EKG / ECG
Study Guide

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What is the EKG showing me?

Before you can begin reading the EKG you need to understand what it is that you are looking at in relations to the heart. First and foremost, to remember is the EKG is only showing you the electrical function of the cardiac conduction system. It guarantees nothing when it comes to mechanical function of the heart.

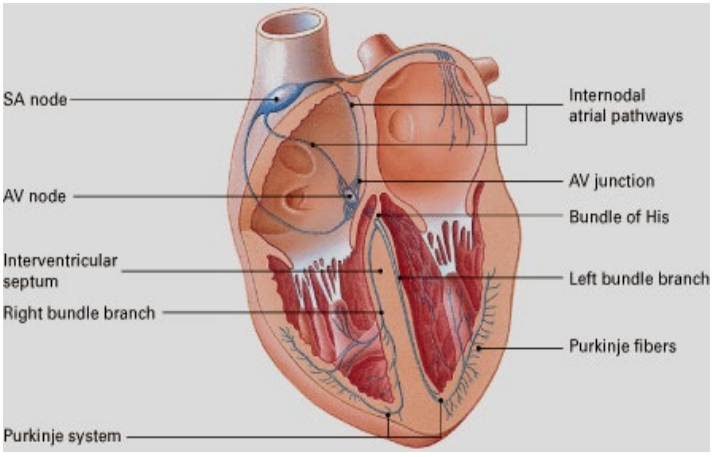
It is actually very simple to understand an EKG as each "blip" represents a certain portion of electrical activity in the heart. All EKG interpretations should start with a baseline or "normal sinus rhythm". On the EKG the "blips" are given the labels **P**, **P-R interval**, **QRS**, **S-T** segment and **T** wave. Please look at the reference models below as I describe these. These blips usually indicate the depolarization or active period of the cardiac cycle.

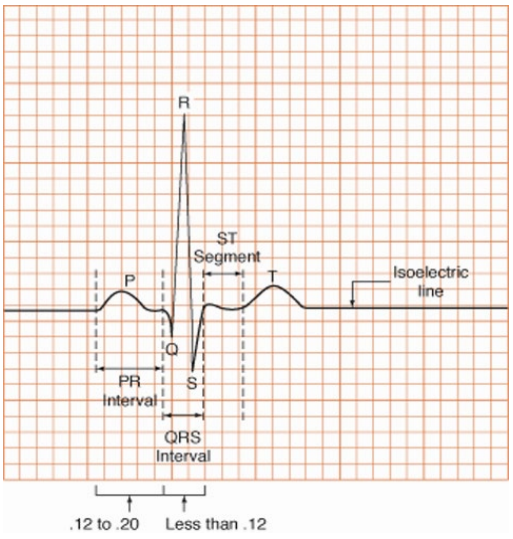
The **"P"** and **"P-R"** interval represent the firing of the SA node, signal traveling through the atrium and pausing at the A-V junction. This pause is extremely important as this ensures the atriums have completely contracted and forced as much blood as possible into the ventricles. This is what is known as the "atrial kick" or "preloading" of the ventricles. This can constitute up to 30% of your cardiac output. Next is the **"QRS"**, this represents the electrical signal passing through the entire ventricular conduction circuit. This is a much shorter time frame as the ventricles must contract quickly to give adequate cardiac output. After the QRS comes the "**S-T segment**" and "**T-wave**". These represent the resting period of the cardiac cycle and the repolarization of the heart to get ready for the entire cycle to start again.

You normally hook up the monitor leads as "**white to right**" "**black on left upper**" and "**red on left lower**". This is what is called the standard "**lead II**". The below right graph would illustrate a typical normal sinus rhythm in lead II. The final base thing to note is the deflections. You will note that all the "blips" are upright. That means the electrical signal is primarily traveling towards the positive lead, in the case of lead II that is your red lead. So in lead II, the more signal heading toward the red lead or the stronger the signal the bigger the "blip".

A final note is, not all patients will have this classic look. This does not mean they do not have a good functioning heart or major problems. There are many things that can alter the "blips", some could be normal for the patient; others may be due to previous heart damage. All you need to know is "treat your patient, not the monitor". If it looks odd, but the patient is not complaining of anything or having symptoms, don't let it worry you, but also don't let your guard down.

Okay, after you review the information, you should be ready to venture to the next pages to go further into EKG interpretation.





Information referenced from: Basic Dysrhythmias-3rd ed., Huszar 2002, Basic Arrhythmias-5th ed, Walraven 1991, Taigman's Advanced Cardiology, Taigman, Miller, Canan 1995

Tips before you begin:

Keep in mind the majority of rhythm strips you look at will be normal or essentially sinus in nature. Therefore, when you are attempting to identify a rhythm do not look deeply into it. You should be able to identify the rhythm at a general glance. Viewing deeply into a rhythm can in fact cause your eyes to play games with you and you will start to see all kinds of things that may or may not be there or are irrelevant.

The following information is a guide to assist you in figuring out rhythms, but do not use this as your only guide. There are many other excellent resources out there. Keep in mind that my suggestions and information may not be the same as the next person. Throughout this guide you will note (**bold#**'s) next to the names, these numbers correlate to the attached EKG's.

To begin one of the very first things you should do is ask the following 5 sinus questions first:

SINUS: Normal **(1&4)** rate 60-100, Brady **(3)** rate 40-60, Tachy **(2&25)** rate 100-140?

- Is there a "P" wave? (atrial depolarization)
- Is there a "QRS"? (ventricular depolarization)
- Is there a "P" before every conducted "QRS"?
- Is there a conducted "QRS" after every "P"?
- Is the "P-R" interval the same & regular on every beat?

If someone has poor skin conduction or moves a lot during EKG interpretation it may generate a hard to read baseline line, this is known as artifact **(26)**. In general, do not let this worry you, but it can mask other issues.

