

EMS Cardiac Confusion
By Lynn Wallis EMT-P

Class Objectives:

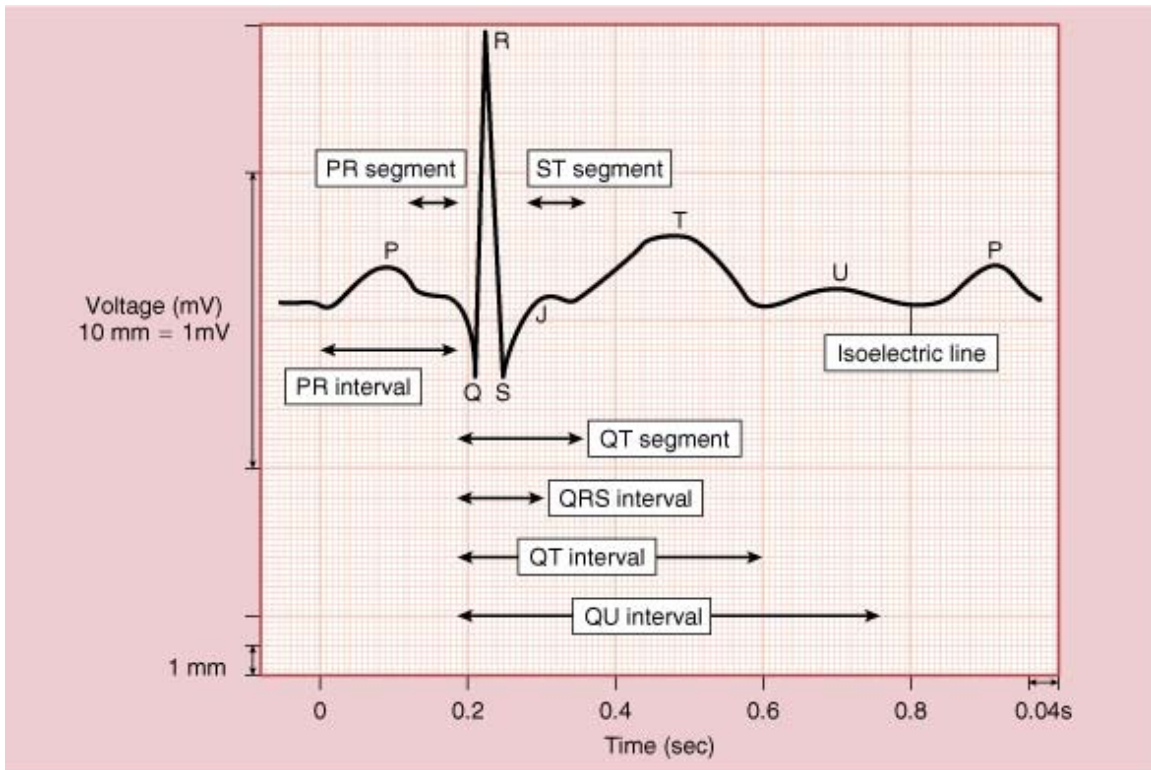
By the end of the lesson the student should be able to:

- 1. Describe the steps necessary to properly diagnosis a cardiac rhythm.**
- 2. Describe the individual parts or segments of an ECG tracing.**
- 3. Will be able to state the differences between SVT and atrial fibrillation.**
- 4. Will be able to properly diagnosis SVT and atrial fibrillation.**

**EMS Cardiac Confusion:
A Brief Review
Lynn Wallis, EMT-P**

As we perform our daily duties we are faced with many life altering decisions. One of the most complicated of these decisions is interpreting electrocardiograms (ECG). There are many factors that must be considered in the interpretation. One area that there has been a noticeable weakness in is the determination between supraventricular tachycardia (SVT) and atrial fibrillation (A-Fib). In order to correctly diagnose these rhythms we must have a basic understanding of the electrocardiogram and what each portion of the complex represents.

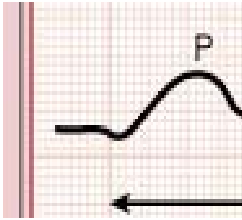
A normal sinus complex is comprised of several sections as demonstrated in this example:



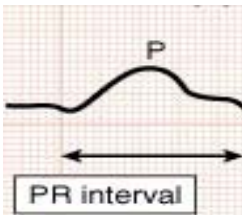
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The first portion of the electrocardiogram is the short portion of the isoelectric line prior to the P wave. This portion of the complex represents the discharge of the SA node and has no deflection. The SA node is the origin of all normal sinus complexes.



