

ECG INTERPRETATION CHEAT SHEET

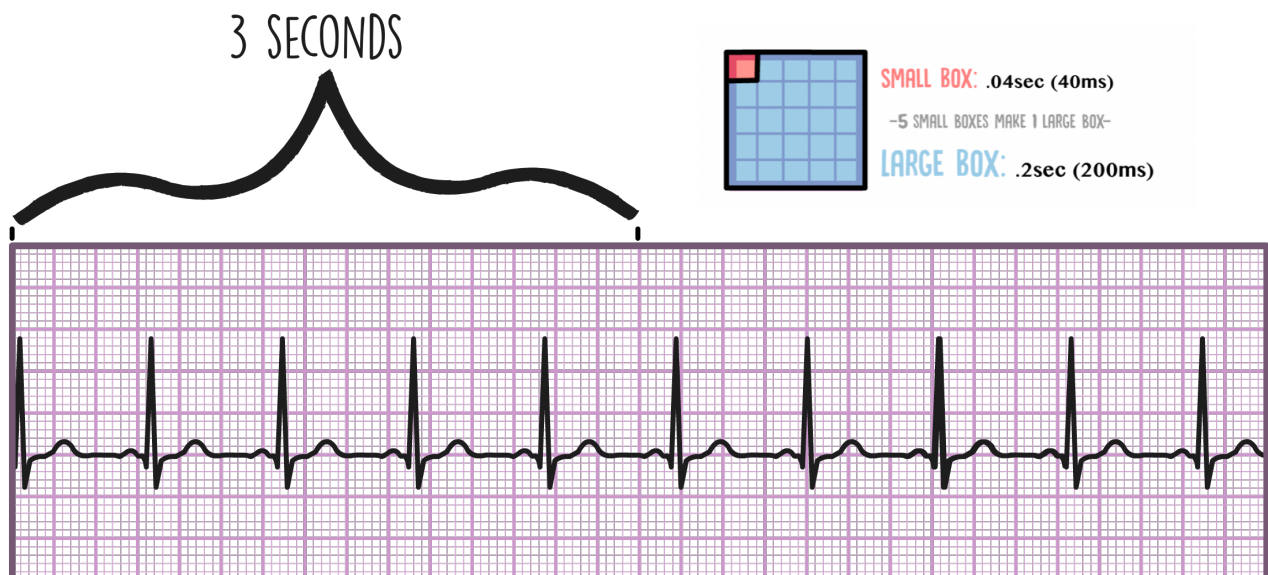
WHAT EXACTLY IS AN ECG?

An ECG (or *EKG*) – which stands for **ELECTROCARDIOGRAM** – looks at an **electrical tracing** of the cardiac activity within your heart. Changes can indicate structural, mechanical, or electrical issues. The electrical tracing is referred to as a **RHYTHM STRIP**. Depending on the number of electrodes, this gives **various different leads** or views of the heart.

The most common ECG is a 12-lead ECG, which utilizes 10 electrodes to get 12 different views of the heart. However, continuous telemetry monitoring usually utilizes 3-5 electrodes, **viewing only a few important leads**, with a primary lead (*usually Lead II*) being continuously monitored.

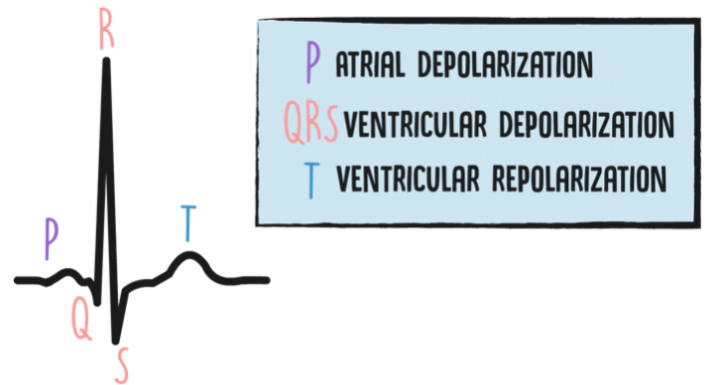
Interpreting a 12-lead ECG is advanced – primarily falling on the responsibility of the physician or advanced practice provider (APP). However, **interpreting rhythm strips (in a single lead) is super important for every inpatient nurse to know** – especially those working in the ED, ICU, Telemetry, or Cardiac units.

THE RHYTHM STRIP

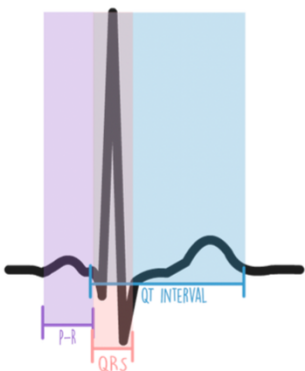


A rhythm strip is made up of **6-seconds**, split into two separate 3-second portions (*marked by black marks above strip*). You will have to analyze and document readings every so often (usually every 8 hours) – especially if you are on a telemetry floor. If you work in the ED, you will have to do this initially on all those patients who it is required, writing your interpretation and any abnormalities. In critical situations, you will need to analyze a rhythm directly from the monitor or the defibrillator.

The P-QRS-T complex is **each heartbeat broken down** into an electrical tracing. The **P-wave** occurs during atrial depolarization, which causes the atria to contract. The **QRS complex** signifies ventricular depolarization - when the ventricles contract. Finally, the **T-wave** is when the ventricles repolarize – meaning the ventricular cells are electrically recharging for another contraction. There is no atrial repolarization seen because this is much smaller and is hidden within the QRS complex.



Remember the rhythm tracing indicates electrical impulses through the heart cells. Just because the electrical impulse is there **does not mean the heart will have the mechanical response** (*i.e. contraction*). This is the case during PEA.



