiac output (Mayo Clinic, 2023). There are different types of ventricular tachycardia. Sustained VT lasts more than 30 seconds. Non-sustained VT lasts less than 30 seconds. Monomorphic VT is characterized by ECG waves that look the same, indicating that the abnormal impulse is originating from one place in the ventricles. Polymorphic VT shows electrical waves that vary in appearance on ECG and indicate that the abnormal rhythm is initiated in multiple locations within the ventricles (Cleveland Clinic, 2025c). Non-sustained VT may be benign, but sustained VT is a medical emergency and can lead to ventricular fibrillation.

Sustained VT causes hypotension, resulting in hypoxia. Symptoms can include chest pain, shortness of breath, palpitations, dizziness, lightheadedness, and fainting. The most common cause of VT is ischemic heart disease due to atherosclerosis. However, it can also occur with heart failure, cardiomyopathy, myocarditis, heart valve disease, previous or current ischemic attack or cardiac surgery, sarcoidosis, long QT syndrome, antiarrhythmic medications, imbalances in electrolytes, and stimulant use such as methamphetamine or cocaine (Cleveland Clinic, 2025c). Torsades de pointes is a specific type of VT that occurs when a long QT interval is present and a beat occurs during the QT interval. On ECG, this appears similar to ventricular tachycardia but has a pattern of twisting points or peaks. Torsades de pointes can rapidly develop into ventricular fibrillation and is considered a medical emergency (Open RN, 2023).

Ventricular Fibrillation



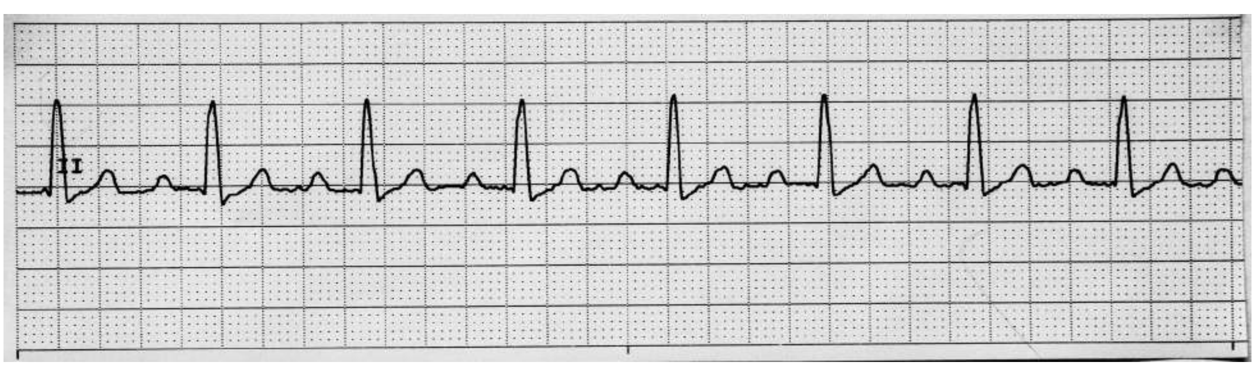
Ventricular fibrillation. Image credit: (Hoyord, 2023)

Like ventricular tachycardia, ventricular fibrillation, often called V-fib, is rapid, irregular, and due to chaotic conduction in the ventricles. This causes the ventricles to quiver rather than contract (Mayo Clinic, 2023). On ECG, V-fib appears with no pattern to the waveforms, and no segments can be discernible or measured. This results in a total lack of effective cardiac contractions and no cardiac output, making it the most dangerous arrhythmia (Open RN, 2023). The occurrence of V-fib is a medical emergency and requires restoration of a regular heart rhythm within minutes for survival (Mayo Clinic, 2023). V-fib is most often caused by heart disease, ischemic attack, heart surgery, untreated arrhythmias, electrolyte imbalances, or electrical shock (Open RN, 2023)

Heart Block

A heart block occurs when there is an obstruction of the normal electrical conduction within the heart. Heart blocks are further categorized by anatomical location: sinus node, atrioventricular, or bundle branch. A sinus node block, also known as a sinoatrial exit block, occurs when the electrical impulse fails to be conducted past the SA node. On an ECG, this appears as a dropped P wave. Causes of SA node block include sick sinus syndrome, increased vagal tone, myocardial infarction, vagal stimulation, myocarditis, and medications such as digoxin and beta-blockers (Sattar & Chhabra, 2023).

An atrioventricular (AV) block is characterized by an obstruction of conduction that occurs anywhere between the SA node and the Purkinje fibers. AV blocks are further categorized into three different types: first-degree, second-degree, and third-degree. A first-degree heart block appears on an ECG as a prolonged PR interval of more than 0.2 seconds. A single P wave continues to precede every QRS complex. This can be a normal finding, but it often indicates an early sign of degenerative disease in the cardiac conduction system or can be due to other causes, such as myocarditis, drug toxicity, hypokalemia, or acute rheumatic fever (Sattar & Chhabra, 2023).



