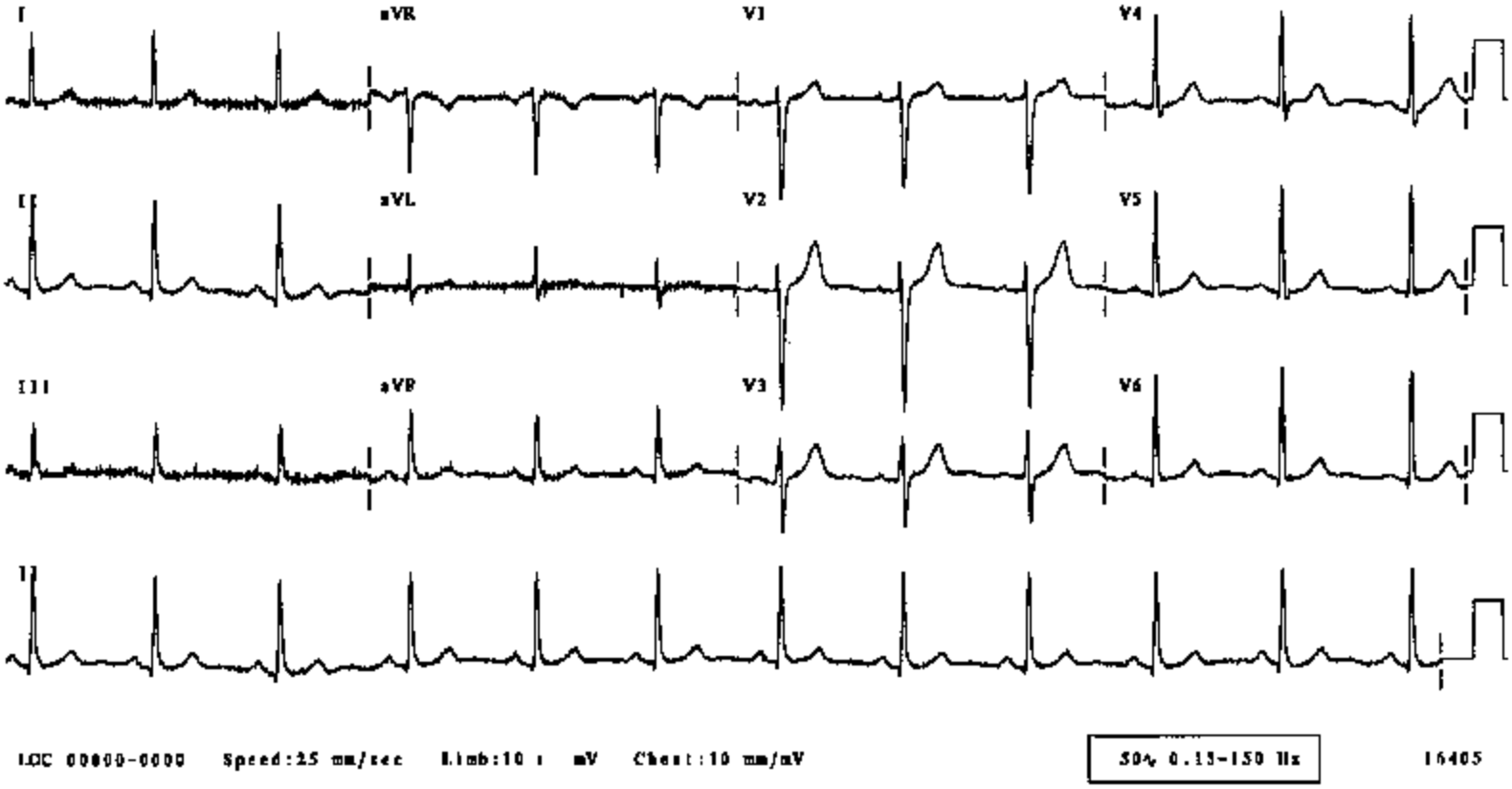
E C G

Rafeek .M.K.
Respiratory therapist

Normal Sinus Rhythm



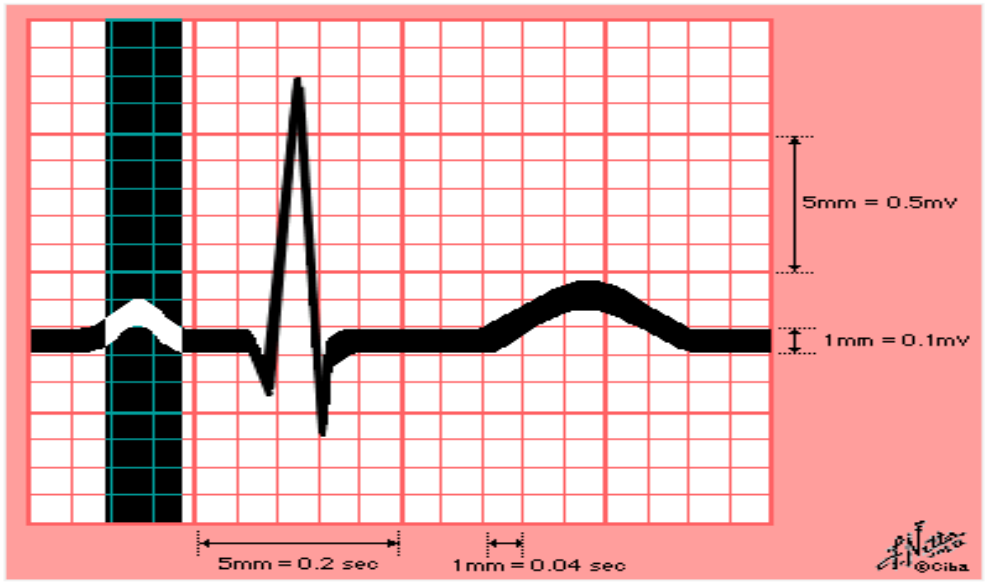
BACK

Electrocardiographic Waves, Intervals and Segments

*** P WAVE**

The P wave begins with the first upward deflection from the