PR INTERVAL	120-200 MS (3-5 SMALL BOXES)
QRS COMPLEX	80 - 120 MS (2-2.5 SMALL BOXES)
QT INTERVAL	350-450 MS

While interpreting a rhythm strip, the graph paper boxes are there so you can easily compare and measure various parts of the tracing. The **PR interval** represents the amount of time it takes for the electrical impulse to go from the SA node in the atria, until it reaches the ventricles. This comes in handy when determining **HEART BLOCKS**, as blocks will slow conduction of the electrical impulse. Although it is called the PR interval, it actually is the **length between the beginning of the P-wave and the beginning of the Q wave**. The normal PR interval is 120-200 ms, or 3-5 small boxes. PR intervals that are consistent but longer than 200 ms indicates a 1st degree heart block.

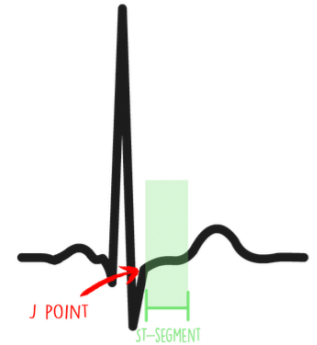
The **QRS complex** width represents how long the electrical impulse takes to depolarize the entire left and right ventricles.

Normally, the QRS complex is narrow 80-100 ms (*2-2.5 small boxes*). If this is widened, it indicates some type of bundle branch block – which is a delay of the conduction between the ventricles.

The **QT interval** is the length of time it takes the electrical impulse to go from the beginning of the ventricles – until the ventricles completely repolarize and are ready for another contraction. This should be between 350-450 ms. If this is elongated – this presents an

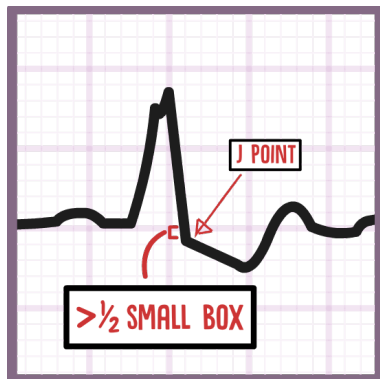
increased risk of various arrhythmias such as **TORSADES** or **VFIB**, especially if > 500 ms. However, if the heart rate is abnormally slow (*bradycardia*) or fast (*tachycardia*), this will not be accurately reflected. Due to this, the QT-c (*QT-corrected*) is usually used which corrects for the heart rate.

The **ST-segment** indicates the beginning of ventricular recovery. The point between the QRS complex and where the ST-segment begins is called the **J-point**. The ST-segment can either be normal (at the isoelectric line), elevated, or depressed. The ST segment should be at the isoelectric line at baseline, measured by the TP segment. ST elevation or depression in at least 2 contiguous leads is likely to indicate **CARDIAC ISCHEMIA** or **INFARCTION**.

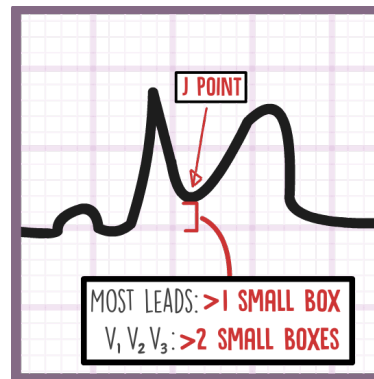


ST depression is defined as greater than 0.5mm (*1/2 small box*) below the isoelectric line. This usually indicates cardiac **ISCHEMIA** – meaning there is a **LACK OF PERFUSION** to some area of the heart. It can also indicate digoxin toxicity or electrolyte abnormalities. ST depression **can either be upsloping, down-sloping, or horizontal** – with down-sloping being more specific for **MYOCARDIAL ISCHEMIA**.

ST elevation is defined as greater than 1mm (*1 small box*) in limb leads and 2mm in precordial leads (V_1, V_2, V_3) **above** the isoelectric line and indicates **MYOCARDIAL NECROSIS** aka infarction. This classically occurs during a **STEMI** (*ST-segment elevation myocardial infarction*). In order to be classified as a **STEMI** – the ST-segment elevation **MUST** be in 2 contiguous leads.



ST-SEGMENT DEPRESSION

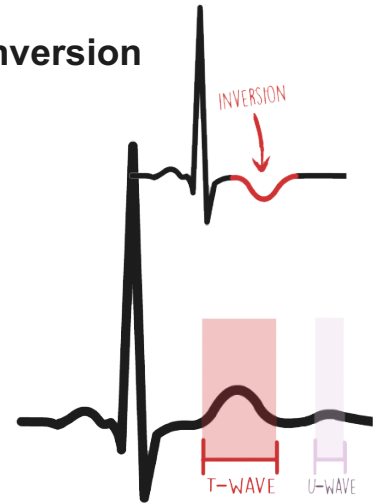


ST-SEGMENT ELEVATION

The **T-wave**, as described above, represents ventricular repolarization. The ventricular cells are getting ready for another electrical impulse – so they can conduct and create another heartbeat.

T waves are typically a smooth “hill”. The T-wave is **typically upright** in lead II, and variable in other leads (*see below*). Any nonspecific T-wave changes could indicate cardiac pathology as sinister as active **ISCHEMIA** and **MI**, baseline from previous cardiac injury, or something completely **BENIGN**.

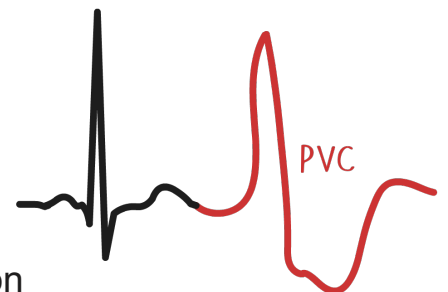
Nonspecific T wave changes can be **T wave flattening** or **T wave inversion (TWI)**, which is when the T-wave is oppositely deflected from what it should be. This isn't always a big deal and many different conditions can cause this – but it most important in recognizing **NEW TWI**. T waves should be **upright in leads I, II, V3, and V6**, inverted in aVR, and all other leads are variable. TWI can indicate cardiac **ISCHEMIA** and **IRRITABILITY**, but can also indicate many other causes.