BLOCKS:

Generally speaking, heart blocks are actually easy to figure out. A heart block is usually a sinus rhythm with a conduction problem usually through the A-V system. As the problem gets worse so does the degree of block. Common causes of heart block are medication or electrolyte problems and rarely are they caused by myocardial infarcts, although if they are it is usually due to problems with the right coronary artery.

1st Degree (13): All sinus questions are "yes". Only difference you will see is a "P-R" interval time over .20 (or it looks long)

2nd Degree-Type I (Wenkebach) (14): All sinus questions are "yes" except the "P-R" interval will progressively get longer until a "QRS" is not generated. Essentially the impulse is held longer & longer in the "A-V" circuit until finally it is held so long that the energy dissipates, and the ventricles are not depolarized and therefore no "QRS" will be generated. If you measure P-P it will be regular, the R-R will not.

2nd Degree-Type II (Mobitz) (15): This rhythm is commonly mistaken for 3rd degree. The easy way to figure this one is you will have multiple "P" waves (P-P will be regular) before the "QRS" complexes. Where you will want to look at is the P-R interval. The P-R interval when a QRS is generated will always be the same in this block.

3rd Degree (Complete) (16): In this one the A-V circuit is usually completely blocked. Ventricular depolarization usually comes from a pacemaker high in the ventricle. P-P & R-R intervals will be regular, but the P-R interval varies on every beat. The QRS complex is usually wide and ventricular rates are in the 20-40 range. The sinus rate "P" may be normal. In severe cases the ventricle will not generate its own beat and all you will see is "P" waves. This is known as ventricular standstill **(30)**

Bundle Branch Blocks (8): These can be confusing and there are many variations. These blocks are normally from a problem in the ventricular circuit. A 12 lead is best for true confirmation. Generally right "bbb" shows a rabbit ear type QRS (primarily lead 3 & V leads) and left "bbb" shows a wide QRS in most all leads. Normally "bbb" is benign unless it is a new onset associated with an acute MI. In these cases be on alert as patients can deteriorate very quickly.

ATRIAL & JUNCTIONAL:

Generally speaking, most rhythms with narrow QRS complexes where you can't easily answer all of the questions in the sinus section are some other atrial rhythm. As a bit of information many term narrow complex rhythms as supraventricular in origin (supra = above). I have defined the most common.

Atrial Fibrillation (23): This is commonly termed as an irregularly irregular rhythm. The baseline will look like a lot of artifact **(26)** but you will note the R-R is constantly changing. Note that you may occasionally see a normally conducted "P" and "QRS". That **does not** make it an irregular sinus rhythm. You will also be able to confirm this by checking the patient's pulse; it will be very irregular with unequal strengths to the beats. **Note:** This rhythm gets harder to figure out when the heart rate climbs over 150. Also, these rhythms will rarely if ever respond to vagal maneuvers.

Atrial Flutter (24): This may be regular or irregular depending on the speed. What you will see is a baseline that looks like the blades of a saw. In most cases the end of one saw tooth will be the beginning of the "QRS" and the end of the "QRS" will be the beginning of the next saw tooth. These rhythms may be evident in the presence of an acute MI. It is very tough for the atriums to maintain this as the atrial rate tends to be in the 300 range.

Atrial Tachycardia (21): Commonly classified with **SVT**. Rates primarily run well over 150 with narrow complex "QRS's". There are many variables and to cover all of them is difficult. Although you may suspect sinus rhythm here it will be very difficult if not impossible to figure out if the peak between "QRS" complexes is a "T" wave or a "P" wave. In some patients this rhythm may come on suddenly and stop just as quickly, commonly termed "paroxysmal". Patients who have had it before will know and may state a "fluttery" feeling in their chest. **Note:** These rhythms can easily be confused with ventricular tachycardia in patients with a history of "bbb" **(22)** and the rate is below 180. As a general rule ventricular tachycardia rarely exceeds 180.

Premature Atrial Complexes (PAC) (6): These can show up in virtually any rhythm. Do not confuse a sinus rhythm with many PAC's with atrial fibrillation. Essentially every so often you will see a "PQRST" that will show up early with a delay before the next sinus beat. The "P" wave of the "PAC" will usually look different than other sinus generated "P" waves. Usually the "QRS" of the "PAC" will look similar to all other QRS's. These may or may not generate a pulse and are rarely an issue unless they are so frequent they are interfering with the underlying rhythm.

Premature Junctional Complexes (PJC) (7): Similar to the PAC except you will not see a "P" wave or you will notice the "P" inverted or following the QRS. All other principals as in PAC's apply here.

Junctional Rhythm (27): These rhythms may be noted in patients with "sick sinus syndrome" or in patients with an acute right sided myocardial infarct. Rates may vary anywhere from 20-60. Junctional rhythms usually generate narrow "QRS" complexes and "P" waves are usually not present, inverted or after the "QRS". These rhythms can sometimes be found early in post resuscitation along with ventricular escape beats. Patients may or may not be symptomatic with these rhythms.

VENTRICULAR: (Rates from 0-40)

Okay here we go with some fun. A rhythm, which is ventricular in origin, will normally be wide and slow, except of course in tachy rhythms. Don't let wide complex rhythms scare you though.

Premature Ventricular Complexes (PVC) (9-12): In conjunction with other rhythms, you may see occasional wide "QRS" complexes that may or may not interrupt the underlying rhythm. These may or may not generate a pulse. These can be one shape "unifocal" **(9&10)** or different shapes "multifocal" **(11)**. 2 in a row are called "couplets" **(12)**. A "geminy" definition relates to the PVC's presence in relation to the underlying "QRS". An example of trigeminy would mean every 3rd beat is a"PVC". In many cases these are benign but be wary in patients with cardiac symptoms and history. Even someone without cardiac problems can generate "PVC's". Use caution when treating, if the patient is asymptomatic from the PVC's try to identify and correct the underlying cause before administering antiarrythmic medications.