baseline and ends with return to the baseline.

The normal P wave measures less than 0.11 second in width, or not quite three small boxes.



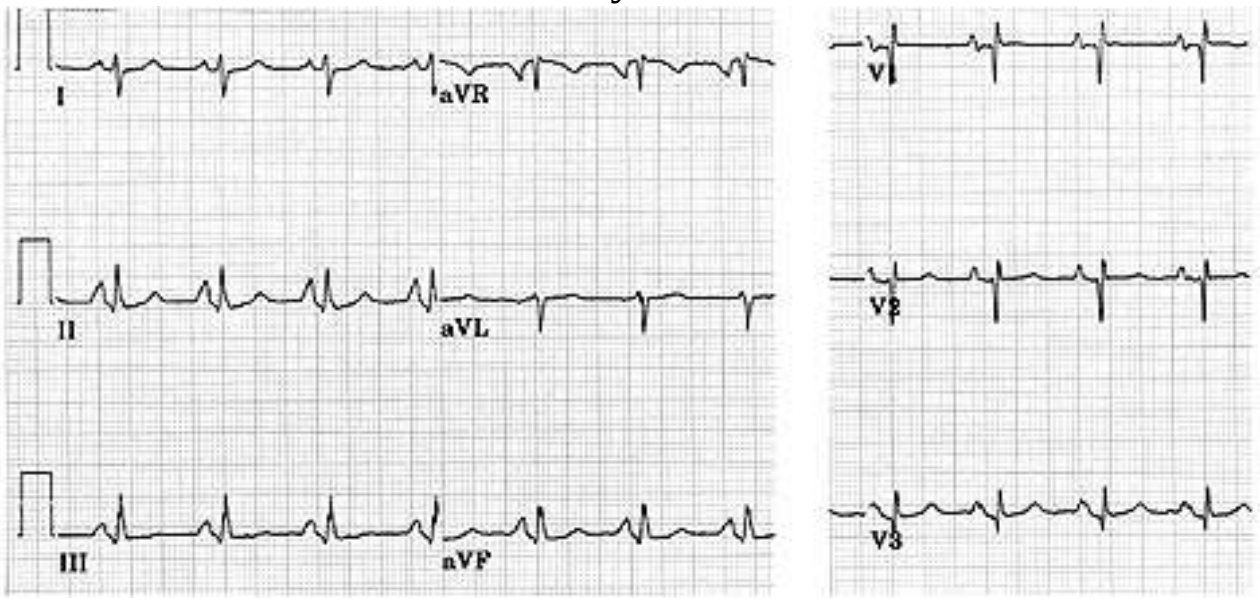
Precceds QRS complex
Amplitude 2- 2.5 mm
Duration 0.06- 0.11
Configuration :usually rounded and upright