The **U-wave** is another small “hill” following the T-wave, which represents the repolarization of the **PURKINJE FIBERS** within the ventricles. This usually is not visible, but may become prominent in the setting of bradycardia, **HYPOKALEMIA**, hypercalcemia, digoxin toxicity.

ECTOPIC BEATS

Ectopic beats or **ECTOPY** are beats originating outside of the SA *node (the normal pacemaker of the heart)*. Any cells which are irritated from **ISCHEMIA** or **DAMAGE** can produce an electrical impulse which is conducted by the other heart cells. These ectopic beats **may or may not actually cause contraction** of the heart (*the impulse may be there but the heart doesn't respond*). This can cause the feeling of **PALPITATIONS** or skipped beats. Whether or not the myocardial cells respond, it causes an **IRREGULAR EARLY BEAT** which **interrupts the normal rhythm**. When interpreting rhythms, you must always interpret the underlying rhythm, and THEN identify any ectopic beats (*i.e. sinus bradycardia with 1 PVC*).



Premature Ventricular Contractions (PVCs) are a very common type of ectopy. They originate within the right or left ventricle, usually from **IRRITATED MYOCARDIAL CELLS**. The ventricles have the most work to do – so this makes sense that they are more prone to getting **IRRITATED**. Since the impulse originates within the ventricles, there are **no P-waves**. The QRS complex will be **wide (>3 small boxes) and strange**. This is because the **T-waves of a PVC usually have an opposite deflection of the QRS** – if the complex is positive (*above the isoelectric line*), then the T-wave will likely be inverted (*below the isoelectric line*).

Sometimes PVCs will succeed each other back-to-back. When there are two PVCs in a row – this is called a **couplet**; when there are 3 or more – this is called a **run**. Technically, this is a run of VTACH. Generally, when this occurs there is significant irritability within the heart, and these patients are at **HIGH RISK** to go into **SUSTAINED VTACH** or **VFIB**.

Sometimes PVCs will fall into patterns – and there are specific names for these. If every other beat is a PVC – this is **BIGEMINY**. If every 3rd beat is a PVC – **TRIGEMINY**. If every 4th beat is a PVC – **QUADRIGEMINY**. These patterns don't necessarily mean much other than are known to occur in a significantly **DISEASED HEART**, but they are important to note when monitoring the rhythm over time.

Premature Atrial Contractions (PACs) maintain the same principal as PVCs, but **originate somewhere in the LEFT OR RIGHT ATRIA**. Because of this – **P-waves are present** – although this can be hidden in the preceding T-wave if close enough. The general morphology (*shape*) of the P-wave will appear **DIFFERENT** (*flattened, notched, etc*), and will **INTERRUPT** the underlying rhythm. The **PR-interval will also usually be different** because the originating cell is not within the SA node.



PACs can occur from ischemia and irritability, but can often occur from **less dangerous** causes such as **CAFFEINE**, stress, **ALCOHOL**, fatigue, poor sleep, and various medications.

Premature Junctional Contractions (PJC)s follow the same principals as above, but they **occur within the AV NODE** between the atria and the ventricles. This means **P-waves can be present but are INVERTED**, but often are **ABSENT** if hidden within the QRS complex itself.

A SYSTEMATIC APPROACH TO RHYTHM INTERPRETATION

There are specific steps to take in order to analyze and correctly interpret a rhythm strip. This becomes especially helpful for those who are new or uncomfortable with analyzing and interpreting rhythm strips.

1. DETERMINE REGULARITY

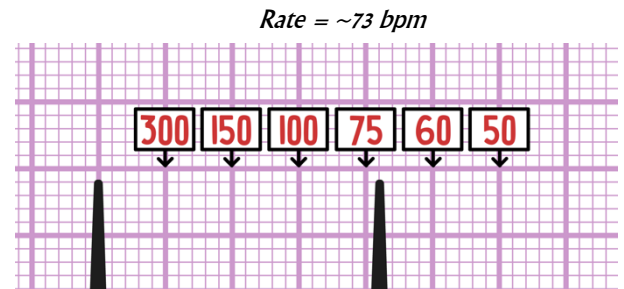
Rhythms are split between regular rhythms and irregular rhythms. Generally, **regular rhythms are less ominous** but can still be *dangerous (i.e. rapid Afib, SVT, atrial flutter, severe bradycardia, VTACH)*. Irregular rhythms usually indicate atrial rhythms, ectopy, or heart blocks. For sinus rhythms that appear to be a normal rate – you can likely just eyeball the regularity. However, it can be beneficial to measure the distance between the R waves of each QRS complex and map out if the R-to-R interval, and make sure it is

generally the same throughout the strip. While doing this, make sure **each QRS complex has a P-wave** which precedes it.

2. DETERMINE RATE

There are ways to calculate the rate, but with current technology this will **usually be provided for you**. Almost always – you can utilize this calculated rate provided somewhere on the rhythm strip. However, rarely **the machines can count incorrectly**.

A quick easy way to estimate the rate, especially during a sinus rhythm, is to count the number of QRS complexes in a 6-second strip, and add a zero (*essentially multiply by 10*). This estimates how many QRS complexes there are in a full minute – or rather the heart rate. For regular rates, you can find an R-wave that is directly on a large box line. Look to where the next R wave lies and count with the intervals provided (300, 150, 100, 75, etc).



3. P WAVES AND PR INTERVAL

Make sure there is a **P-wave before every QRS complex**. If one or two beats are missing a P-wave but the rest have them – consider ectopy. The P-wave will generally look different in each lead but should always be **positively deflected** in a non-junctional rhythm. Next evaluate the PR-interval. Is it a normal length (*3-5 small boxes*)? Is it consistent with each beat? If it is elongated or inconsistent – think 1st, 2nd, or 3rd degree **heart blocks**.

