

PHYSICIANS' PRESS

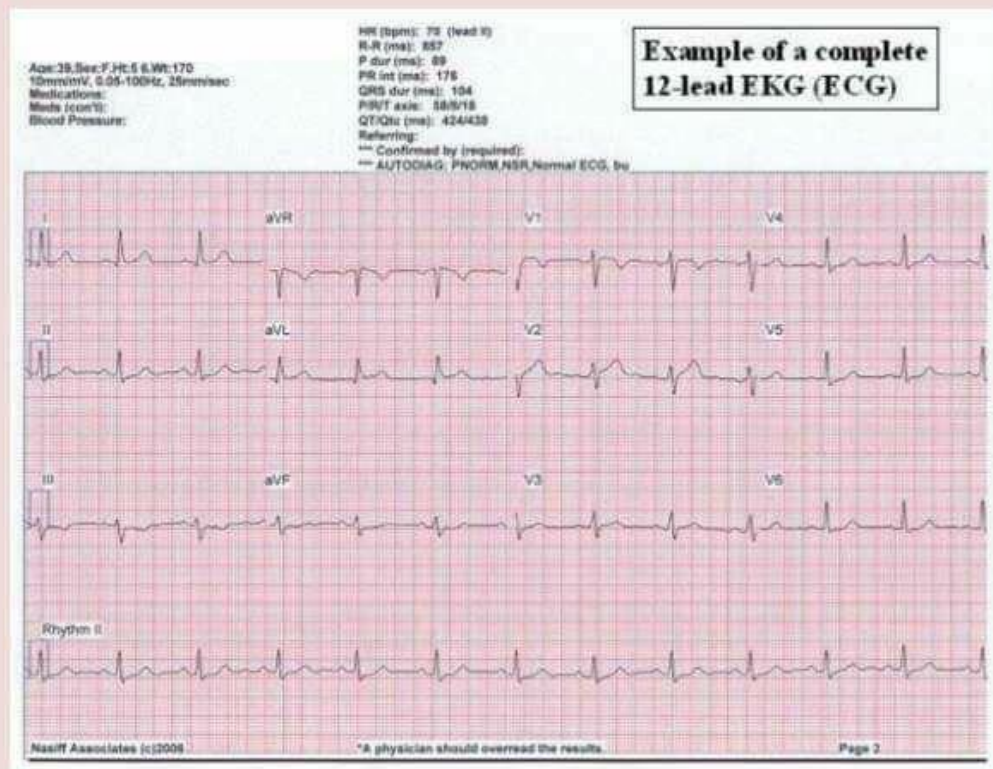
New For  
2009!

# The Complete Guide to **ECGs**

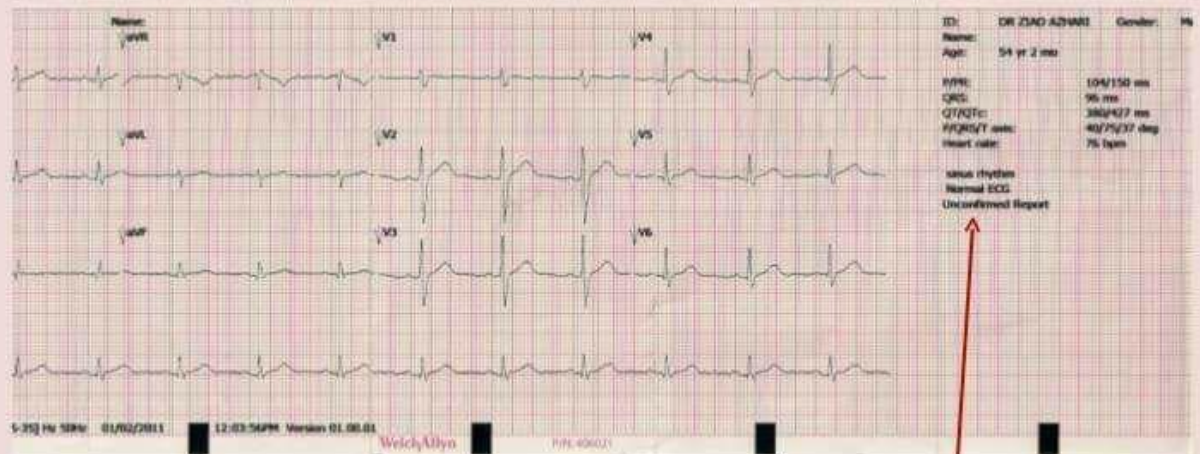
## A Comprehensive Study Guide to Improve ECG Interpretation Skills