L 1 - + ve (Upright
L 2 - +ve
L3 - Usually +ve
AVR - Usually – ve
AVL - Usually +ve
AVF - +ve
VI - Biphasic (variable)
V1- V6- +ve

Hypertrophy

Right atrial enlargement

– Take a look at this ECG. What do you notice about the P waves?

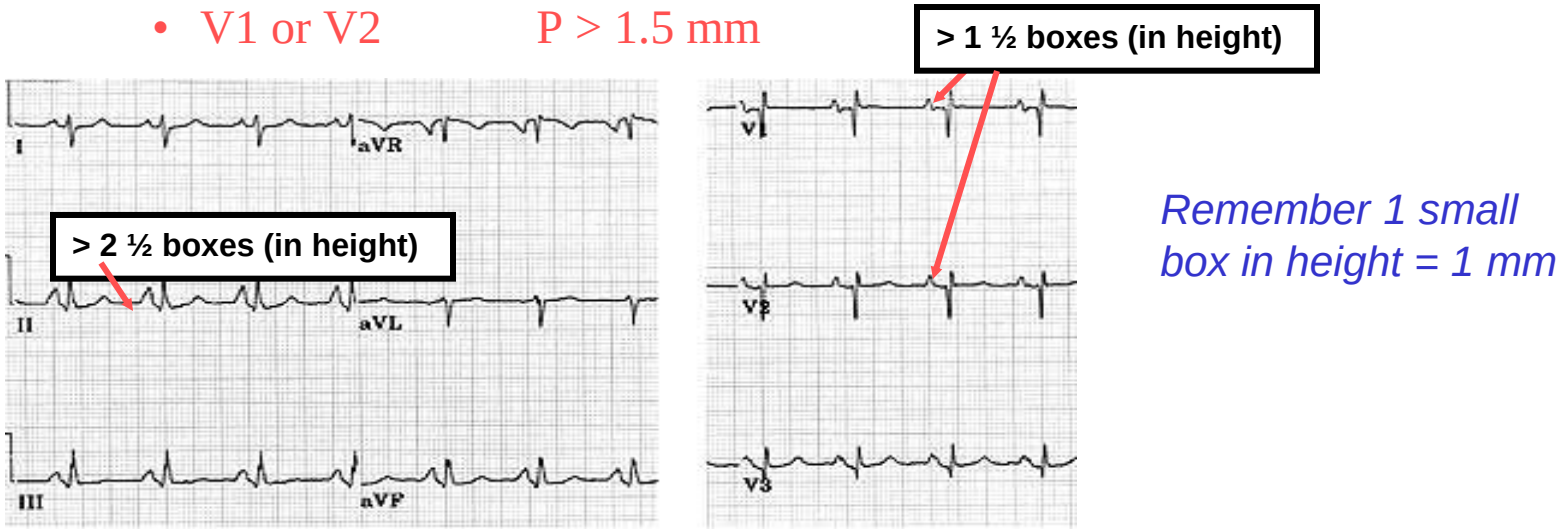


The P waves are tall, especially in leads II, III and avF.
Ouch! They would hurt to sit on!!