Ventricular Tachycardia (17): This will be a wide very regular rhythm. Generally, the rates vary and tend to be in the 150-180 ranges, rarely does the rate go over 180 in adults. Depending on the patient's problems this rhythm may or may not generate a pulse. On occasion you may see a "P" wave floating along the "QRS". This rhythm can be mistaken for Ventricular Fibrillation in patients with poor skin conduction or if the EKG size on the monitor is set high. Be sure to check your patient very well with this rhythm. "**Torsades de Pointe"** is also a version, usually linked to electrolyte (magnesium) problems and defined by the "R" wave changing directions every few beats.

Ventricular Fibrillation (18): Simply put, "NO PULSE". If you see a very irregular baseline with no discernable "QRS" complexes and of course no pulse, then you most likely have ventricular fibrillation. The larger the impulses usually mean it is relatively early onset. The longer a patient is in this rhythm the smaller the impulses will get until our next rhythm shows up. In witnessed cases; defibrillation is the primary treatment; in unwitnessed cases, CPR should be performed for 2 minutes prior to defibrillating as the heart muscle needs fresh blood and oxygen before you hit it with electricity. Even though the heart isn't beating, the fibrillation will use up the oxygen in the cells.

Asystole (20): Keep this in mind "asystole is your friend". The primary conduction circuit will rarely come back into play during resuscitation until all altered electrical activity is stopped. You should check this rhythm in a couple of different leads or even try turning the monitor "QRS size up as fine ventricular fibrillation can be hiding. Pacing is an option but rarely works in this rhythm; but it must be done early if there is any chance it will work. Make sure you look at all possible causes (h's & t's). No need to explain this further it is "flat line"

Idioventricular (19&29): This is a very slow wide complex. Very common in the end stages of a dying heart **(agonal) (19)**, but also may be present as initial rhythms during resuscitation **(ventricular escape) (29).** This will be a judgment call. During resuscitation the heart often will start back up very slowly, usually with wide complex rhythms until the heart muscle and pacemaker sites are supplied with well oxygenated blood again. This is why CPR right after defibrillation is so important. These beats are not adequate on their own to perfuse the heart or brain. And contrary to old beliefs, you will not hurt a patient by doing CPR even if their heart is beating.

Pulseless Electrical Activity (PEA): PEA is truly not a rhythm, but a condition. If a patient has electrical activity on the monitor that you would think should have a pulse (like sinus rhythm) and does not, then look for the cause (h's & t's).

Implanted Pacemakers (28): Some patients may have implanted pacemakers, although rarely seen you may note a small straight spike before the "P" or "QRS" depending on the pacemaker type. Many paced rhythms will show wider "QRS" patterns or they may be upside down.

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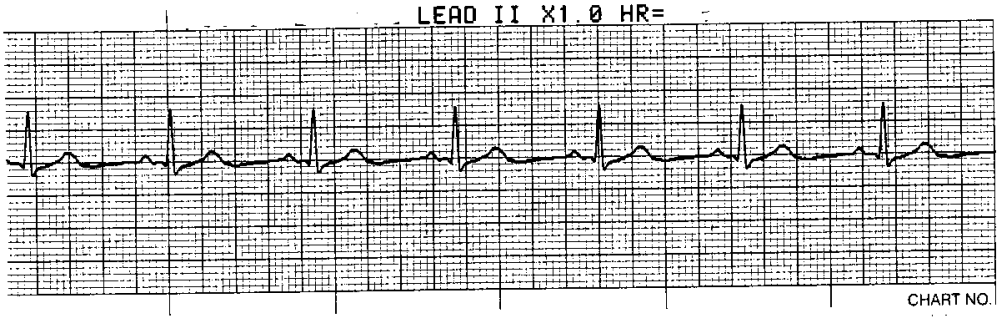

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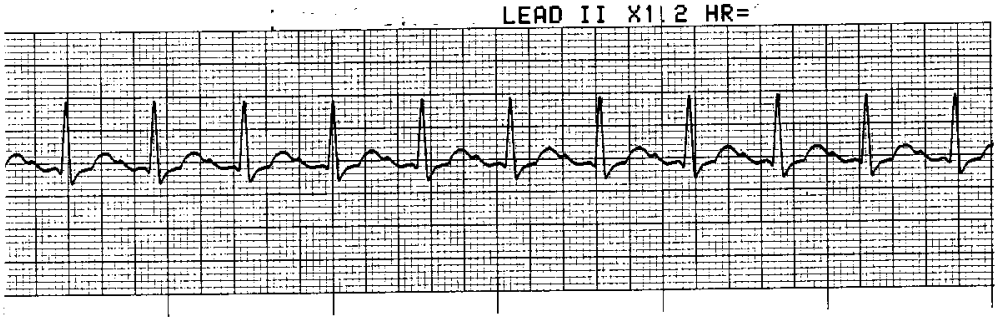

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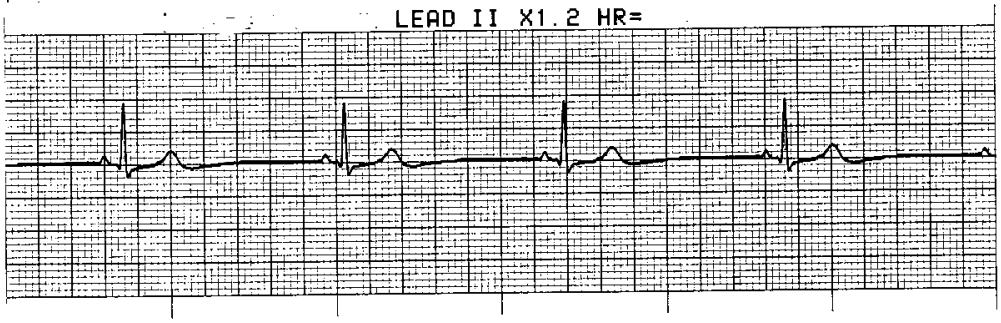