4. QRS AND QT INTERVAL

Make sure they all appear to **look the same** (*same morphology*). If one or two complexes looks completely different, consider a **PVC** or paced beat. Next measure the QRS complex width – remember **it should be 2-3 small boxes**. If it is longer than 3 small boxes – consider **Bundle Branch Block**. The QT-interval can be measured as well, but this should be given to you on an ECG and isn't always required to be calculated on a rhythm strip. Remember though – **if the QRS is widened, the QT-interval will be widened as well** but will not necessarily predispose the patient to a fatal arrhythmia.

5. ST-Segment and T Wave

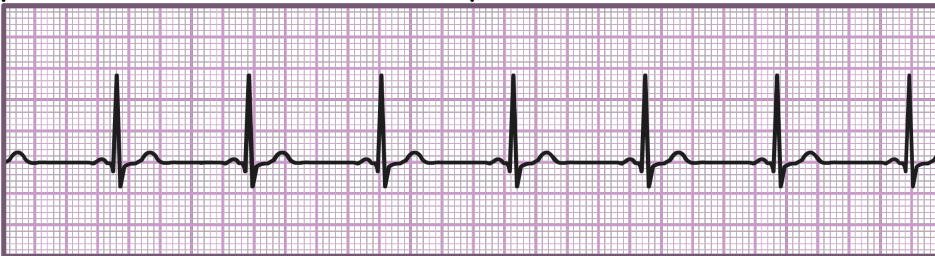
Look at the J-point. Is there any **ST elevation or depression**? If so – does the elevation or depression last longer than 2 small boxes? Next evaluate the T-wave – does it “look” normal? Remember **normal T-waves have a slower upstroke and a faster downstroke**, and should be **positively deflected in Lead I and II**. Is there any T-wave inversion (*upside-down*)? Are the T-waves tall or peaked? If they are notched – it may just be atrial repolarization hidden with the T-wave.

6. ECTOPIC BEATS

After you establish the underlying rhythm, take a closer look at the ectopic beats or irregularities. Determine whether the beats originate from the atria (*P-waves present*) in PACs, the AV node (*P-waves absent or inverted*) in PJsCs, or the ventricles (*P-waves absent with wide QRS and inverted T-wave*) in PVCs.

REGULAR RHYTHMS

NORMAL SINUS RHYTHM (NSR)



RATE: 60–100 BPM

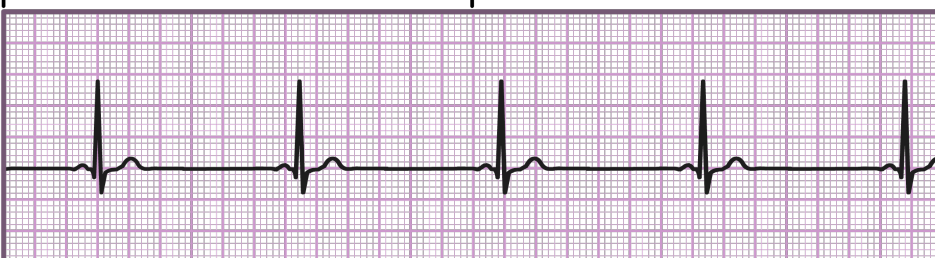
P-WAVES: PRECEDES EACH QRS COMPLEX, UNIFORM

PR-INTERVAL: 3–5 SMALL BOXES, CONSISTENT

QRS: NARROW (2–3 SMALL BOXES), FOLLOWS EACH P-WAVE

NSR is the rhythm that every healthy person should have at rest (*aside from fit individuals with SB*). This represents **healthy cardiac electrical conduction**. Be warned though – **if the patient does NOT have a pulse then this is Pulseless Electrical Activity**. This can occur when the electrical signal is sent but the heart does not respond to this signal.

SINUS BRADYCARDIA



RATE: <60 BPM

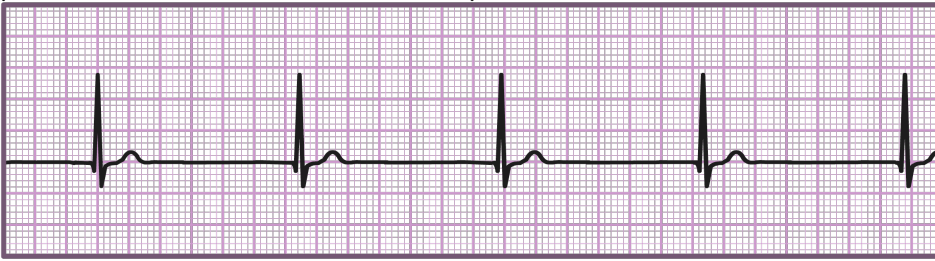
P-WAVES: PRECEDES EACH QRS COMPLEX, UNIFORM

PR-INTERVAL: 3–5 SM BOXES, CONSISTENT

QRS: NARROW (2–3 SM BOXES), FOLLOWS EACH P-WAVE

Sinus Bradycardia is just like NSR, but **the rate is <60 bpm**. This is usually a healthy variant in certain individuals. Younger fit athletes tend to have resting heart rates 40–60, and slower while sleeping. Additionally, it is not uncommon for older individuals to have resting heart rates in the 40s or 50s as well, especially if on Beta-Blockers like Metoprolol. With this rhythm – it is important to assess whether or not the patient is symptomatic – are they dizzy, SOB, have chest pain?