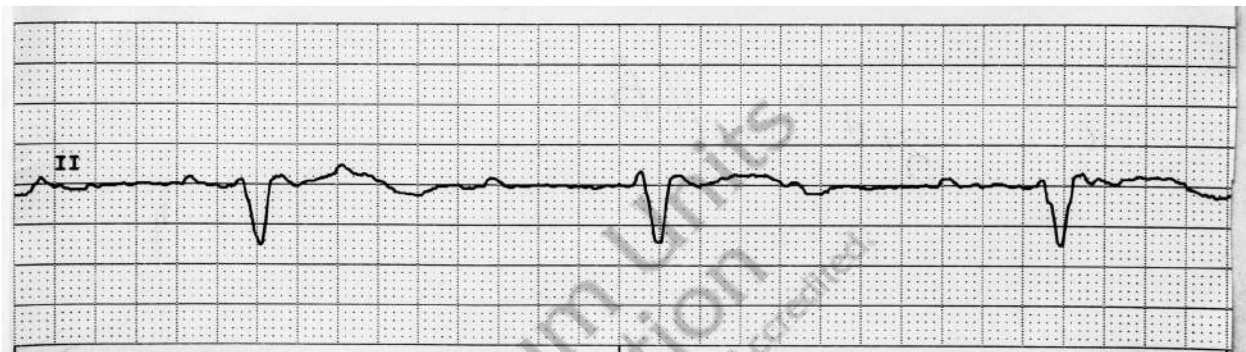
First degree heart block. Image credit: (Hoyord, 2023)

There are two types of second-degree heart block. These are Mobitz type I (or Wenkebach) and Mobitz type II. In Mobitz type I block, there is a variable block across the AV node or bundle of His, often increasing in intensity, resulting in eventual drop of the impulse, which usually occurs every third or fourth impulse. On an ECG, a Mobitz type I block appears as a progressively lengthening PR interval followed by a sudden absence of a QRS complex after a P wave. There is typically a pattern sequence to this type of rhythm. Patients with Mobitz type I block are usually asymptomatic. This type of block may occur in cases of myocardial infarction or myocarditis, and can lead to deterioration if cardiac output is inadequate. In Mobitz type II block, the P wave is occasionally dropped without a progressive lengthening of the PR interval. This is known as the all-or-nothing phenomenon. A Mobitz type II block most often occurs below the AV node at the bundle of His. This type of block is commonly associated with severe cardiac disease and can progress to a third-degree heart block (Sattar & Chhabra, 2023).

Second degree heart block type II. Image credit: (Hoyord, 2023)

A third-degree heart block occurs when there is complete electrical dissociation between the atria and ventricles. This causes both the atria and ventricles to beat at their intrinsic rates (Sattar & Chhabra, 2023). On ECG, there is no correlation between the P waves and QRS complex, though they both occur consistently. The

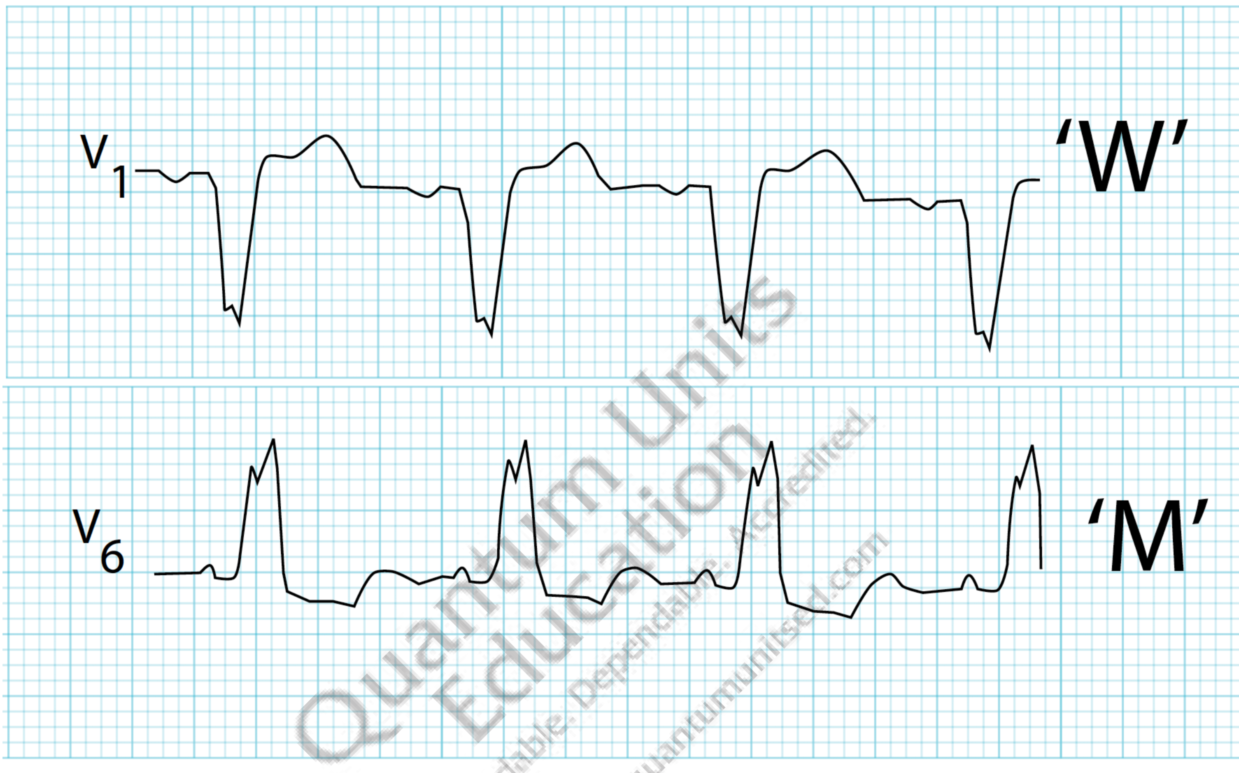
QRS complex is the only measurable aspect of the ECG. Symptoms of third-degree heart block include chest pain, fatigue, and shortness of breath. The patient may also have reduced cardiac output due to the heart's inefficiency as a pump (Open RN, 2023). The most common cause of third-degree heart block is advanced degenerative disease of the cardiac conduction system. In cases of myocardial infarction or Lyme disease, third-degree heart block may be reversed with prompt intervention (Sattar & Chhabra, 2023).