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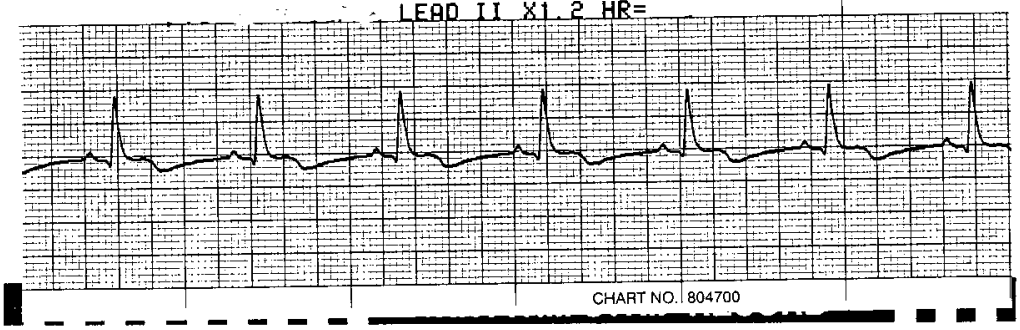

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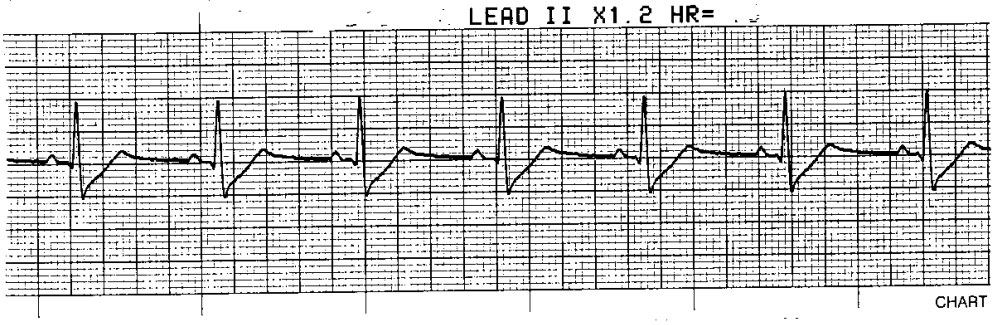

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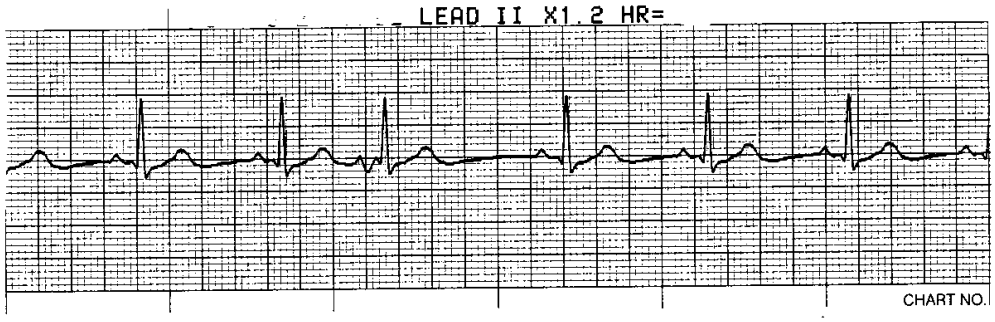

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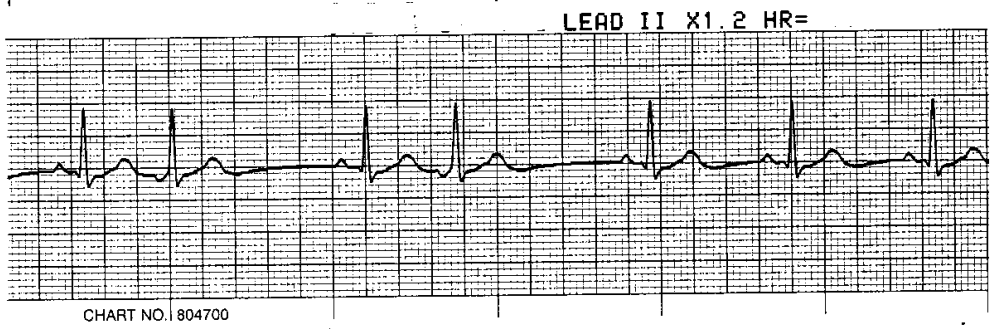

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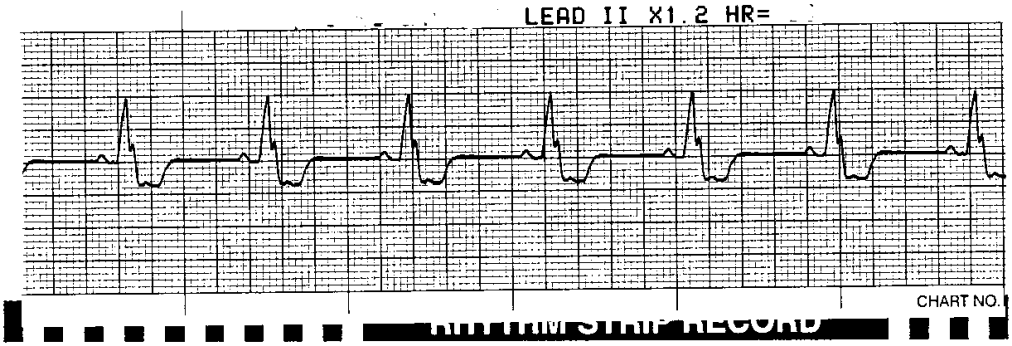