Hypertrophy

Right atrial enlargement

- To diagnose RAE you can use the following criteria:
  - II P > 2.5 mm, or
  - V1 or V2 P > 1.5 mm



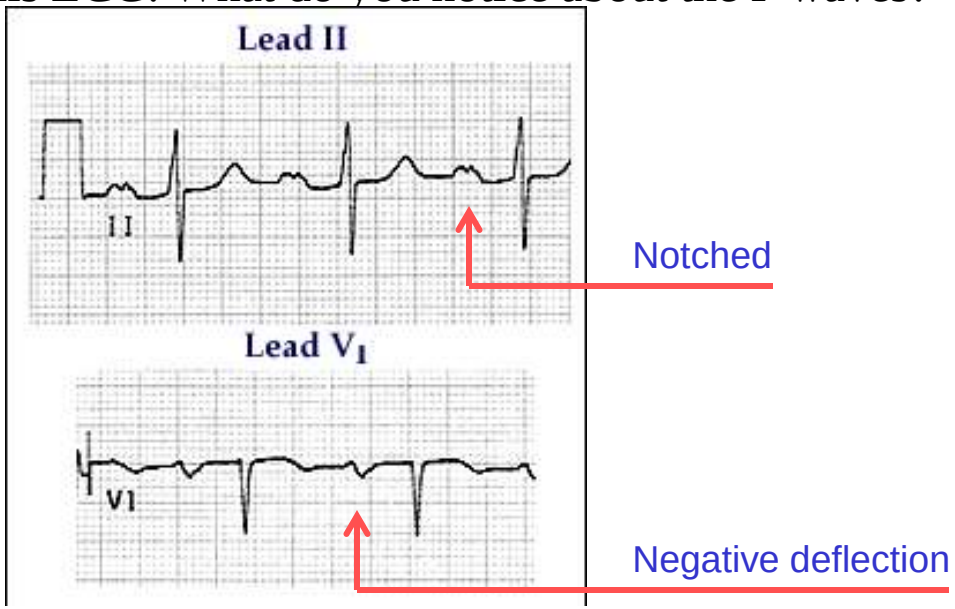
Remember 1 small box in height = 1 mm

A cause of RAE is RVH from pulmonary hypertension.

Hypertrophy

Left atrial enlargement

– Take a look at this ECG. What do you notice about the P waves?

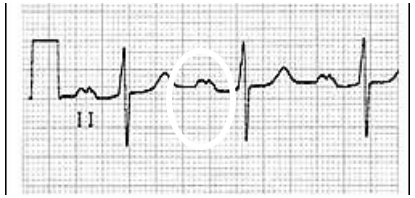


The P waves in lead II are notched and in lead V1 they have a deep and wide negative component.

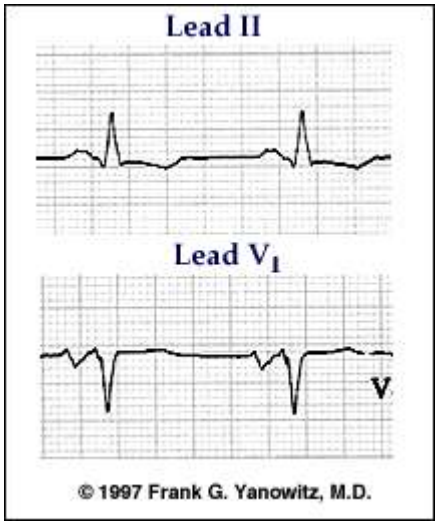
Rate Rhythm Axis Intervals **Hypertrophy** Infarct

Left atrial enlargement

- To diagnose LAE you can use the following criteria:
  - II > 0.04 s (1 box) between notched peaks, or
  - V1 Neg. deflection > 1 box wide x 1 box deep



A common cause of LAE is LVH from hypertension.



What is the correct diagnosis of this ECG?