Third degree heart block. Image credit: (Hoyord, 2023)

Bundle Branch Block

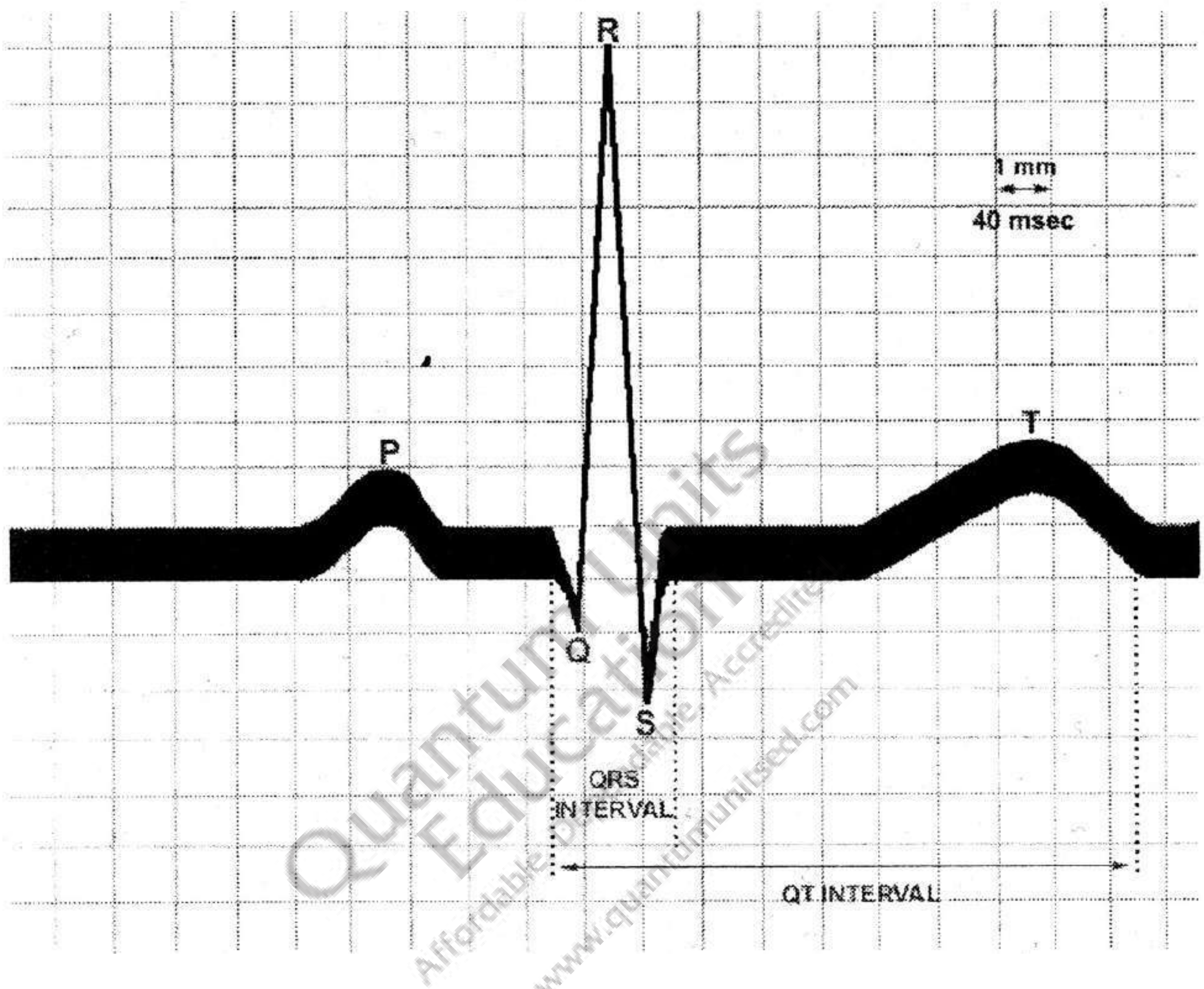
Bundle branch block is a type of heart block that affects the ventricles. It occurs when there is a block in conduction of either the left or the right bundle branch, causing a lag in conduction on the blocked side (Sattar & Chhabra, 2023). On an ECG, both right and left bundle branch blocks are indicated by a wide QRS complex greater than 0.12 seconds, though more in-depth analysis is necessary to determine whether a left or right block is present (Open RN, 2023). In some people, a right bundle branch block may be a standard variant, but in most, it is caused by a conduction system disorder. Left bundle branch blocks typically occur due to a pathological cause, such as degeneration of the cardiac conduction system or myocardial infarction (Sattar & Chhabra, 2023). When a right bundle branch block occurs, the left ventricle will contract before the right ventricle. If there is a left bundle branch block, the right ventricle contracts before the left ventricle, reducing the heart's ability to act as an efficient pump. Both left and right bundle branches can be blocked, causing bradycardia (Cleveland Clinic, 2022).