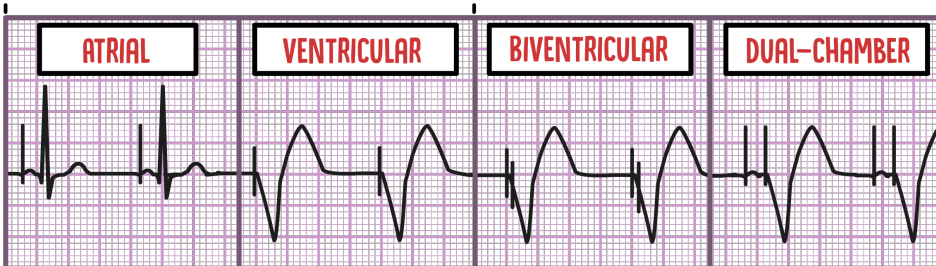
JUNCTIONAL RHYTHMS



RATE: 40–60 BPM, FASTER WITH ECTOPIC RHYTHM
P-WAVES: USUALLY ABSENT, SOMETIMES INVERTED
PR-INTERVAL: USUALLY NOT AVAILABLE
QRS: NARROW (AT PATIENT'S BASELINE)

Junctional rhythms occur when the **AV node takes over the job of the SA node** – which is normally the pacemaker of the heart. This occurs in two different scenarios. One, there is **dysfunction of the SA node** – this causes a HR of 40-60 bpm termed a “**Junctional escape rhythm**”. Or two, for whatever reason the **AV node is firing faster** than the SA node – which is termed “**Junctional ectopic rhythm**”. If the HR exceeds 100 bpm, this is termed **Junctional tachycardia**.

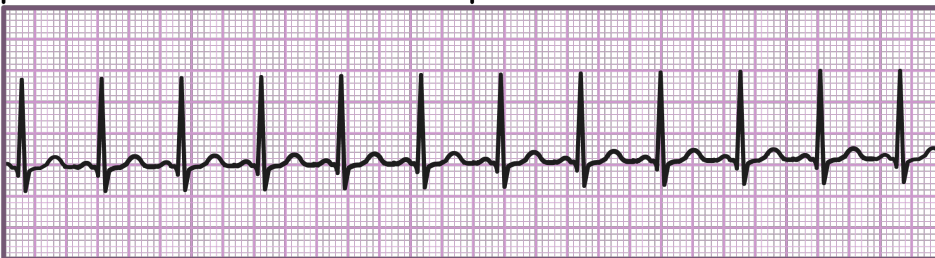
PACED RHYTHMS



RATE: AT LEAST 50–60 BPM
P-WAVES: MAY BE PRESENT, ABSENT, OR INVERTED
PR-INTERVAL: DOES NOT AFFECT IF PRESENT
QRS: NARROW (ATRIAL), OR WIDE

Paced rhythms occur when the **patient has a pacemaker** – usually implanted with leads in the **atria only, the right ventricle, both ventricles (biventricular), or both the atria and the ventricles (dual-chamber)**. The pacer will spike, causing stimulation of the cardiac tissue to conduct an electrical impulse. The complexes will look different depending on which type of pacemaker is present. However, you need to make sure the Pacer spike mode on your telemetry monitor is set to on – otherwise you may get confused and the pacer spikes won't show up on a standard rhythm strip.

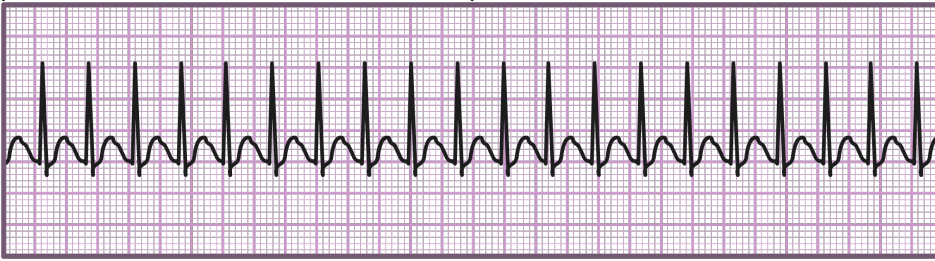
SINUS TACHYCARDIA



RATE: >100 BPM
P-WAVES: PRESENT
PR-INTERVAL: SHORTENED BUT CONSISTENT
QRS: NARROW

Sinus tachycardia is a regular rhythm which is just like NSR, except the **rate is >100 bpm**. This generally occurs in response to **stimulation** such as exercise or anxiety, or as a **physiologic response** to improve blood flow and oxygenation. This is a very common rhythm.

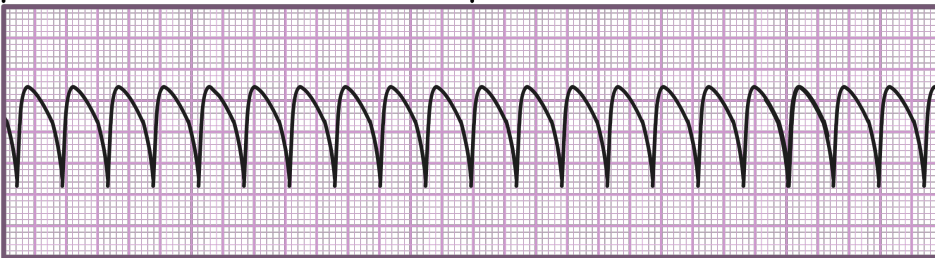
SUPRAVENTRICULAR TACHYCARDIA (SVT)



RATE: 150–250 BPM
P-WAVES: PRESENT BUT HIDDEN IN T-WAVE
PR-INTERVAL: N/A
QRS: NARROW

SVT is a type of fast heart rate that originates anywhere above the ventricles, **but usually refers to AVNRT or AVRT**. This occurs more frequently in younger and middle-aged individuals and can be triggered by **alcohol, caffeine, or recreational drugs** like cocaine. However, this can occur in older individuals as well, and can be triggered by anything which stresses the heart (*think about Hs and Ts from ACLS*).