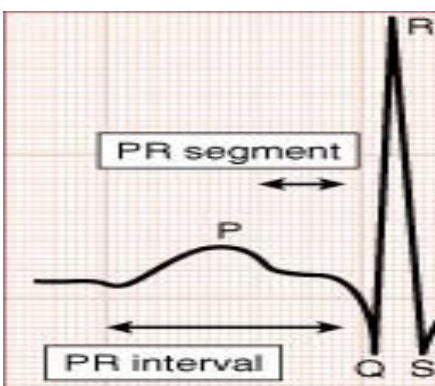
The second portion of the electrocardiogram is the P wave: This portion of the complex represents the left to right atrial depolarization and is an initial low amplitude positive deflection preceding the QRS complex. The duration is generally 0.4 seconds. Atrial repolarization occurs simultaneously with depolarization of the ventricular myocardium. Thus, the atrial T wave is hidden by the QRS complex and not observed on the routine electrocardiogram. The normal P wave is upright in all leads except R.



The third portion of the electrocardiogram is the portion of the isoelectric line between the end of the P wave and the beginning of the QRS complex. This represents activation of the AV node and bundle of His. There is no positive or negative deflection.

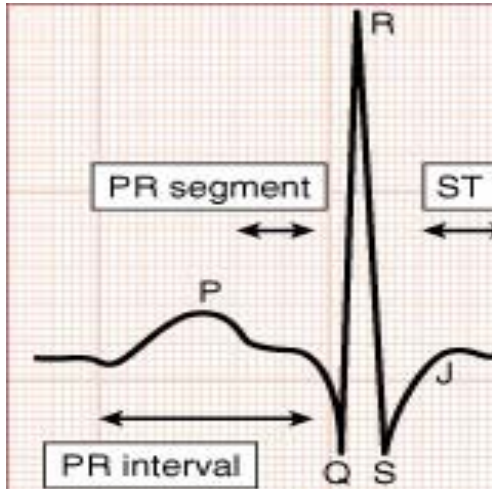
The second and third portions comprise to make the PR segment. (Note: The PR segment and the PR interval are not the same thing.) The PR segment is not routinely measured, but may be commented on if it is depressed or elevated. During the PR segment, the electrical wave moves slowly through the atrioventricular (AV) node. This activity is not seen on the electrocardiogram.

The PR interval starts at the beginning of the P wave and ends with the beginning of the QRS complex. It includes the time for atrial depolarization (the P wave), conduction through the AV node and conduction through the His-Purkinje fibers. The length of the PR interval changes with the heart rate, but is normally 0.12 to 0.20 seconds. The PR interval may be prolonged when conduction of the electrical wave through the AV node is slow. This may be seen with degenerative disease of the node, or with Digoxin, hyperkalemia, hypercalcemia, or hypothermia. The PR interval may be unusually short when conduction is rapid. A mildly short PR interval may be seen with hypokalemia or hypocalcemia. An artificially short PR interval occurs when the QRS complex begins early, as happens with an extra conducting bundle – Wolff-Parkinson-White Syndrome (WPW).

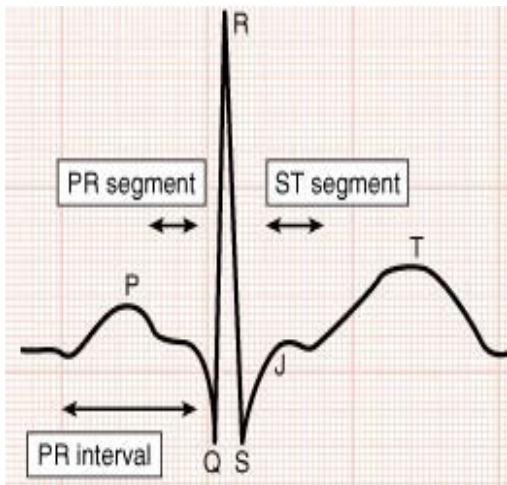


The next portion of the electrocardiogram is comprised of 3 segments. This is known as the QRS complex and represents activation of the ventricles. The first portion is called the Q wave if the deflection is in a downward direction. This represents septal depolarization. This is shown as a negative deflection (from baseline). The first positive or upward deflection is the R wave which represents depolarization of the left ventricular myocardium. The negative deflection following the R wave is the S wave which represents terminal depolarization of the high lateral wall. The entire QRS duration lasts for 0.06 to .10 seconds (2 ½ small boxes)