Left bundle branch block. Image credit: (McGee, 2024)

Right bundle branch block. Image credit: (McGee, 2024)

Long QT syndrome



Prolonged QT interval. Image credit: (Moss and Robinson, 2002)

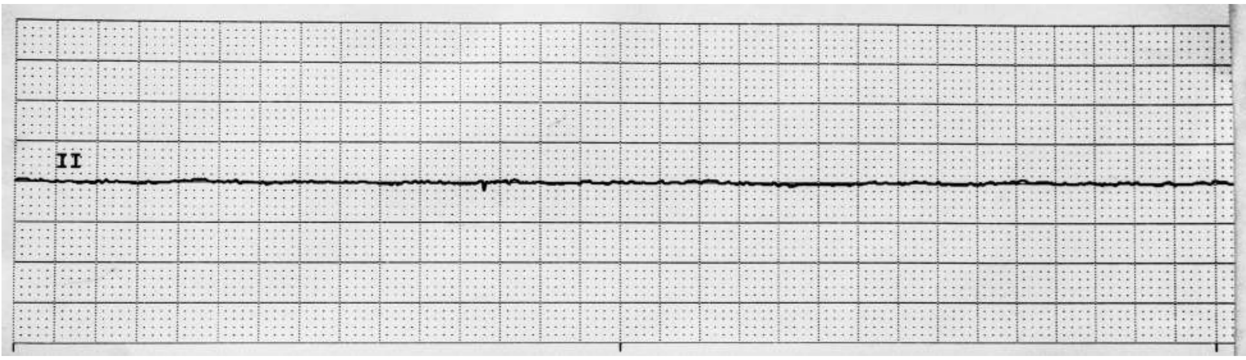
Long QT syndrome occurs when the QT interval exceeds 0.45 seconds (Krahn et al., 2022). When long QT syndrome occurs, the conduction system takes longer than usual to recharge between heartbeats (Cleveland Clinic, 2023). A prolonged QT interval increases the risk for serious ventricular arrhythmias, including Torsades de Pointes, ventricular tachycardia, and ventricular fibrillation. Causes of long QT syndrome include certain medications, electrolyte abnormalities including hypocalcemia and hypomagnesemia, and congenital long QT syndrome (Sattar &

Chhabra, 2023). The risk associated with long QT syndrome depends on the cause and other factors, such as age, sex, QTc interval, and genetic background (Krahn et al., 2022).

Cardiac Arrest

Cardiac arrest occurs when the heart's conduction system fails, leading to a cessation of circulation. There are four arrhythmias associated with cardiac arrest. These are ventricular fibrillation, pulseless ventricular tachycardia (such as Torsades de Pointes), pulseless electrical activity, and asystole. During ventricular fibrillation and pulseless ventricular tachycardia, the ventricles are unable to contract appropriately, leading to a cessation of circulation (Maury et al., 2024). Asystole occurs when there are no electrical impulses in the heart. On ECG, this appears as a flat line. Pulseless electrical activity is similar to asystole. While there does appear to be normal electrical activity on the ECG, it is not strong enough to stimulate a heartbeat (Open RN, 2023). Pulseless electrical activity and asystole are considered unshockable rhythms, meaning an effective cardiac rhythm cannot be restored through the use of a defibrillator (Maury et al., 2024).

Torsades de Pointes. Image credit: (Hoyord, 2023)



Asystole. Image credit: (Hoyord, 2023)

Section 4 Personal Reflection

Why is it important for nurses to be very familiar with the appearance and measurements of normal sinus rhythm? How does a conduction problem in the atria affect the ventricles? How do abnormalities in cardiac conduction affect overall circulation? What are the arrhythmias that indicate cardiac arrest? What should the nurse's response be to each of the arrhythmias?