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RHYTHM STRIP RECORD

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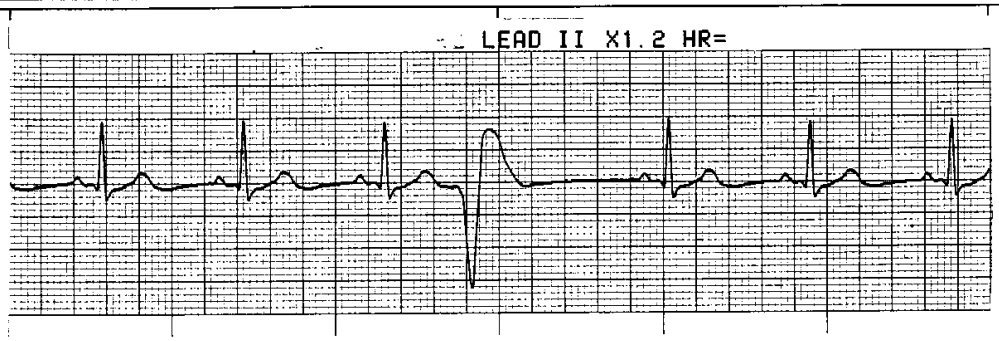

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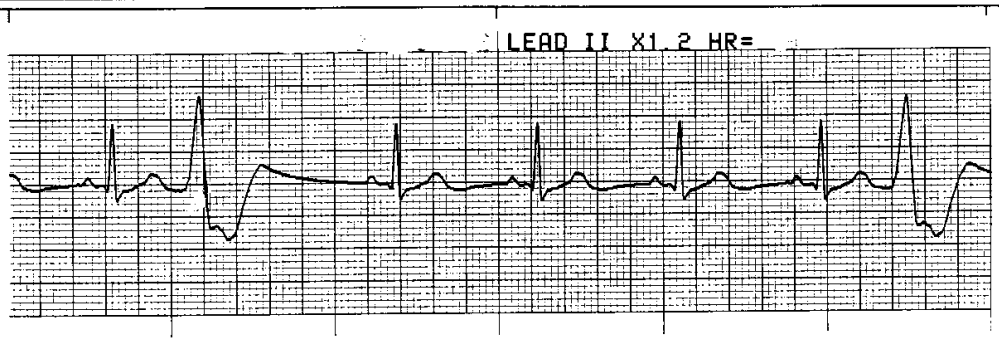

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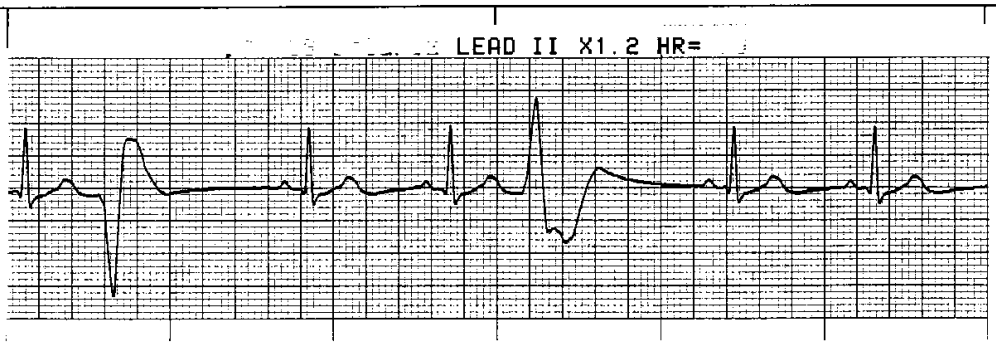

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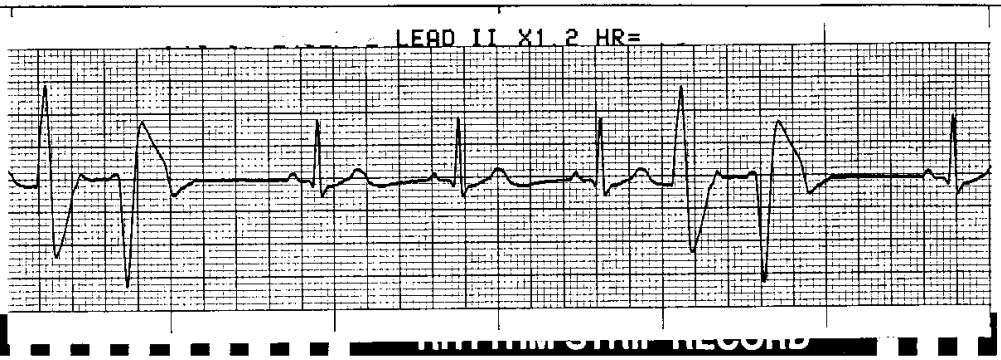

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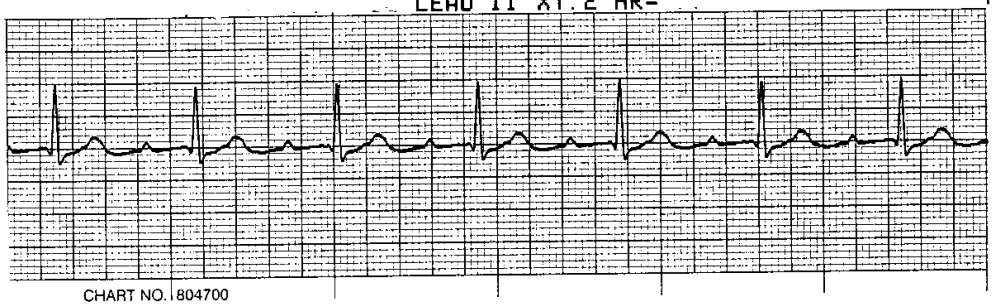

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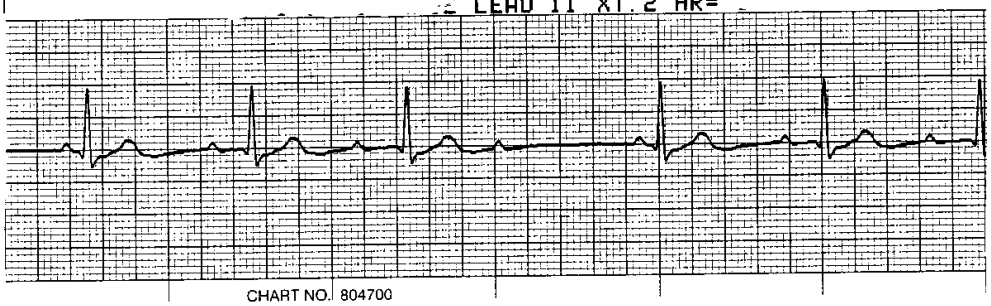