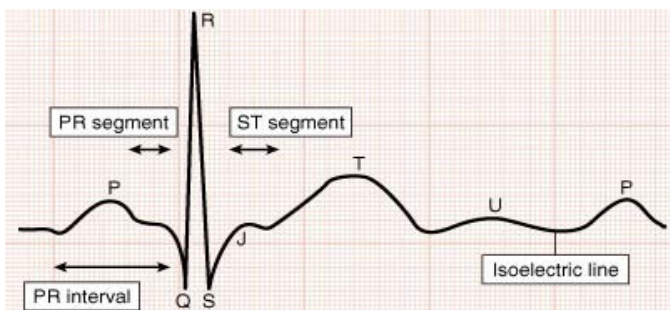
and is not influenced by heart rate. Lengthening of the QRS indicates some blockage of the electrical action in the conducting system. This may be due to ischemia, necrosis of the conducting tissue, electrolyte abnormality, or hypothermia.



The next portion follows the QRS segment and represents full ventricular activation. There is no deflection noted. This is also the area where the J point is located. The J point represents the end of the QRS complex and the beginning of the ST segment. The ST segment occurs after ventricular depolarization has ended and before repolarization has begun. It is a time of electrocardiographic silence.



The next portion is the T wave. The T wave represents the period of ventricular repolarization. Since the rate of repolarization is slower than depolarization, the T wave is broad, has a slow upstroke, and rapidly returns to the isoelectric line following its peak. Since depolarization begins at the endocardial surface and spreads to the epicardium while repolarization begins at the epicardial surface and spreads to the endocardium, the direction or vector of ventricular depolarization is opposite to that of ventricular repolarization.



Occasionally you may have a U wave. The U wave may be seen in some leads; especially the right precordial leads V2 to V4. The exact cause of this wave is uncertain, although it has been suggested that it represents delayed repolarization of the His-Purkinje system. Alternatively, it may

represent a mechanical event such as ventricular relaxation.

Now that we have reviewed the basic electrocardiogram, let's review the basic steps to diagnosing an electrocardiogram. Although this can be difficult at times, a systematic approach along with a general knowledge of arrhythmias will lead to a correct diagnosis.

STEP 1:

LOCATE THE P WAVE.

This is the first and most important step in electrocardiogram diagnosis.

*Are the P waves visible? Absence of the P wave can occur secondary to atrial fibrillation. Alternatively, P waves may be present but not visible if they are buried within the QRS complex as in a junctional rhythm or AV nodal reentrant tachycardia. They may also be located within the ST segment as with an AV reentrant tachycardia or ventricular tachycardia.

*What is the rate of the P waves? If the rate is less than 60 then a bradycardia is present. If the P wave rate is greater than 100 then a tachycardia is present. On average, sinus tachycardia occurs at rates of 100-180, atrial tachycardia, AV nodal reentrant tachycardia, or AV reentrant tachycardia occurs at rates of 150 – 250, and atrial rates of 260 – 320 can be seen with atrial flutter.

*What is the morphology of the P wave? The normal sinus P wave is generally upright in leads I, II, and aVF and may be biphasic in leads III and IV. A negative P wave in the inferior leads or lead I suggests an ectopic rhythm.

STEP 2:

ESTABLISH THE RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEX.

The next step is to determine the relationship between the P waves and the QRS complexes.

*Are the P waves associated with the QRS complexes in a 1:1 fashion? If not, are there more or less P waves than QRS complexes and what are the atrial and ventricular rates? If there are more P waves than QRS complexes then there is some type of AV block present. If there are more QRS complexes than P waves then the rhythm is an accelerated ventricular or junctional rhythm.

*Do P waves precede each QRS complex as in the case with most normal rhythms? What is the PR interval and is it fixed?

STEP 3:

ANALYZE THE QRS MORPHOLOGY.

*If the QRS complexes are of normal duration (.12 sec) and morphology, then the rhythm is Supraventricular. It is essential to analyze the QRS in all electrocardiograms to be sure that they are normal.

*If the QRS is wide and bizarre then the rhythm is either supraventricular with aberrant conduction or it is of ventricular origin. It may be possible to differentiate the two by careful inspection of the QRS morphology.

STEP 4:

SEARCH FOR OTHER CLUES.

Often the diagnosis of a rhythm disturbance can be made by clues provided by breaks in the rhythm or other irregularities in an otherwise regular rhythm. As an example, an

increase in the degree of AV block as occurs with carotid sinus massage may unmask the flutter waves of atrial flutter. Capture beats and fusion beats may be the clues which help establish AV dissociation and a diagnosis of ventricular tachycardia.