Section 5: Nursing Implications

Timely recognition and intervention of cardiac arrhythmias can improve patient outcomes. While some cardiac arrhythmias may be benign, others require immediate medical intervention, including cardioversion and/or medications such as beta-blockers, antiarrhythmic medications, and anticoagulation therapy (Nagpal et al., 2024). Nurses must be able to recognize signs of clinical deterioration, including airway compromise, tachypnea, bradycardia, tachycardia, hypotension, symptomatic hypertension, decreased level of consciousness, agitation, seizure, and decreased urine output (Fulton II & Nordquist, 2025). If at any point during the assessment and continued monitoring of the patient, the patient deteriorates clinically, the nurse should activate a rapid response alert or code blue alarm and notify the provider. If outside of the hospital, emergency medical services should be contacted for transport to a hospital (Nesheiwat et al., 2023). If cardiac arrest occurs, ACLS guidelines emphasize high-quality CPR and defibrillation (Fulton II & Nordquist, 2025).

Any patient reporting symptoms of a potential cardiac problem should be immediately placed on a cardiac monitor and have vital signs assessed. At that time, the nurse should assess the basic heart monitor tracing for potentially dangerous arrhythmias and report any abnormal findings to the provider immediately. If the patient is not currently hemodynamically unstable, a history and physical exam are important for gathering information about the onset of symptoms, past medical history, current vital signs, and any abnormal physical symptoms. This physical exam must include auscultation of the heart and palpation of the apical pulse. Pulmonary status must also be assessed. The extremities should be observed for potential symptoms of cardiac disease. A 12-lead ECG will likely be ordered for any individual presenting with possible cardiac symptoms. The nurse can also expect lab work to be ordered, including a complete blood count, basic metabolic panel, and thyroid function tests. A chest X-ray may also be ordered. Any abnormal findings should be reported to the provider (Nesheiwat et al., 2023).

When a patient experiences an arrhythmia accompanied by cardiac symptoms, intravenous access should be established. While intravenous access is preferred, in the case of cardiac arrest, intraosseous access should be obtained if intravenous access is unsuccessful (Fulton II & Nordquist, 2025).

There are specific ACLS guidelines for symptomatic arrhythmias with a pulse. If the patient is experiencing symptomatic bradycardia, the healthcare team should ensure airway patency, monitor pulse oximetry, provide supplemental oxygen or ventilation as needed, perform hemodynamic monitoring, including a 12-lead

ECG, and establish IV access. They should then conduct a focused neurological exam, followed by a focused physical assessment. Potential treatment interventions for symptomatic bradycardia may include administering atropine, epinephrine, or dopamine. Interventions may also include temporary transcutaneous cardiac pacing and treatment of the underlying cause of the arrhythmia (Fulton II & Nordquist, 2025).

If the patient has tachycardia, ACLS guidelines indicate that they must first be assessed for hemodynamic stability, followed by a more complete assessment to determine the cause of tachycardia. If the patient is stable, interventions should focus on treating the underlying cause of tachycardia. If the patient is not stable, cardioversion is necessary. Other interventions may include calcium channel blockers, beta-blockers, amiodarone, digoxin, and, in some cases, elective cardioversion (Fulton II & Nordquist, 2025).

Advanced Cardiac Life Support (ACLS) guidelines establish interventions that have been found to improve clinical outcomes. One emphasis is on effective communication and performance of the resuscitation team during cardiac arrest. There should be an identified leader, rapid initiation and correct technique of chest compressions, early delivery of the first defibrillator shock, and ongoing performance assessment to ensure all roles are performed effectively, and individuals who need to rotate out of a position are rotated. The suggested roles for a six-person high-performance resuscitation team are an airway manager, a chest compressor, and a cardiac monitor/defibrillator. The chest compressor and cardiac monitor should alternate roles regularly to prevent fatigue that can lead to ineffective chest compressions. Leadership roles on the team should include a clearly identified team leader, an intravenous/intraosseous medication administrator, and a recorder. Each team member must have a clear understanding of their role (Fulton II & Nordquist, 2025).

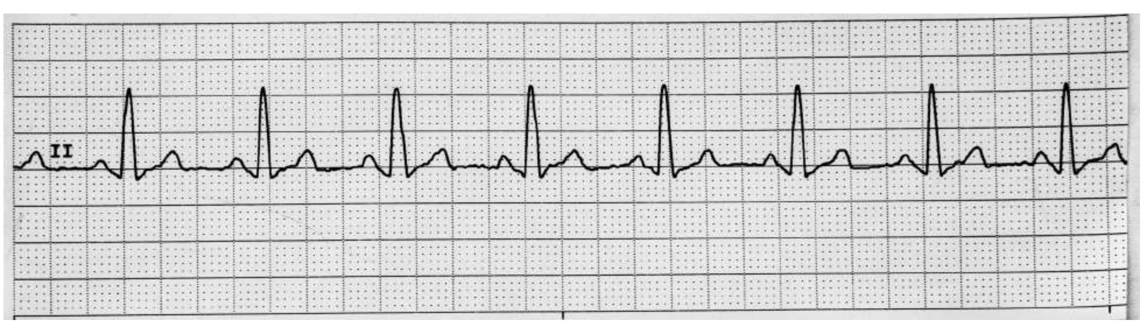
Following the patient's stabilization, the nurse must continue to monitor the patient. Coordination of care is necessary to determine when it is appropriate to discharge the patient, including ensuring that necessary medications are available. The nurse must also provide patient education. Education should include instructions on taking medications as prescribed, smoking cessation (if applicable), and maintaining all follow-up appointments (Nesheiwat et al., 2023).