### Third Edition

OBTAIN A N ECG, ACT CONFIDENT, READ THE PT DETAILS



## OBTAIN A N ECG, ACT CONFIDENT, READ THE PT DETAILS



Some ECG machines come with interpretation software. This one says the patient is fine. **DO NOT** totally trust this software.

## The best way to interpret an ECG is to do it step-by-step



- Rate
- Rhythm
- Cardiac Axis
- P – wave
- PR - interval
- QRS Complex
- ST Segment
- QT interval (Include T and U wave)
- Other ECG signs

RATE



## CALCULATING RATE

As a general interpretation, look at **lead II** at the bottom part of the ECG strip. This lead is the **rhythm strip** which shows the rhythm for the whole time the ECG is recorded. Look at the number of square between one R-R interval. To calculate rate, use any of the following formulas:

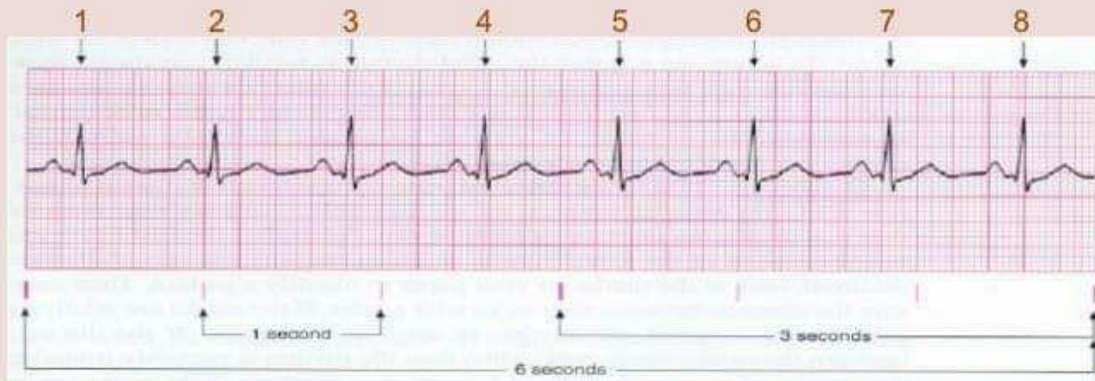
$$\text{Rate} = \frac{300}{\text{the number of **BIG SQUARE** between R-R interval}}$$

OR

$$\text{Rate} = \frac{1500}{\text{the number of **SMALL SQUARE** between R-R interval}}$$

## CALCULATING RATE

If you think that the **rhythm is not regular**, count the number of electrical beats in a 6-second strip and multiply that number by 10. (Note that some ECG strips have 3 seconds and 6 seconds marks) Example below:

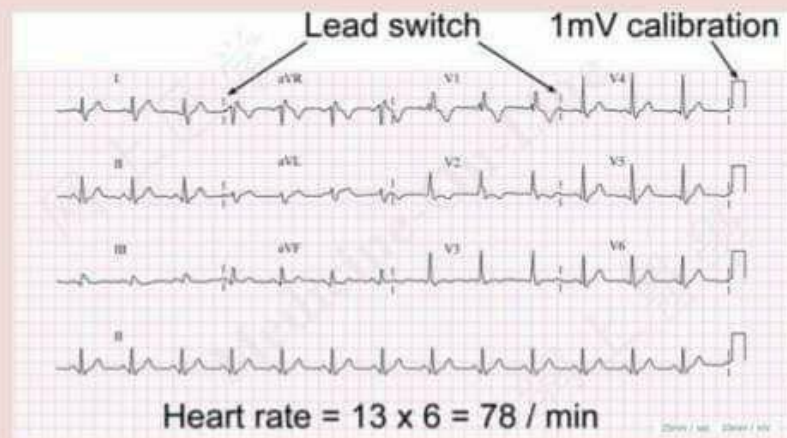


There are 8 waves in this 6-second strip.