VENTRICULAR TACHYCARDIA (VTACH)

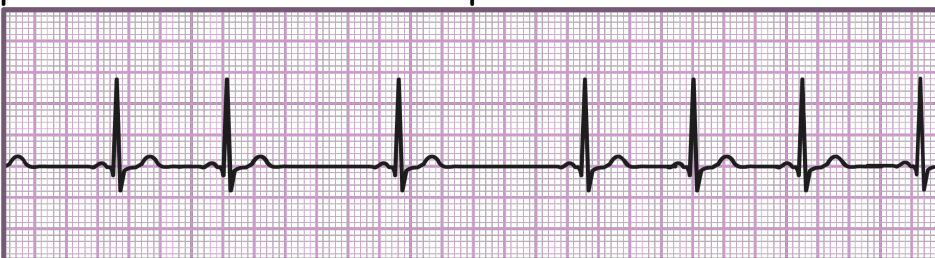


RATE: 100–250 BPM
P-WAVES: NONE
PR-INTERVAL: N/A
QRS: WIDE (>3 SMALL BOXES)

VTACH is a **serious rhythm** that usually indicates an **unstable patient**. If the patient is pulseless – this is **cardiac arrest** and the patient needs to be coded and **defibrillated ASAP**. If there is a pulse – the patient may or may not be reporting symptoms but this is still a serious situation **and the patient can decompensate at any moment**. The defibrillation pads should connect the patient to the defibrillation device, and close communication with the Provider is imperative.

IRREGULAR RHYTHMS

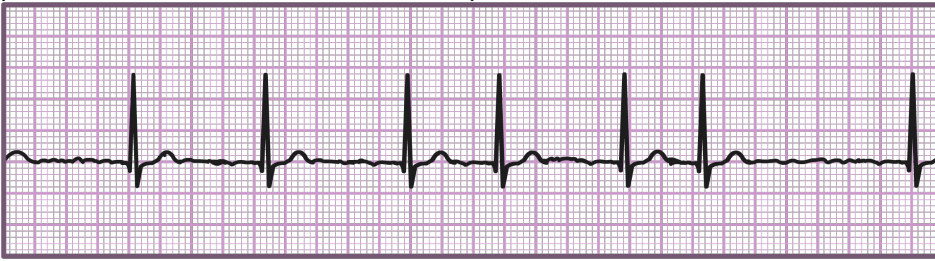
SINUS ARRHYTHMIA (SA)



RATE: 60–100 BPM
P-WAVES: PRESENT
PR-INTERVAL: UNAFFECTED
QRS: NARROW

Sinus arrhythmia is a (*almost always*) **benign** variant of NSR. This means that everything is the same as NSR except that it is **irregular** so it will not map out. This commonly occurs with the **respiratory cycle** – speeding up during inhalation and slowing for expiration. However, it can occur in a **diseased heart** or indicate **digitalis toxicity**.

ATRIAL FIBRILLATION (AF)



RATE: ANY, IF >100 BPM CONSIDERED "RVR"
P-WAVES: UNMEASURABLE
PR-INTERVAL: NONE
QRS: NARROW

AF is a common cardiac arrhythmia, especially **among the elderly**. The **atria of the heart quiver or fibrillate** instead of beating in an organized fashion. This can cause symptoms such as fatigue and SOB, and places the patient at **increased risk for developing a blood clot** within the heart. However, **many elderly patients are asymptomatic** and simply live with this disorder. AF has a tendency to run too fast if the patient is not on a **beta-blocker or calcium-channel blocker**. This is termed **AF RVR** (*rapid ventricular response*).

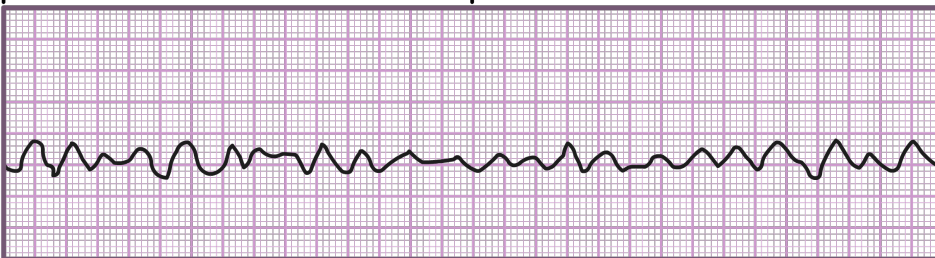
ATRIAL FLUTTER (AFLUTTER)



RATE: ANY RATE
P-WAVES: MANY "F"-WAVES (SAW-TOOTH PATTERN)
PR-INTERVAL: N/A
QRS: NARROW

Atrial flutter is Afib's little brother. It is essentially the same rhythm, except **the atria are not quivering quite as fast**. This causes **visible P-waves** which appear in a **saw-tooth pattern** – commonly a 2:1 P to QRS ratio. Because this tends to occur in a pattern, it is actually fairly common for Aflutter to **appear regular**.

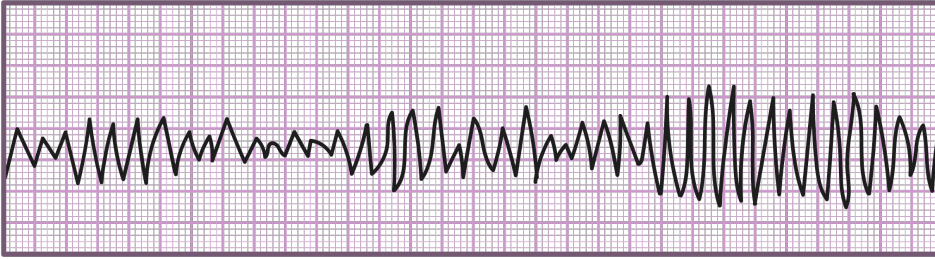
VENTRICULAR FIBRILLATION (VFIB)



RATE: NONE
P-WAVES: ABSENT
PR-INTERVAL: N/A
QRS: ABSENT

VFIB is one of the **worst-case scenarios and is not a perfusing rhythm**. These patients are in **cardiac arrest** and **will not be responsive or have a pulse**. This rhythm is similar to the concept of AF, except **the ventricles are quivering**. Within seconds the patient will go **unresponsive** due to **lack of blood flow** to the brain. The patient needs to be **coded and defibrillated ASAP**. The sooner they are shocked, the better chance a perfusing rhythm will be established.