A. LVH

B. RVH

C. LAE

D. RAE

E. Bi-atrial enlargement

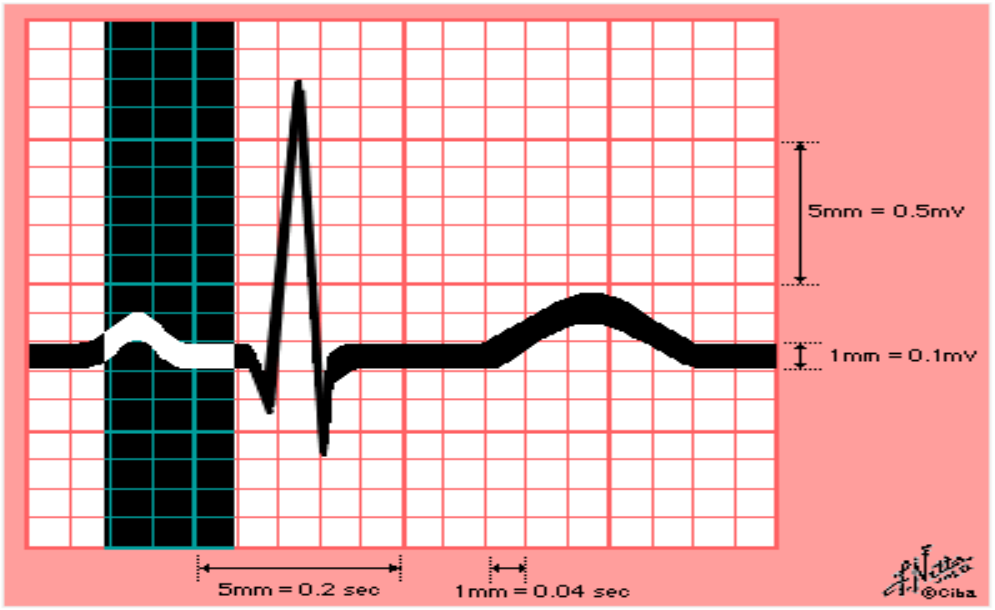
- **The correct answer is C.**

  LAE is best seen in V1 with a prominent negative (posterior) component measuring 1mm wide and 1mm deep.

Electrocardiographic Waves, Intervals and Segments

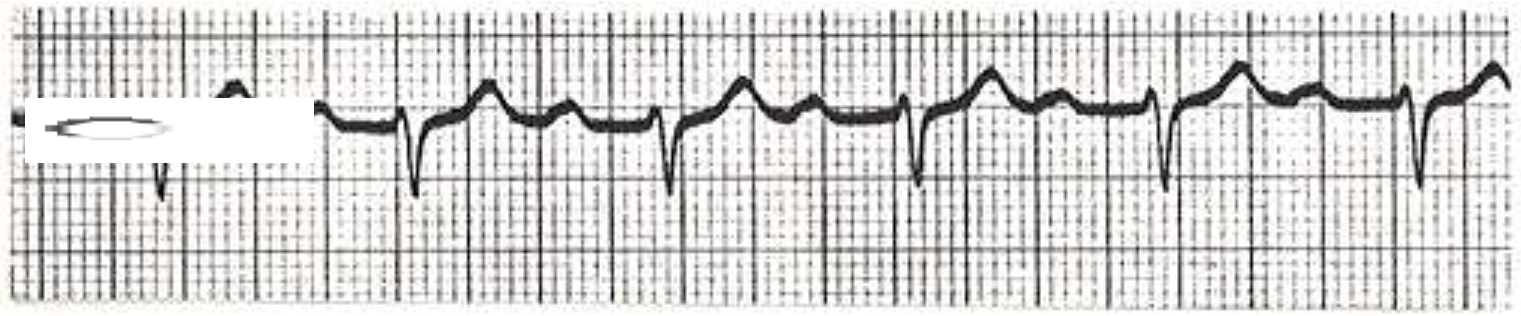
*** PR INTERVAL**

The PR interval is measured from the first upward deflection of the P wave to the first deflection of the QRS from the baseline, whether negative (Q) or positive (R). The normal PR interval varies slightly according to age and heart rate, but, for all practical purposes, it can be said to range from 0.12 to 0.20 second, or three to five small boxes.