$$\begin{aligned}\text{Rate} &= (\text{Number of waves in 6-second strips}) \times 10 \\ &= 8 \times 10 \\ &= 80 \text{ bpm}\end{aligned}$$

## CALCULATING RATE

You can also count the number of beats on any one row over the ten-second strip (the whole length) and multiply by 6. Example:



$$\begin{aligned}\text{Rate} &= (\text{Number of waves in 10-second strips}) \times 6 \\ &= 13 \times 6 \\ &= 78 \text{ bpm}\end{aligned}$$

## CALCULATING RATE

Interpretation	bpm	Causes
Normal	60-99	-
Bradycardia	<60	hypothermia, increased vagal tone (due to vagal stimulation or e.g. drugs), athletes (fit people) hypothyroidism, beta blockade, marked intracranial hypertension, obstructive jaundice, and even in uraemia, structural SA node disease, or ischaemia.
Tachycardia	>100	Any cause of adrenergic stimulation (including pain); thyrotoxicosis; hypovolaemia; vagolytic drugs (e.g. atropine) anaemia, pregnancy; vasodilator drugs, including many hypotensive agents; FEVER, myocarditis

RHYTHM



## RHYTHM

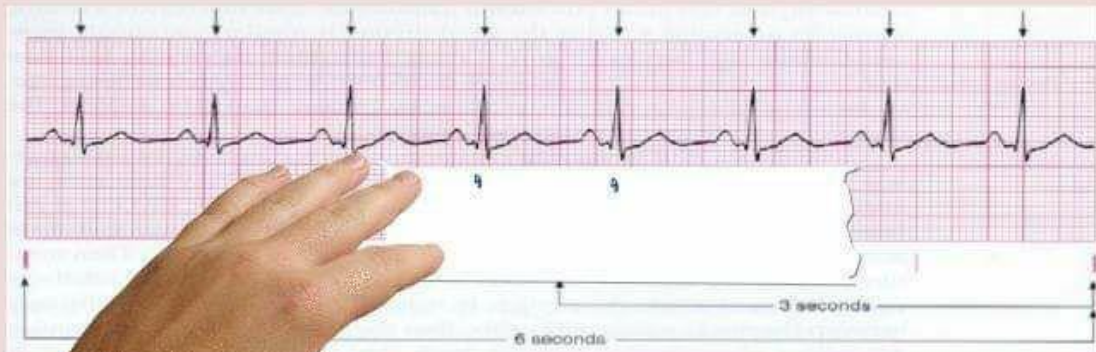
Look at p waves and their relationship to QRS complexes.

Lead II is commonly used

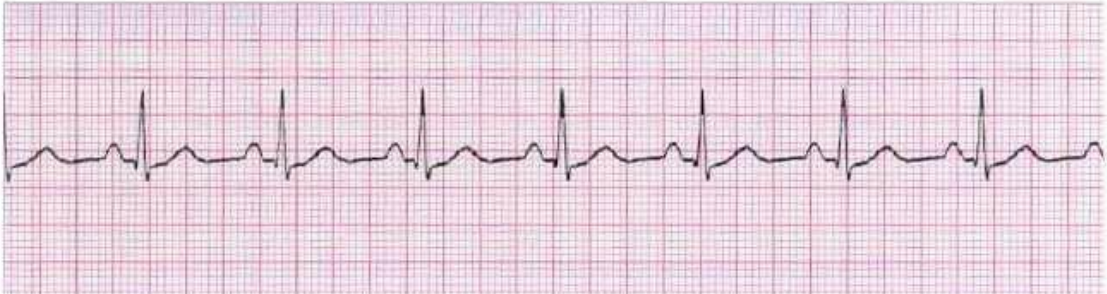
Regular or irregular?