Section 5 Personal Reflection

How can early recognition of an arrhythmia improve a patient's outcome? Why do you think some arrhythmias are considered benign while others are an emergency? Why is it important to know ACLS guidelines? How do ACLS guidelines improve patient outcomes? What patient education is necessary when a patient is discharged after experiencing an arrhythmia?

Section 6: Case Studies

1. A typically healthy 25-year-old female presents with complaints of shortness of breath. When placed on the monitor, the nurse identifies a regular rate of 80 beats per minute, a consistent P-wave, followed by a QRS complex. Her blood pressure is within normal limits, and her oxygen saturation is 97% on room air.



What rhythm is present on the ECG?

a. Sinus bradycardia

b. Normal sinus rhythm

c. Sinus tachycardia

d. First degree heart block

What is an appropriate response to these findings?

a. Initiate a rapid response alert

b. Prepare to administer cardiac medications

c. Continue with a physical assessment and monitor the patient

d. Anticipate that the provider will order a fluid bolus

2. A 67 year old male is seen at the cardiac care clinic for routine follow-up after experiencing a myocardial infarction a year ago. He continues to have symptoms of shortness of breath, intermittent chest paint, and fatigue. The nurse reviews the ECG.

What rhythm is identified on the ECG?

a. Atrial tachycardia

    b. Mobitz type II second-degree heart block

    c. Third-degree heart block

    d. Long QT syndrome

   What should the nurse expect as next steps in this patient's care?

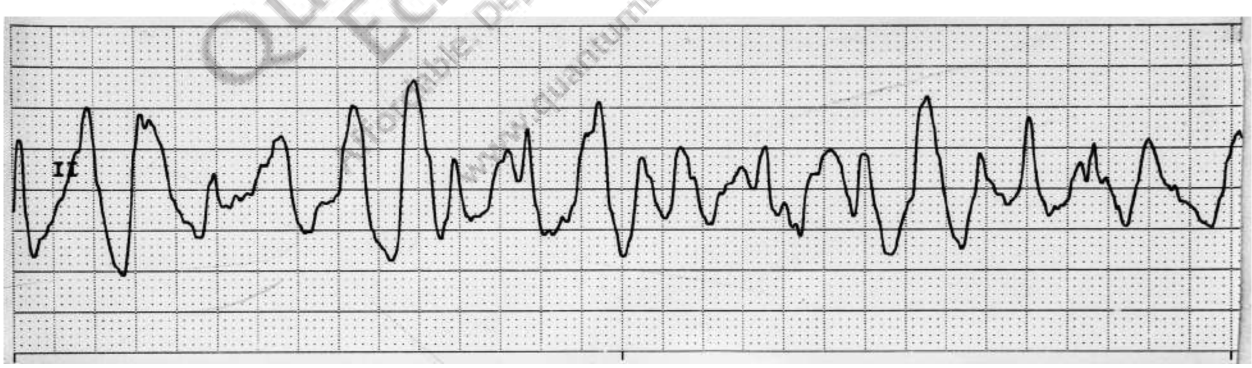
    a. Continued monitoring with clinic follow up in four weeks

    b. Initiation of defibrillation in the clinic

    c. Scheduling for pacemaker placement to prevent progression to a third degree heart block

    d. Scheduling home health visits for blood pressure monitoring

3. A patient presents with no pulse, is unconscious, and is not breathing spontaneously. When placed on the monitor, there is no discernible waveform, the following cardiac rhythm is shown.



   What rhythm is represented?

    a. Normal sinus rhythm

    b. Pulseless electrical activity

    c. Atrial tachycardia

d. Ventricular fibrillation

What is the most appropriate response to this rhythm?