TORSADES DE POINTES



RATE: VENTRICULAR RATE OF 160–250BMP

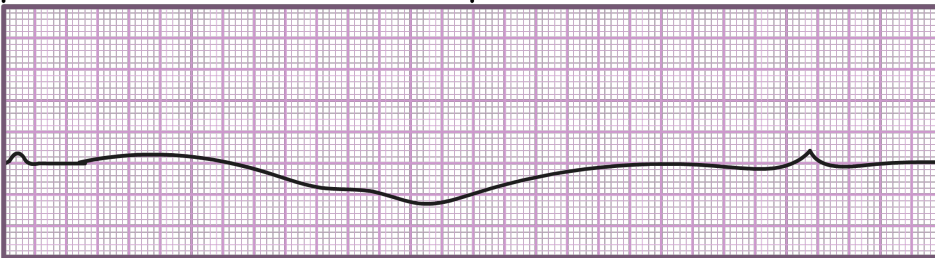
P-WAVES: ABSENT

PR-INTERVAL: NONE

QRS: N/A

Torsades is actually a type of **VTACH**. The difference is that it is **polymorphic** and caused by **QT prolongation**. The rhythm literally appears to twist around the isoelectric name – which is fitting because Torsades De Pointes literally means “twisting of the points” in French. This is another **critical rhythm** which can be **pulseless** and decompensate into VFIB or asystole

ASYSTOLE



RATE: NONE

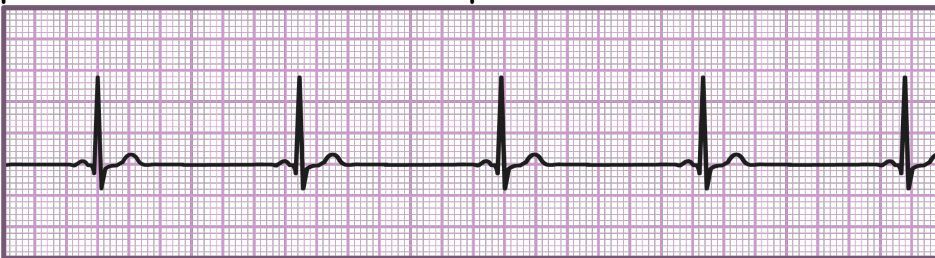
P-WAVES: NONE

PR-INTERVAL: NONE

QRS: NONE

Asystole is the characteristic “**flat-line**”. This is a heart that has **no electrical conduction** and thus no mechanical beating. These patients are **unresponsive** and need **coded** – however their chances of reestablishing a perfusing rhythm are worse than with pulseless VTACH or VFIB.

PULSELESS ELECTRICAL ACTIVITY



RATE: VARIABLE

P-WAVES: APPEAR NORMAL

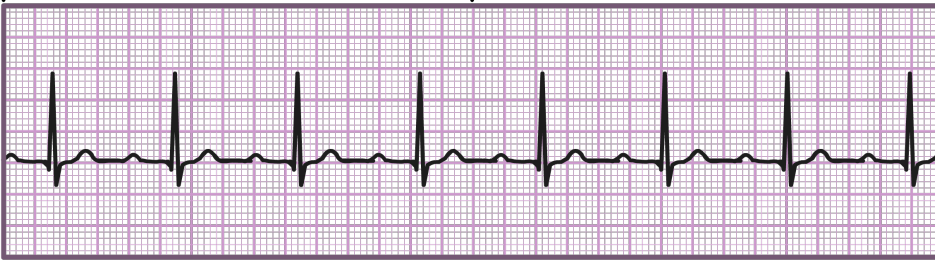
PR-INTERVAL: APPEAR UNAFFECTED

QRS: APPEAR NARROW

PEA **mimics bradycardia or sinus rhythm**. There are electrical impulses throughout the heart – but **the heart is not responding** to that impulse – meaning **the heart is not beating**. These patients present the same as Asystole and given time without intervention will progress to asystole.

HEART BLOCKS

1ST DEGREE AV BLOCK

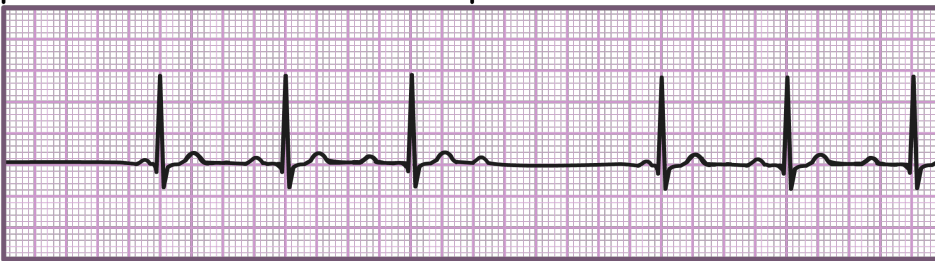


RATE: UNAFFECTED
P-WAVES: UNAFFECTED
PR-INTERVAL: >5 SMALL BOXES
QRS: UNAFFECTED

A 1st degree atrioventricular block is a **common** heart block and rather **benign**. There is some type of **delay** or interruption which **slows the electrical impulse** between the atria and the ventricles. This is technically not heart block but rather a “prolonged AV conduction”. Causes include structural abnormalities, various drugs such as **beta-blockers** or calcium channel blockers, or **previous heart attack**.