If in doubt, use a **paper strip** to map out consecutive beats and see whether the rate is the same further along the ECG.

Measure ventricular rhythm by measuring the R-R interval and atrial rhythm by measuring P-P interval.



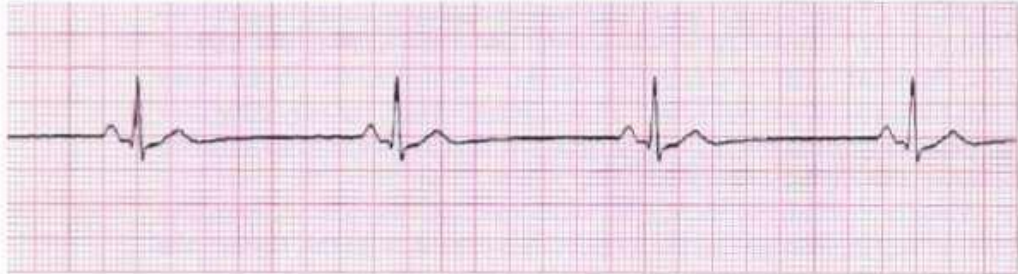


**Normal Sinus Rhythm**

ECG rhythm characterized by a usual rate of anywhere between 60-99 bpm, every P wave must be followed by a QRS and every QRS is preceded by P wave. Normal duration of PR interval is 3-5 small squares. The P wave is upright in leads I and II

## RHYTHM

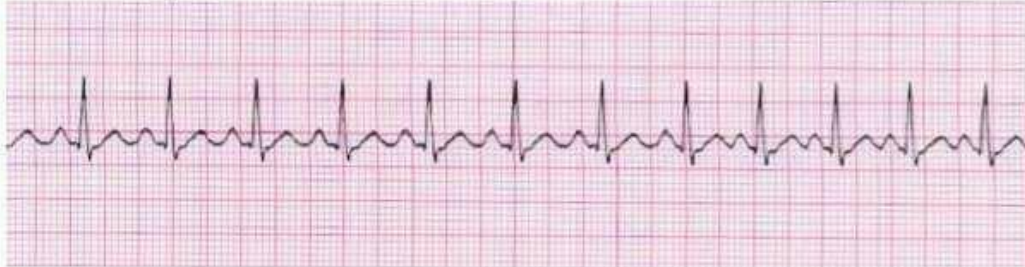
### Sinus Bradycardia



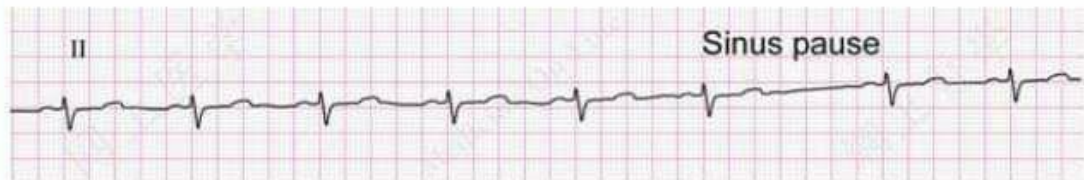
Rate < 60bpm, otherwise normal

## RHYTHM

### Sinus Tachycardia



Rate >100bpm, otherwise, normal

**Sinus pause**

In disease (e.g. sick sinus syndrome) the SA node can fail in its pacing function. If failure is brief and recovery is prompt, the result is only a missed beat (sinus pause). If recovery is delayed and no other focus assumes pacing function, cardiac arrest follows.