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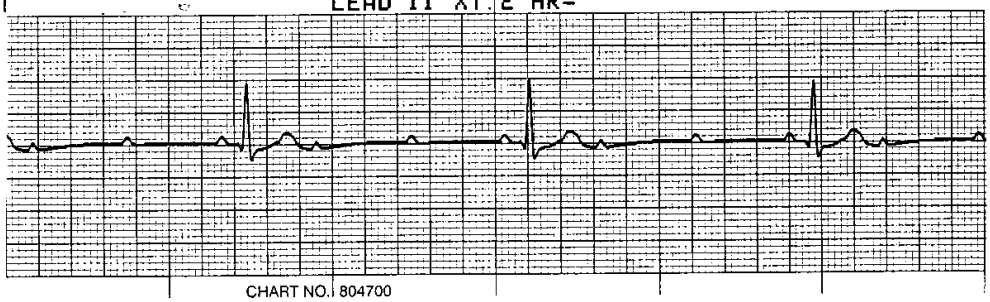

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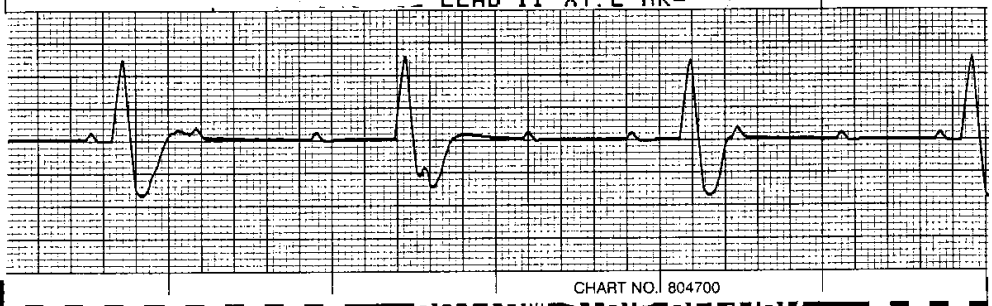

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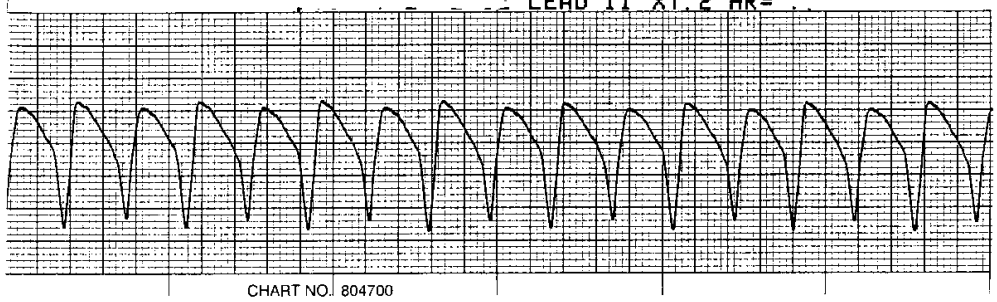

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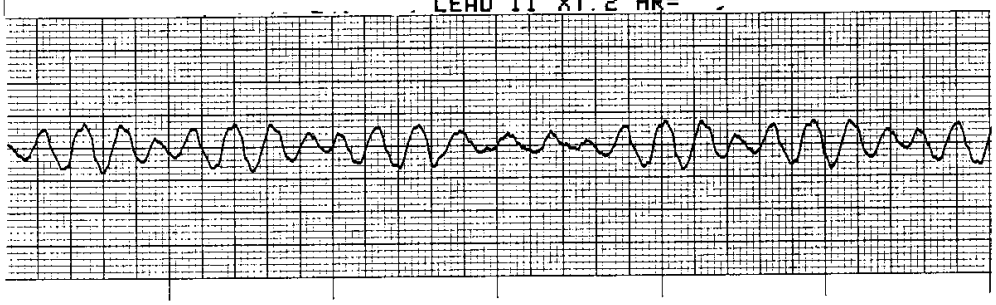

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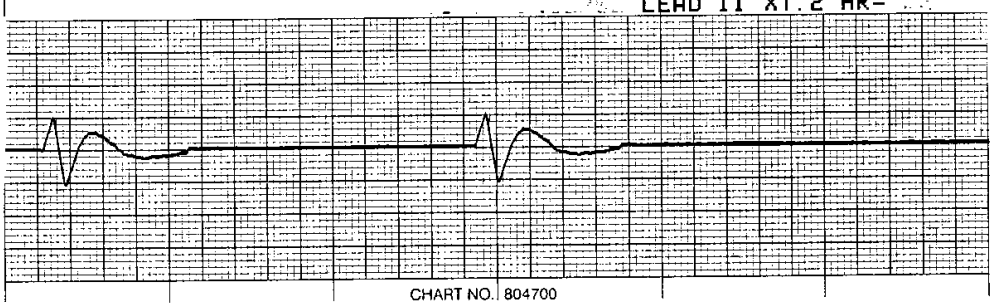

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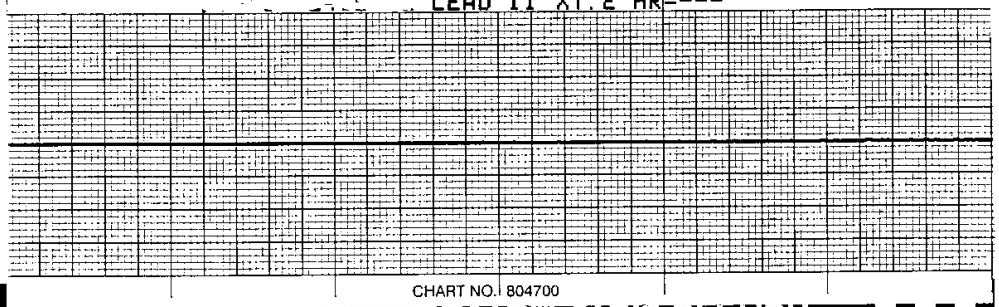