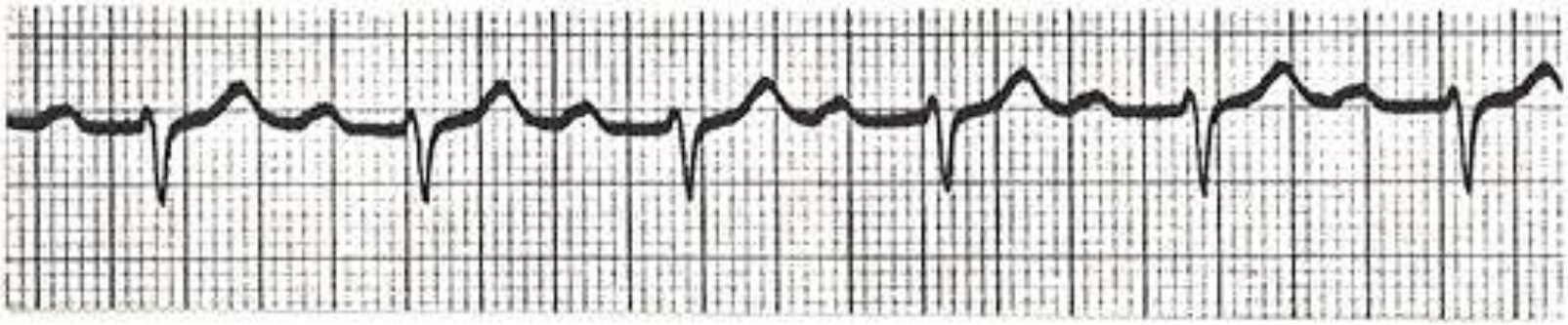
Begning of P –begning of QRS

Normal duration 0.12sec- 0.2sec



What is the PR interval in this ECG

A. 0.12 sec **B.** 0.16 sec **C.** 0.20 sec **D.** 0.28 sec **E.** 0.50 sec



- **The correct answer is D.**

  You measure PR from the beginning of P to the beginning of QRS. The normal PR interval is 0.12 - 0.20 sec, or 120 to 200 ms. 1st degree AV block is defined by PR intervals greater than 200 ms.

Rhythm #10

- Rate? 60 bpm
- Regularity? regular
- P waves? normal
- PR interval? 0.36 s
- QRS duration? 0.08 s

Interpretation? *1st Degree AV Block*

1st Degree AV Block

- Deviation from NSR
  - PR Interval > 0.20 s

1st Degree AV Block

- Etiology: Prolonged conduction delay in the AV node or Bundle of His.

Rhythm #11

- Rate? 50 bpm
- Regularity? regularly irregular
- P waves? nl, but 4th no QRS
- PR interval? lengthens
- QRS duration? 0.08 s

Interpretation? *2nd Degree AV Block, Type I*

2nd Degree AV Block, Type I

- Deviation from NSR
  - PR interval progressively lengthens, then the impulse is completely blocked (P wave not followed by QRS).

2nd Degree AV Block, Type I

- Etiology: Each successive atrial impulse encounters a longer and longer delay in the AV node until one impulse (usually the 3rd or 4th) fails to make it through the AV node.

Rhythm #12

- Rate? 40 bpm
- Regularity? regular
- P waves? nl, 2 of 3 no QRS
- PR interval? 0.14 s
- QRS duration? 0.08 s

Interpretation? *2nd Degree AV Block, Type II*

2nd Degree AV Block, Type II

- Deviation from NSR
  - Occasional P waves are completely blocked (P wave not followed by QRS).

2nd Degree AV Block, Type II

- Etiology: Conduction is all or nothing (no prolongation of PR interval); typically block occurs in the Bundle of His.