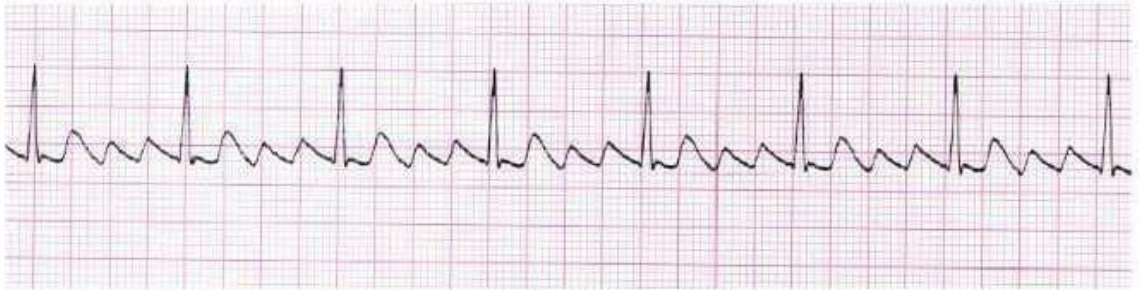


### Atrial Fibrillation



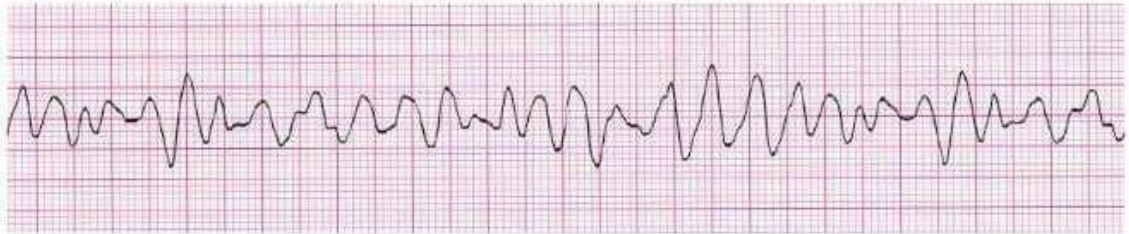
A-fib is the most common cardiac arrhythmia involving atria.

Rate= ~150bpm, irregularly irregular, baseline irregularity, no visible p waves, QRS occur irregularly with its length usually  $< 0.12s$

**Atrial Flutter**

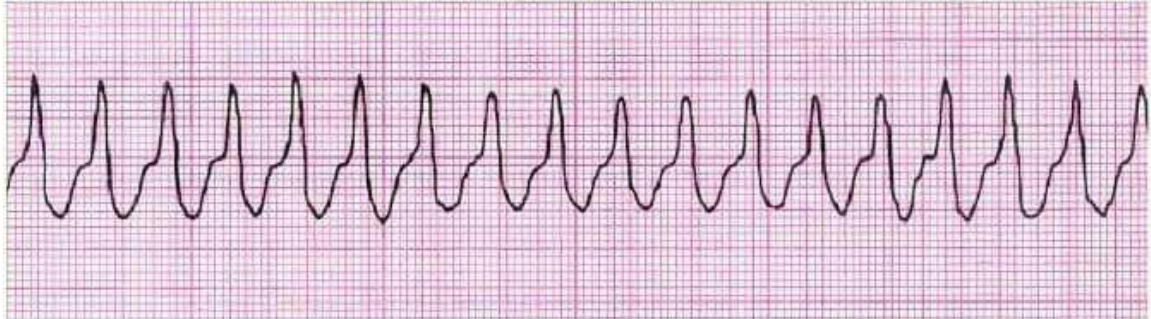
Atrial Rate= $\sim$ 300bpm, similar to A-fib, but have flutter waves, ECG baseline adapts 'saw-toothed' appearance'. Occurs with atrioventricular block (fixed degree), eg: 3 flutters to 1 QRS complex:

### **Ventricular Fibrillation**



A severely abnormal heart rhythm (arrhythmia) that can be life-threatening.  
Emergency- requires Basic Life Support  
Rate cannot be discerned, rhythm unorganized