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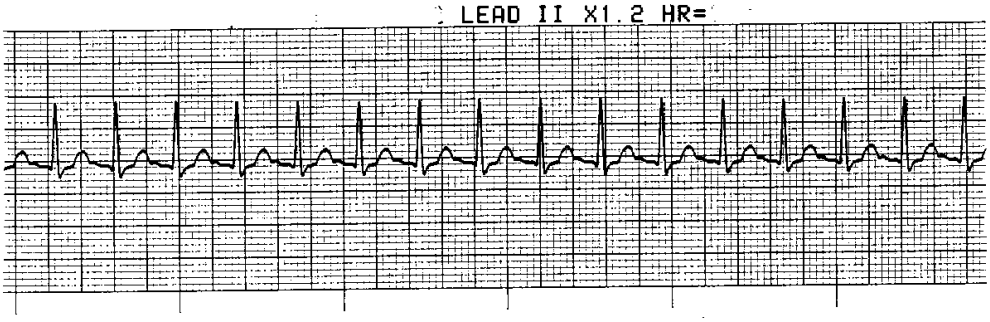

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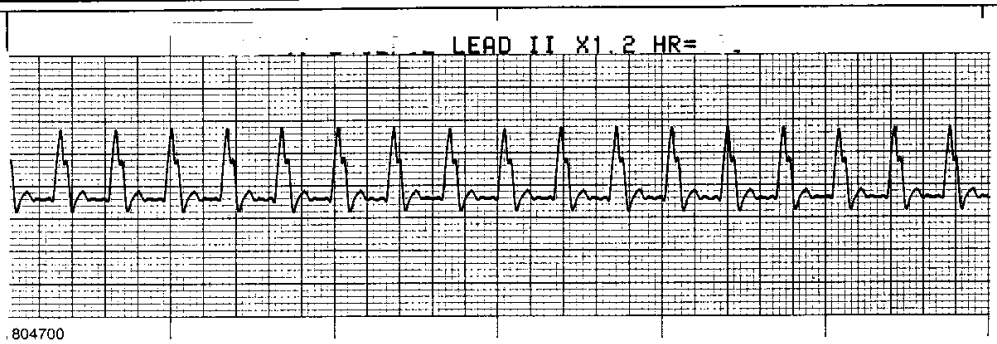

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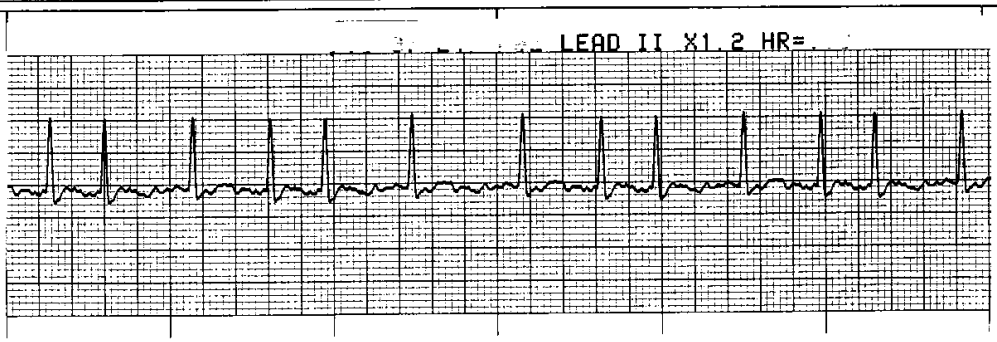

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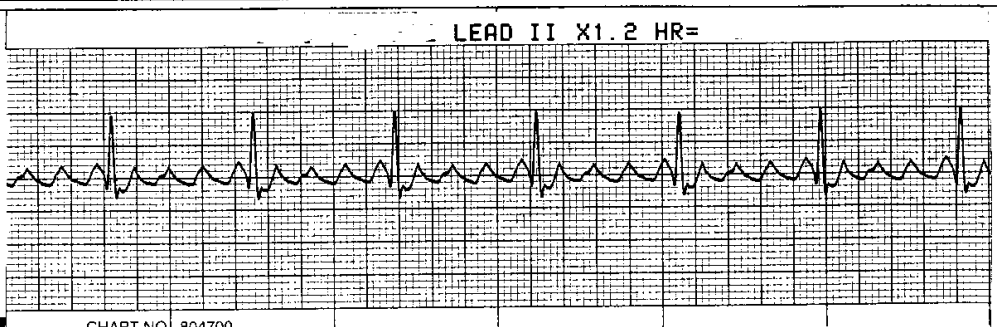

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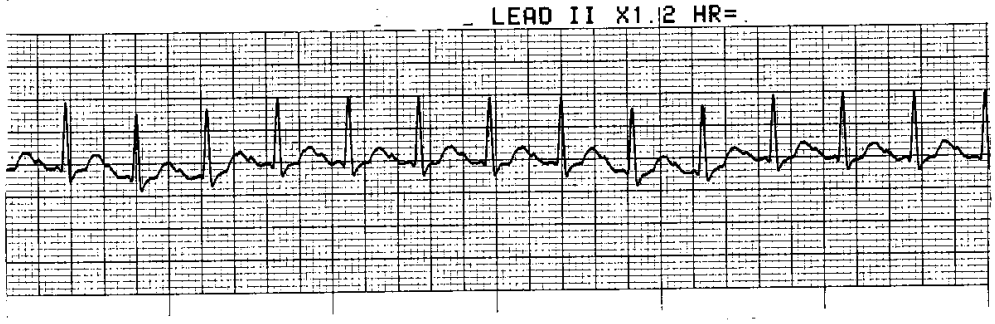