The regularity of the QRS complexes should be established by asking the following questions:

*Do the QRS complexes occur with regular intervals or are they irregular?

*If the complexes are irregular, is there a pattern to the irregularity? Is the rhythm regularly irregular, or is there group beating (e.g., a repeating pattern of irregularity)?

STEP 5:

INTERPRET THE RHYTHM IN THE CLINICAL SETTING.

Often the clinical history, including drugs being taken, can be helpful in establishing a diagnosis. As an example, a regular wide complex rhythm in an elderly patient first occurring post MI is most likely ventricular tachycardia. Similarly a narrow complex tachycardia of sudden onset in a young person is likely AV nodal or AV reentrant tachycardia.

However, the clinical presentation and associated hemodynamic findings do not necessarily correlate with the etiology of an abnormal rhythm. The presence of hemodynamic stability during a tachycardia, for example, does not imply a Supraventricular etiology, nor does instability mean that the diagnosis is ventricular tachycardia.

CURRENT DIFFICULTY IN EMS RHYTHM DIAGNOSIS

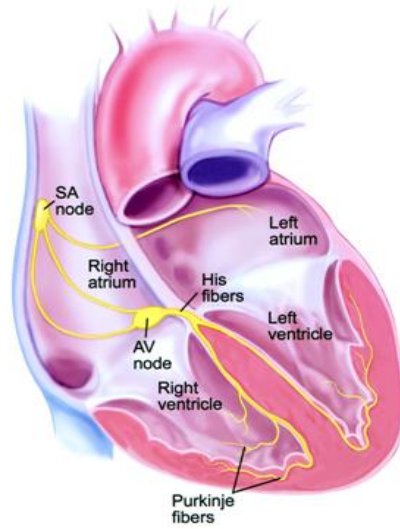
One of the more recent difficulties that has been presented is the difference between supraventricular tachycardia (SVT) and Atrial fibrillation (A-fib). The following is a review of Supraventricular tachycardia and atrial fibrillation:

Supraventricular tachycardia is defined as any tachycardia in which the atrium including the AV node and AV junction portion are critical to the perpetuation of the tachycardia. Electrocardiographically, Supraventricular tachycardias are characterized by a “narrow” QRS reflecting conduction over the His Purkinje system. However, Supraventricular tachycardia may be “wide QRS” if bundle branch block or other intraventricular conduction disturbance is present.

There are two primary types of Supraventricular tachycardia: AV nodal reentrant tachycardia (AVNRT) and AV reentrant tachycardia (AVRT).

The following diagram demonstrates the normal electrical conduction system of a cardiac beat.

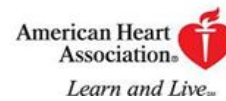
Diagram of the heart and the electrical conduction system of the heart



Wang, F. J. et al. *Circulation* 2002;106:206-209

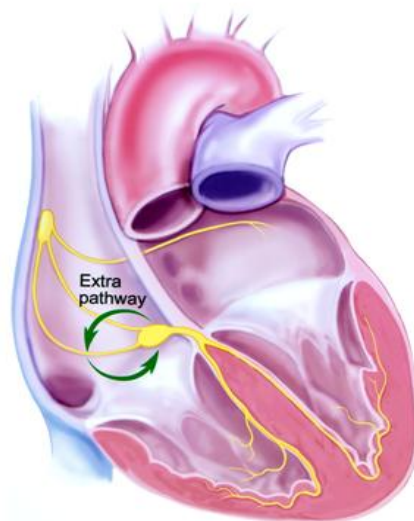
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We know that the normal electrical impulses begin in the SA node, across the right and left atrium, through the AV node and His fibers, and through the Purkinje fibers into the right and left ventricle. The following diagram demonstrates AV nodal reentrant tachycardia:

Diagram of AV nodal reentrant tachycardia (AVNRT)



Wang, F. J. et al. *Circulation* 2002;106:206-209

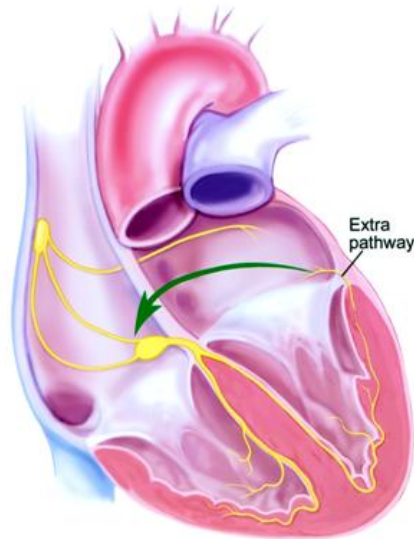
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This occurs because the electrical impulses travel in a circle using extra fibers in and around the AV node. The next diagram demonstrates AV reentrant tachycardia:

A diagram of AV reentrant tachycardia (AVRT)



Wang, F. J. et al. *Circulation* 2002;106:2046-2050

Circulation

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This type of Supraventricular tachycardia occurs because of extra electrical conduction via extra fibers between the atria and ventricles. This is called a bypass tract or accessory pathway. The electrical impulse travels down the AV node to the ventricle and back to the atria through the extra fibers.

Supraventricular will present at a rate usually between 150 to 250 beats per minute. The QRS complex will be narrow (Less than .12 sec) unless there is a possible bundle branch block involved. There will be P waves present but will probably not be identifiable because they are buried in the T wave or QRS complex. The rate will be REGULAR and will correlate with the QRS complexes. The onset will usually be sudden.

Signs and symptoms could possibly include:

Sudden onset

Palpitations

Lightheadedness

Dizziness

Loss of consciousness

Chest pain

Shortness of breath

Typically the patient will have symptoms, but occasionally, they may have no symptoms at all. Treatment for Supraventricular is described in the Supraventricular tachycardia protocol:

Atrial Fibrillation is defined as an uncontrolled quivering of the atria. During atrial fibrillation, electrical discharges are not generated solely by the SA node. Instead, electrical discharges come from other parts of the atria. These discharges are rapid and irregular and may exceed 350 discharges per minute. The rapid and irregular discharges cause ineffective contractions of the atria. In fact, the atria quiver rather than beat as a unit. This reduces the ability of the atria to pump blood into the ventricles. These rapid and irregular electrical discharges from the atria then pass through the AV node and into the ventricles, causing the ventricles to contract irregularly and usually rapidly. The most common symptoms of atrial fibrillation are:

- Palpitations
- Irregular heart beat
- Dizziness
- Fainting
- Weakness
- Fatigue
- Shortness of breath
- Angina

Atrial fibrillation is not treated in the prehospital setting. Cardioversion, either electrical or chemical, is very risky and should only be performed in the controlled hospital environment. One of the major concerns of treating atrial fibrillation is the risk of systemic embolization by a blood clot from a previously fibrillating left atrium. Patient should be placed on anticoagulation therapy prior to cardioversion. It takes a minimum of five days to see any results from anticoagulation therapy. No attempt should be made to cardiovert atrial fibrillation that has been present for more than 48 hours. Due to the fact that the patient may not know that he is in atrial fibrillation, you cannot make a prehospital determination as to the time that the atrial fibrillation has been present.

Let's look at a chart comparing supraventricular tachycardia and atrial fibrillation:

	Supraventricular tachycardia	Atrial Fibrillation
Onset	Sudden Onset	Uncertain
Symptoms	Palpitations Lightheadedness Dizziness Loss of consciousness Chest pain Shortness of breath	Palpitations Weakness/Fatigue Dizziness Fainting Angina Shortness of breath
Heart Rate	<u>Regular</u>	<u>Irregular</u>
Pulse Rate	Fast >150 bpm	Variable depending on age and current therapy
P Waves	<u>Present</u>	<u>Absent</u>

As we can see, there are several similar signs and symptoms. There are 2 critical symptoms that are imperative to a correct diagnosis. Supraventricular tachycardia has a regular heart rate and a present P wave (P wave may not be visible due to rapid rate). Atrial fibrillation has an irregular heart rate and absent P waves. If no determination can be made as to which rhythm the patient is in using the correct method to attain diagnosis

then supportive measures should be given and the patient transported to the hospital in a timely manner.

Performing the wrong treatment on a patient in atrial fibrillation can result in cardiac injury, stroke, pulmonary embolus, and worse case scenario, DEATH!!!

Make sure that you know what rhythm you are treating and performing the correct treatment before taking action.

Lynn Wallis, EMT-P, Sr. FTO, Lubbock EMS
Atrial Fibrillation, <http://en.wikipedia.org>
Web based learning packages, www.lhsc.on.ca
Circulation, <http://circ.ahajournals.org>
Argyle, B., Micro EKG Computer Program Manual, Mad Scientist Software, Alpine, Utah