### Ventricular tachycardia

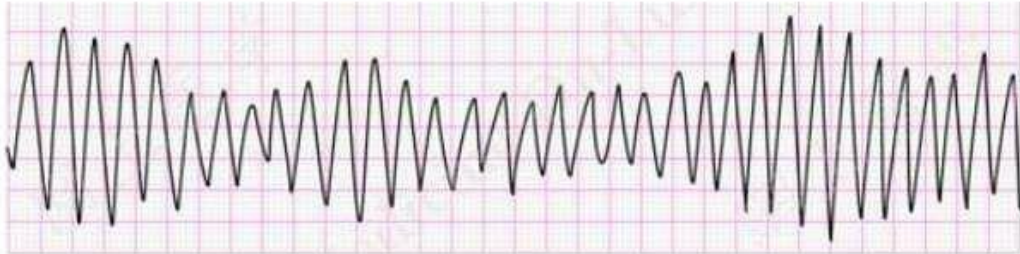


fast heart rhythm, that originates in one of the ventricles- potentially life-threatening arrhythmia because it may lead to ventricular fibrillation, asystole, and sudden death.

Rate=100-250bpm

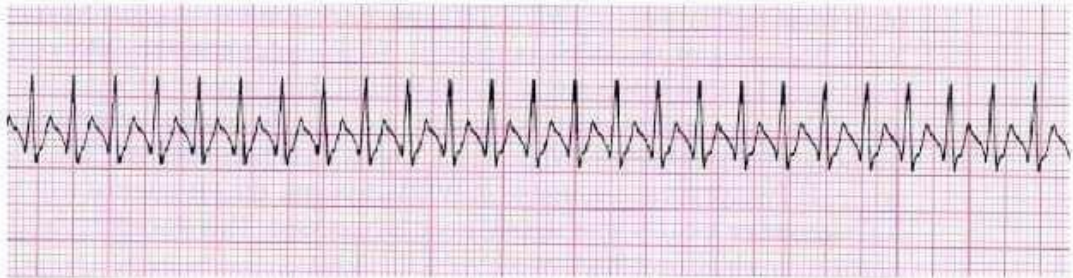


### **Torsades de Pointes**



literally meaning twisting of points, is a distinctive form of polymorphic ventricular tachycardia characterized by a gradual change in the amplitude and twisting of the QRS complexes around the isoelectric line. Rate cannot be determined.

### Supraventricular Tachycardia



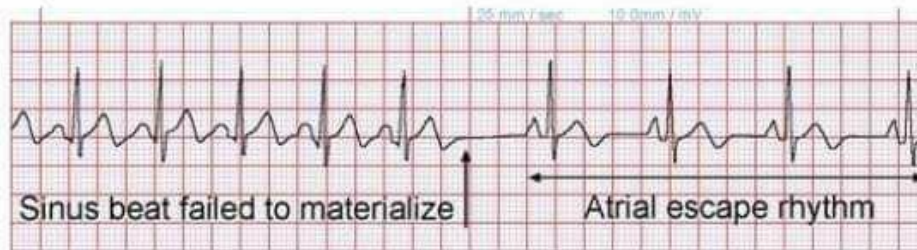
SVT is any tachycardic rhythm originating above the ventricular tissue. Atrial and ventricular rate = 150-250bpm  
Regular rhythm, p is usually not discernable.

**\*Types:**

- Sinoatrial node reentrant tachycardia (SANRT)
- Ectopic (unifocal) atrial tachycardia (EAT)
- Multifocal atrial tachycardia (MAT)
- A-fib or A flutter with rapid ventricular response. Without rapid ventricular response both usually not classified as SVT
- AV nodal reentrant tachycardia (AVNRT)
- Permanent (or persistent) junctional reciprocating tachycardia (PJRT)
- AV reentrant tachycardia (AVRT)