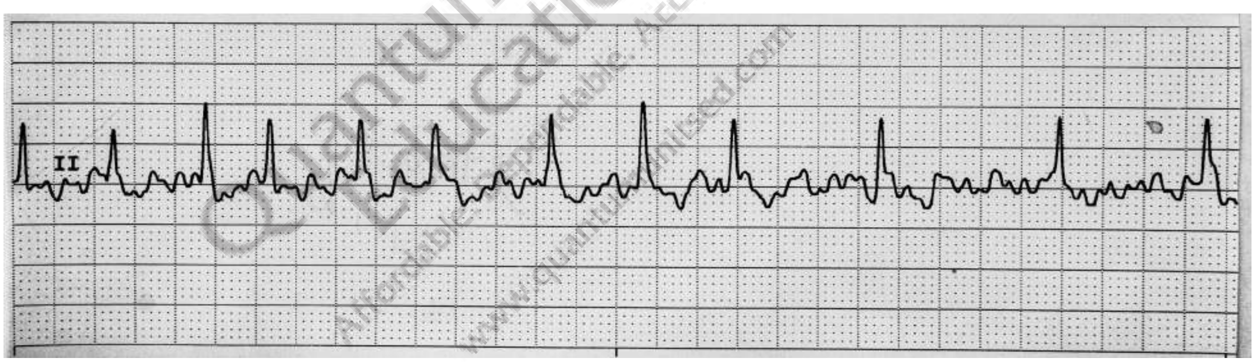
a. Initiate a code blue alarm and follow ACLS guidelines for cardioversion

b. Initiate a code blue alarm; this rhythm is not considered “shockable”

c. Administer epinephrine

d. Apply a temporary transcutaneous pacemaker

4. A 92-year-old patient has had an ambulatory ECG monitor for the past week due to reports of heart palpitations and fatigue. While reviewing the remote ECG, the nurse observes the following rhythm.



Which arrhythmia is this patient experiencing?

a. Premature atrial contractions (PACs)

b. Atrial fibrillation

c. Ventricular fibrillation

d. First-degree heart block

What is the most appropriate response to this rhythm?

a. Notify the provider and schedule follow-up appointment to discuss treatment options

b. Notify the provider and advise the patient to proceed to the emergency department

c. This is a normal finding and does not require provider notification

d. Notify the provider, but expect that monitoring will be discontinued

Section 7: Conclusion

Identifying and interpreting basic ECG rhythms can be intimidating for many nurses. When a nurse understands the basics of cardiac conduction and the underlying pathophysiology of arrhythmias, it becomes easier to interpret ECG rhythms, enabling the nurse to identify ECG alterations. Nurses who are prepared to identify potentially life-threatening arrhythmias can intervene more quickly. Early provider notification and adherence to evidence-based ACLS guidelines prevent further clinical deterioration and promote optimal outcomes.

References

American Heart Association (AHA). (2024, September 24). *Heart Conduction Disorders*. Retrieved 3-2-26 from https://www.heart.org/en/health-topics/arrhythmia/about-arrhythmia/conduction-disorders

Cleveland Clinic. (2022, May 5). *Bundle Branch Block*. Retrieved 3-30-26 from https://my.clevelandclinic.org/health/diseases/22938-bundle-branch-block

Cleveland Clinic. (2023, March 20). *Long QT syndrome (LQTS)*. Retrieved 3-30-26 from https://my.clevelandclinic.org/health/diseases/17183-long-q-t-syndrome-lqts

Cleveland Clinic. (2025a, June 26). *Atrial Tachycardia*. Retrieved 3-30-26 from https://my.clevelandclinic.org/health/diseases/21800-atrial-tachycardia

Cleveland Clinic. (2025b, January 17). *Cardiac Conduction System*. Retrieved 3-26-26 from https://my.clevelandclinic.org/health/body/21648-heart-conduction-system

Cleveland Clinic. (2025c, August 13). *Ventricular Tachycardia*. Retrieved 3-30-26 from https://my.clevelandclinic.org/health/diseases/17616-ventricular-tachycardia

Friedman, P. A. (2024). The Electrocardiogram at 100 Years: History and Future. *Circulation*, *149*(6), 411-413. https://doi.org/doi:10.1161/CIRCULATIONAHA.123.065489

Hoyord, D. (2023). Appendix of Rhythm Strips. *Nursing Advanced Skills*. WisTech Open. https://wtcs.pressbooks.pub/nursingadvancedskills/chapter/appendix/

InformedHealth.org. (2023, June 6). *In brief: What is an electrocardiogram?* Institute for Quality and Efficiency in Health Care. Retrieved 3-27-26 from https://www.ncbi.nlm.nih.gov/books/NBK536878/

Johns Hopkins Medicine. (2026). *Anatomy and Function of the Heart's Electrical System*. Retrieved 3-2-2026 from https://www.hopkinsmedicine.org/health/conditions-and-diseases/anatomy-and-function-of-the-hearts-electrical-system

Kashou, A. H., Basit, H., & Chhabra, L. (2022, October 3). *Physiology, Sinoatrial Node*. StatPearls Publishing Retrieved 3-2-26 from https://www.ncbi.nlm.nih.gov/books/NBK459238/

Katal, N., Gupta, S., Verma, P., & Sharma, B. (2023). Deep-Learning-Based Arrhythmia Detection Using ECG Signals: A Comparative Study and Performance Evaluation. *Diagnostics*, *13*(24), 3605. https://www.mdpi.com/2075-4418/13/24/3605