Rhythm #13

- Rate? 40 bpm
- Regularity? regular
- P waves? no relation to QRS
- PR interval? none
- QRS duration? wide (> 0.12 s)

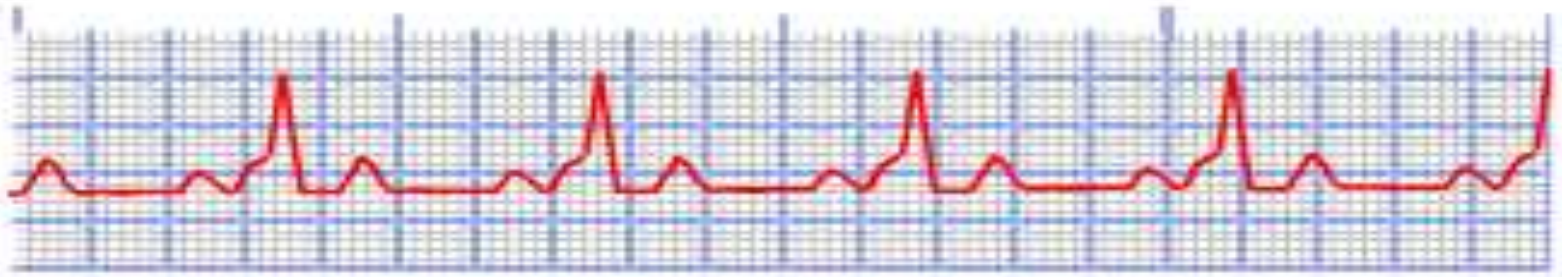
Interpretation? *3rd Degree AV Block*

3rd Degree AV Block

- Deviation from NSR
  - The P waves are completely blocked in the AV junction; QRS complexes originate independently from below the junction.

3rd Degree AV Block

- Etiology: There is complete block of conduction in the AV junction, so the atria and ventricles form impulses independently of each other. Without impulses from the atria, the ventricles own intrinsic pacemaker kicks in at around 30 - 45 beats/minute.



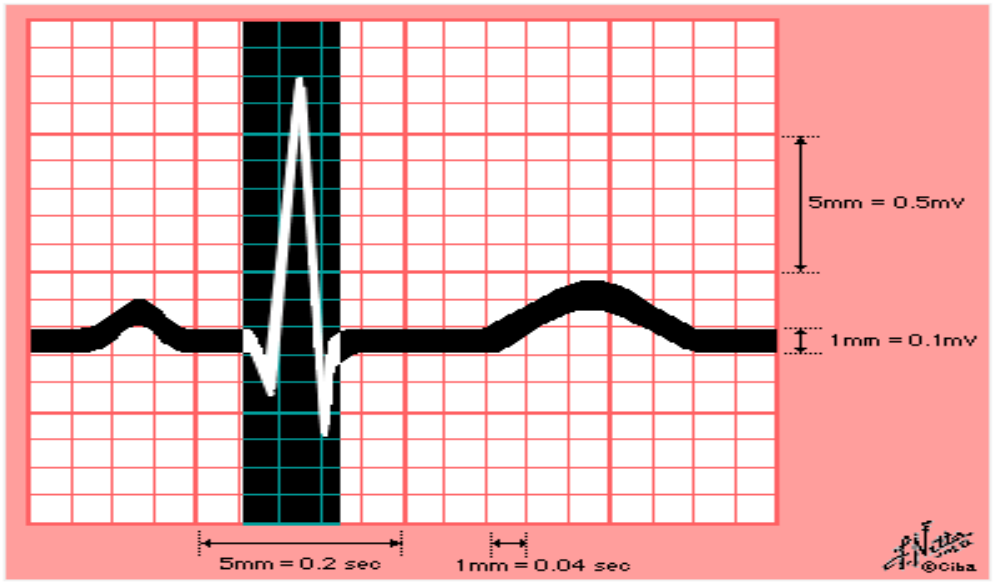
Wolff-Parkinson-White Syndrome

Wolff-Parkinson-White syndrome is a pre-exitation occurance enabled by an accessory pathway (Bundle of Kent) that connects the atria to the ventricles .The sluring of the beginning of the QRS - called a Delta wave -results from part of the ventricles depolarizing early (preexcitation) before being met by the normal depolarization of ventricles (from the bundle branchs). A short PR interval is also expected.

Electrocardiographic Waves, Intervals and Segments

*** QRS INTERVAL**

The QRS interval is measured from the first deflection of the QRS from the baseline, whether negative or positive, to the eventual return of the QRS to the baseline. The QRS interval should be less than 0.10 second, or two and one-half small boxes.