## RHYTHM

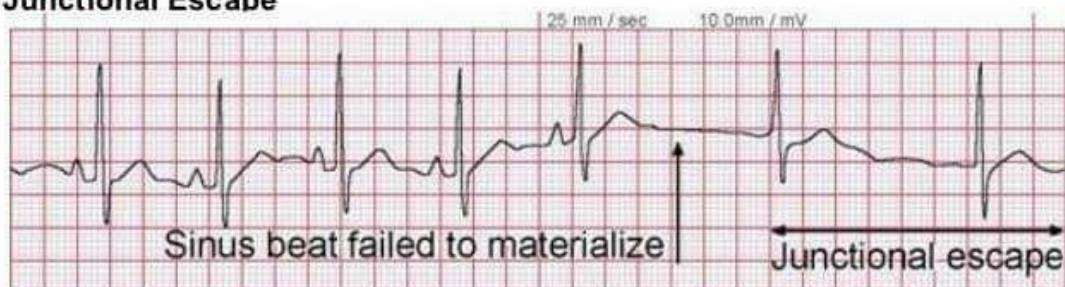
### Atrial Escape



a cardiac dysrhythmia occurring when sustained suppression of sinus impulse formation causes other atrial foci to act as cardiac pacemakers. Rate= 60-80bpm, p wave of atrial escape has abnormal axis and different from the p wave in the sinus beat. However QRS complexes look exactly the same.

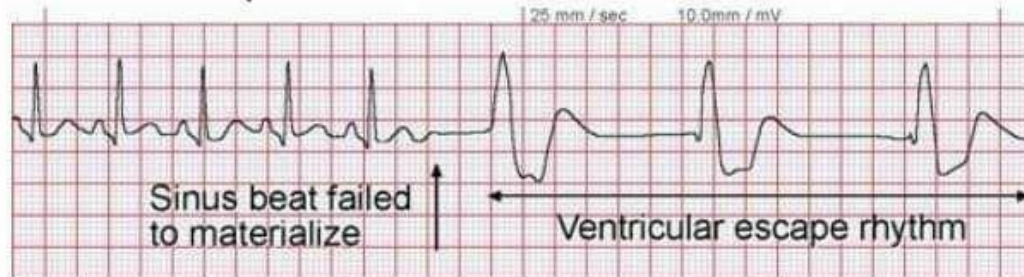
## RHYTHM

### Junctional Escape



Depolarization initiated in the atrioventricular junction when one or more impulses from the sinus node are ineffective or nonexistent. Rate: 40-60 bpm, Rhythm: Irregular in single junctional escape complex; regular in junctional escape rhythm, P waves: Depends on the site of the ectopic focus. They will be inverted, and may appear before or after the QRS complex, or they may be absent, hidden by the QRS. QRS is usually normal

## Ventricular escape

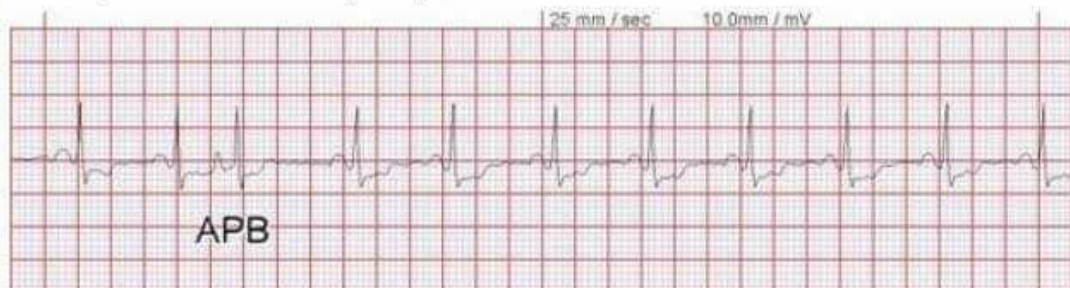


The depolarization wave spreads slowly via abnormal pathway in the ventricular myocardium and not via the His bundle and bundle branches.