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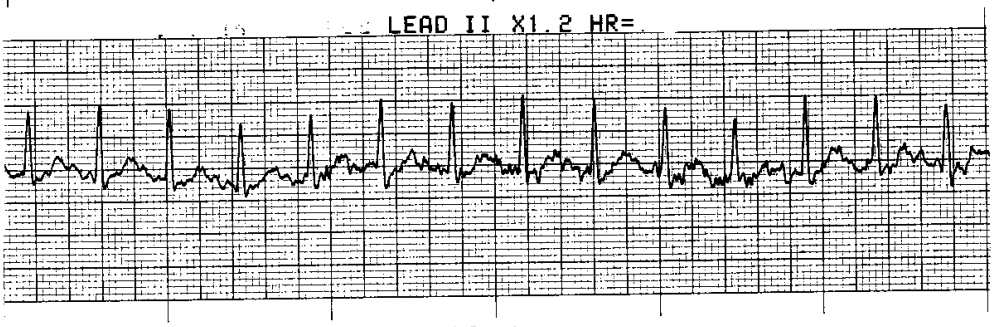
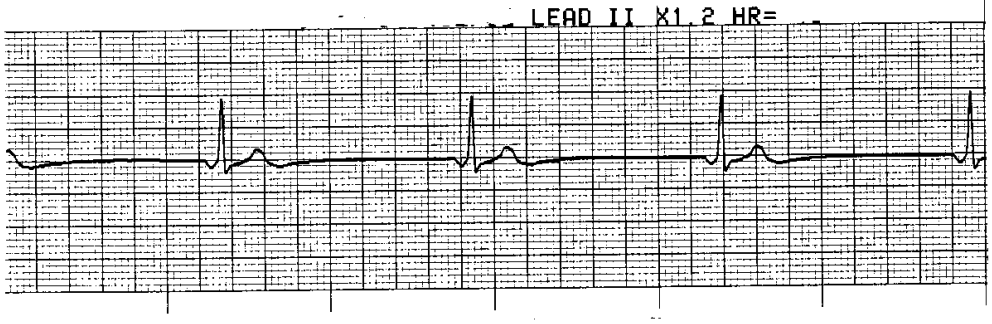
Sign. _____

26



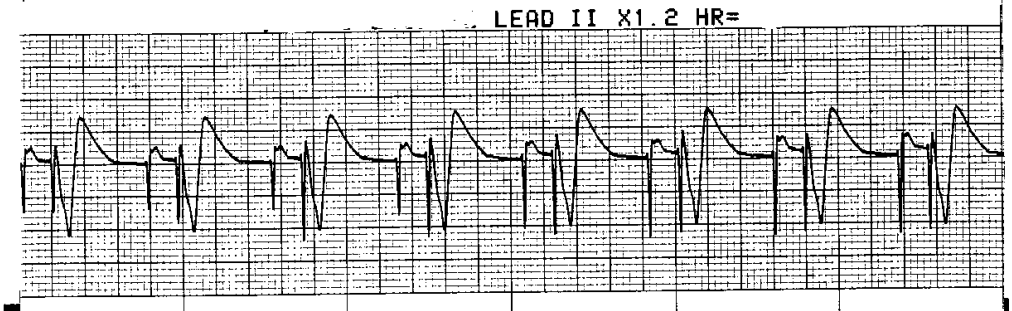
Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

27



Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

28



Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

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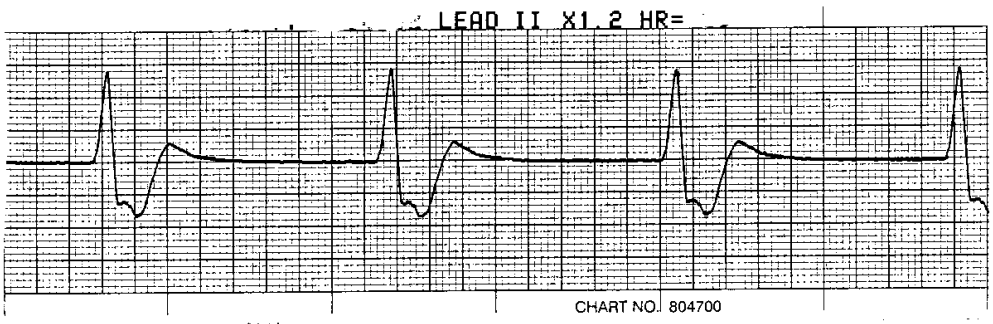
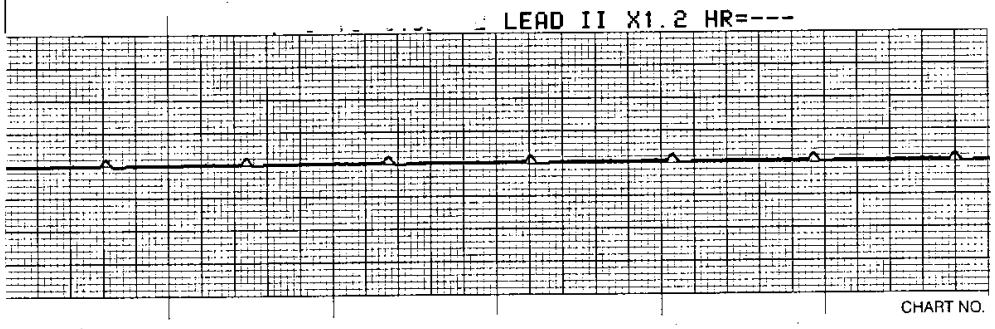
RHYTHM STRIP RECORD

29



Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

30



Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

Rate _____
Rhythm _____
PR int. _____
QRS _____
QT _____
Analysis _____
_____
_____
Sign. _____

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RHYTHM STRIP RECORD