Kingma, J., Simard, C., & Drolet, B. (2023). Overview of Cardiac Arrhythmias and Treatment Strategies. *Pharmaceuticals*, *16*(6), 844. https://www.mdpi.com/1424-8247/16/6/844

Ko, D., Chung, M. K., Evans, P. T., Benjamin, E. J., & Helm, R. H. (2025). Atrial Fibrillation: A Review. *JAMA*,*333*(4), 329-342. https://doi.org/10.1001/jama.2024.22451

Krahn, A. D., Laksman, Z., Sy, R. W., Postema, P. G., Ackerman, M. J., Wilde, A. A. M., & Han, H.-C. (2022). Congenital Long QT Syndrome. *JACC: Clinical Electrophysiology*, *8*(5), 687-706.https://doi.org/doi:10.1016/j.jacep.2022.02.017

Leventopoulos, G., Koros, R., Travlos, C., Perperis, A., Chronopoulos, P., Tsoni, E., Koufou, E.-E., Papageorgiou, A., Apostolos, A., Kaouris, P., Davlouros, P., &

Tsigkas, G. (2023). Mechanisms of Atrial Fibrillation: How Our Knowledge Affects Clinical Practice. *Life*, *13*(6), 1260. https://www.mdpi.com/2075-1729/13/6/1260

Liwanag, M., & Willoughby, C. (2023, June 26). *Atrial Tachycardia*. StatPearls Publishing. Retrieved 3-30-26 from https://www.ncbi.nlm.nih.gov/books/NBK542235/

Matthew R. Fulton, II, & Nordquist, E. (2025, February 11). *Advanced Cardiac Life Support (ACLS)*. StatPearls Publishing. Retrieved 3-30-26 from https://www.ncbi.nlm.nih.gov/books/NBK613285/

Maury, P., Marimpouy, N., & Beneyto, M. (2024). What's the cardiac rhythm at the time of cardiac arrest? Disputed dogma or true fact? *Europace*, *27*(1). https://doi.org/10.1093/europace/euae299

Mayo Clinic. (2023, October 13). *Heart arrhythmia*. Retrieved 3-30-26 from https://www.mayoclinic.org/diseases-conditions/heart-arrhythmia/symptoms-causes/syc-20350668

Mayo Clinic Staff. (2024, March 7). *Supraventricular Tachycardia*. Retrieved 3-30-26 from https://www.mayoclinic.org/diseases-conditions/supraventricular-tachycardia/symptoms-causes/syc-20355243

McGee, J. (2023). *Bundle Branch Blocks and Hemiblocks.* EKG Essentials: A Student Handbook. University of Arkansas. https://uark.pressbooks.pub/ekgmanual/chapter/bundle-branch-blocks-hemiblocks/

Moss, A. J., & Robinson, J. L. (2002). The Long-QT Syndrome. *Circulation*, *105*(7), 784-786. https://doi.org/doi:10.1161/hc0702.105125

Nagpal, A. K., Pundkar, A., Singh, A., & Gadkari, C. (2024). Cardiac Arrhythmias and Their Management: An In-Depth Review of Current Practices and Emerging Therapies. *Cureus*, *16*(8), e66549. https://doi.org/10.7759/cureus.66549

National Heart, Lung, and Blood Institute. (2022, March 4). *Arrhythmias Causes and Triggers*. National Institutes of Health. Retrieved 3-28-26 from https://www.nhlbi.nih.gov/health/arrhythmias/causes

National Heart, Lung, and Blood Institute (NHLBI). (2025, June 25). *How the Heart Beats*. National Institutes of Health. Retrieved 3-2-26 from https://www.nhlbi.nih.gov/health/heart/heart-beats

Nesheiwat, Z., Goyal, A., Jagtap, M., & Shammas, A. (2023, April 26). *Atrial Fibrillation (Nursing)*. StatPearls Publishing Retrieved 3-30-26 from https://www.ncbi.nlm.nih.gov/books/NBK568719/

Oberman, R., Shumway, K. R., & Bhardwaj, A. (2023, July 30). *Physiology, Cardiac*. StatPearls Publishing. Retrieved 3-2-26 from https://www.ncbi.nlm.nih.gov/books/NBK526089/

Open Resources for Nursing (Open RN). (2023). Interpret Basic ECG. In K. Ernstmeyer & E. Christman (Eds.), *Nursing Advanced Skills*. Chippewa Valley Technical College. https://www.ncbi.nlm.nih.gov/books/NBK594493/

Rogoff, B., & Pride, Y. B. (2022, February 10). *EKG Rhythm*. StatPearls Publishing. Retrieved 3-30-26 from https://www.ncbi.nlm.nih.gov/books/NBK555952/

Sattar, Y., & Chhabra, L. (2023, June 5). *Electrocardiogram*. StatPearls Publishing. Retrieved 3-26-26 from https://www.ncbi.nlm.nih.gov/books/NBK549803/

Setiawidayat, S. (2023). The Duration of the Cycle to Get the P Amplitude on A Discrete Electrocardiogram. *Jurnal Rekayasa Elektrika Vol*, *19*(2), 86-92.

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