“IF THE R IS FAR FROM P – THEN YOU HAVE A 1ST DEGREE”

2ND DEGREE TYPE 1 AV BLOCK (WENCKEBACH)

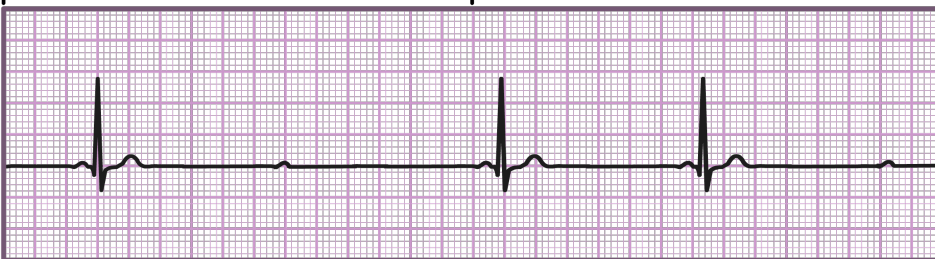


RATE: VARIABLE BUT USUALLY <60 BPM
P-WAVES: UNAFFECTED
PR-INTERVAL: PROGRESSIVELY LONGER UNTIL QRS DROPPED
QRS: NARROW; DROPPED IN A PATTERN (I.E. 3:1)

A 2nd degree type 1 AV block or **Wenckebach** is when the electrical impulse **progressively gets delayed and then completely blocked in a pattern**. This means the PR-interval is normal or **prolonged** and **inconsistent**. Occasionally, there will be P-waves where the QRS is dropped, and the pattern will reset. If **symptomatic** and **hemodynamically unstable** – they should be treated with atropine and temporary pacing – with possible implanted pacemaker needed.

“LONGER LONGER LONGER DROP – THEN YOU HAVE A WENCKEBACH”

2ND DEGREE TYPE 2 AV BLOCK (MOBITZ 2)



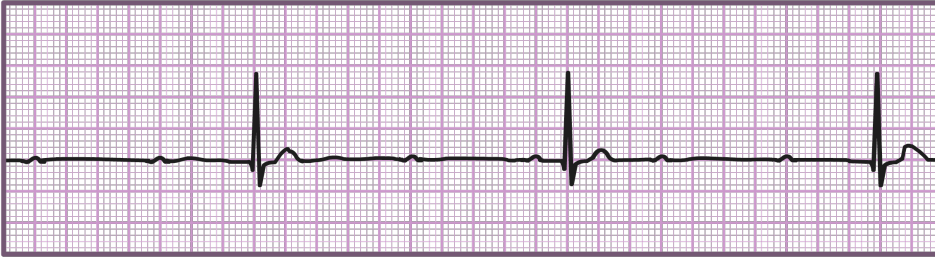
RATE: VARIABLE – USUALLY <60BPM
P-WAVES: UNAFFECTED
PR-INTERVAL: UNAFFECTED EXCEPT WHEN QRS DROPPED
QRS: OCCASIONALLY DROPPED

A 2nd degree Mobitz II AV block is when the electrical impulse **occasionally gets blocked** to the ventricles. This means the P-waves are normal or prolonged but **consistent**. However, occasionally there will be P-waves where the **QRS is dropped**. If symptomatic and

hemodynamically unstable – they should be treated with atropine and temporary pacing – with possible implanted pacemaker needed.

"IF SOME PS DON'T GET THROUGH – THEN YOU HAVE A MOBITZ II"

3RD DEGREE AV BLOCK (COMPLETE HEART BLOCK)



RATE: VARIABLE – BUT <60 BPM
P-WAVES: NORMAL RATE, REGULAR
PR-INTERVAL: VARIES EACH BEAT
QRS: SLOW RATE, REGULAR

Complete heart blocks are **ominous**, and the patient is **almost always symptomatic**. This is when the atria and the ventricles just are not communicating. This means the P-waves will map out and be regular with each other, and the ventricles will map out and be regular with each other. However – they **will not correlate** with each other at all. These patients need immediate atropine and temporary pacing until a **permanent pacemaker** can be inserted.

"IF PS AND QS DO NOT AGREE – THEN YOU HAVE A 3RD DEGREE"

BUNDLE BRANCH BLOCKS



RATE: UNAFFECTED
P-WAVES: UNAFFECTED
PR-INTERVAL: UNAFFECTED
QRS: WIDENED (>3 SMALL BOXES)

Bundle branch blocks occur between the ventricles. This is a fairly **common** heart block which **slows conduction** through the **ventricles**. This means there is an abnormally **widened** and **irregular-looking QRS** complex which will look different depending on which lead. There are Right and Left BBBs – however you cannot tell the difference based off of one rhythm strip. You would need a 12-lead ECG and look at leads V1 and V6.

WANT TO LEARN MORE?

This is a great overview of how to read a rhythm strip, but if you want to be a true ECG RHYTHM MASTER, check out my online video course for nurses! Not only do I teach you how to interpret a rhythm strip, you'll also know how and why they occur, and the clinical management involved with each arrhythmia!

Check out more information on the course including the curriculum and the price [here](#).



REFERENCES

UPTODATE

<https://www.uptodate.com/contents/ecg-tutorial-basic-principles-of-ecg-analysis>

<https://www.uptodate.com/contents/ecg-tutorial-myocardial-ischemia-and-infarction>

<https://www.uptodate.com/contents/ecg-tutorial-st-and-t-wave-changes>

<https://www.uptodate.com/contents/ecg-tutorial-ventricular-arrhythmias>

<https://www.uptodate.com/contents/ecg-tutorial-intraventricular-block>

<https://www.uptodate.com/contents/ecg-tutorial-atrial-and-atrioventricular-nodal-supraventricular-arrhythmias>

<https://www.uptodate.com/contents/ecg-tutorial-atrioventricular-block>

<https://www.uptodate.com/contents/ecg-tutorial-rhythms-and-arrhythmias-of-the-sinus-node>

OTHER WEBSITES

<https://en.ecgpedia.org>

https://learningcentral.health.unm.edu/learning/user/onlineaccess/CE/bac_online/index.html

<https://litfl.com/ecg-library/>

TEXTBOOKS

Basic Arrhythmias (7th edition) – *Gail Walraven*

ECGs Made Easy (6th edition) – *Barbara Aehlert*

Rapid Interpretation of EKGs (6th edition) – *Dale Dubin, MD*

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