## RHYTHM

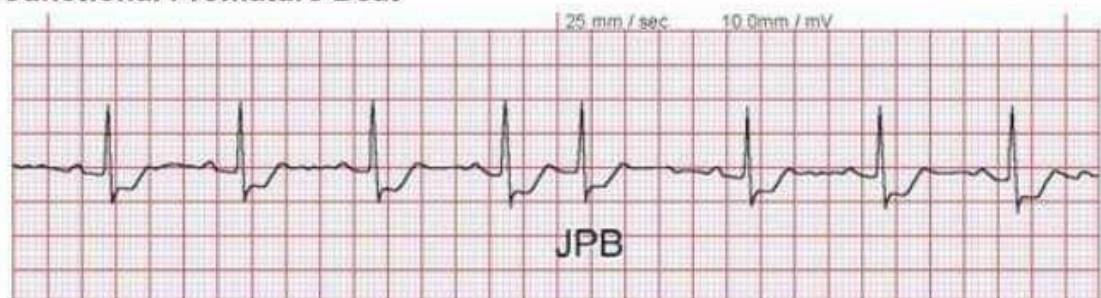
### Atrial premature beat (APB)



Arises from an irritable focus in one of the atria. APB produces different looking P wave, because depolarization vector is abnormal. QRS complex has normal duration and same morphology .

## RHYTHM

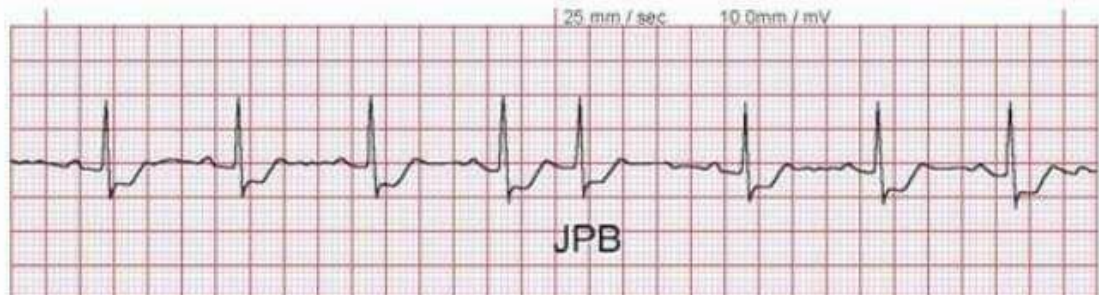
### Junctional Premature Beat



Arises from an irritable focus at the AV junction. The P wave associated with atrial depolarization in this instance is usually buried inside the QRS complex and not visible. If p is visible, it is -ve in lead II and +ve in lead aVR and it may occur before or after QRS.

## RHYTHM

### Junctional Premature Beat



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## RHYTHM

### Premature Ventricular Complexes (PVCs)



is a relatively common event where the heartbeat is initiated by the heart ventricles (arrow) rather than by the sinoatrial node. Rate depends on underlying rhythm and number of PVCs. Occasionally irregular rhythm, no p-wave associated with PVCs. May produce bizarre looking T wave.

## RHYTHM

### Asystole



a state of no cardiac electrical activity, hence no contractions of the myocardium and no cardiac output or blood flow.  
Rate, rhythm, p and QRS are absent

## RHYTHM

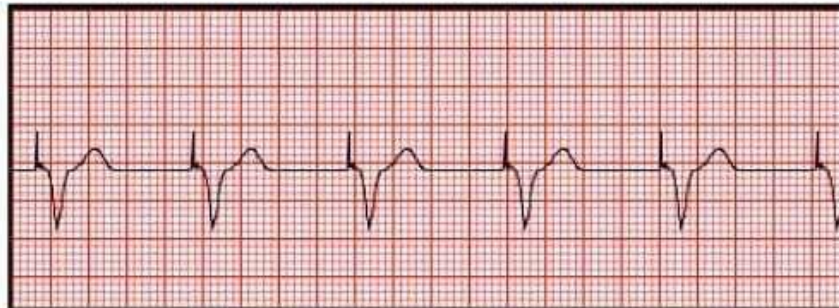
### Pulseless Electrical Activity (PEA)



Not an actual rhythm. The absence of a palpable pulse and myocardial muscle activity with the presence of organized muscle activity (excluding VT and VF) on cardiac monitor. Pt is clinically dead.



## Artificial pacemaker



Sharp, thin spike. Rate depends on pacemaker, p wave maybe absent or present

Ventricular paced rhythm shows wide ventricular pacemaker spikes

## Adult Advanced Life Support Algorithm