Charecteristics

-Amplitude:differ in each of 12 leads

-Duration:no longer than 0.10sec

-Configuration : normally looks different in each lead

Deflection

+ve or –ve depending on the lead

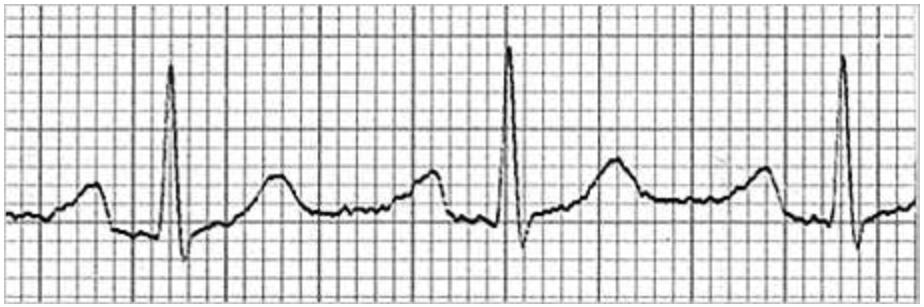
+ve defl :L1,2,3,aVL,aVF, V4,5,6

-ve defl :aVR V1,2,3

R wave max in V4

S wave max in V2

NORMAL



What is the QRS duration seen here?

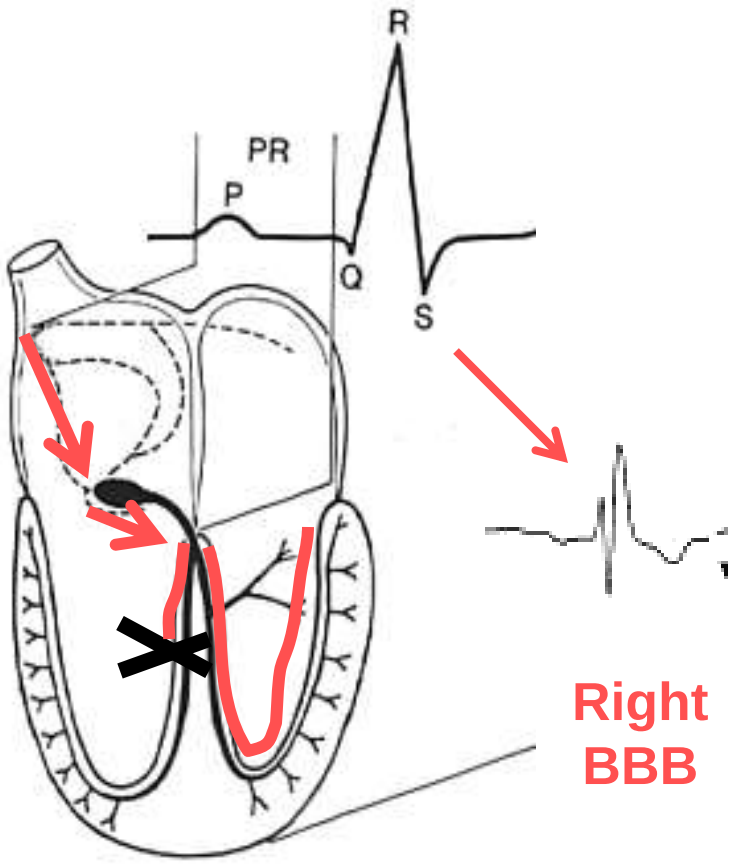
A. 0.04 sec **B.** 0.06 sec **C.** 0.10 sec **D.** 0.12 sec **E.** 0.14

- Normal QRS duration is 0.06 sec to 0.10 sec measured from the beginning to the end of the complex. Remember, the QRS complex represents the simultaneous activation of the ventricles. However, most of the QRS complex is from the larger left ventricle

Bundle Branch Blocks

So, depolarization of the Bundle Branches and Purkinje fibers are seen as the QRS complex on the ECG.

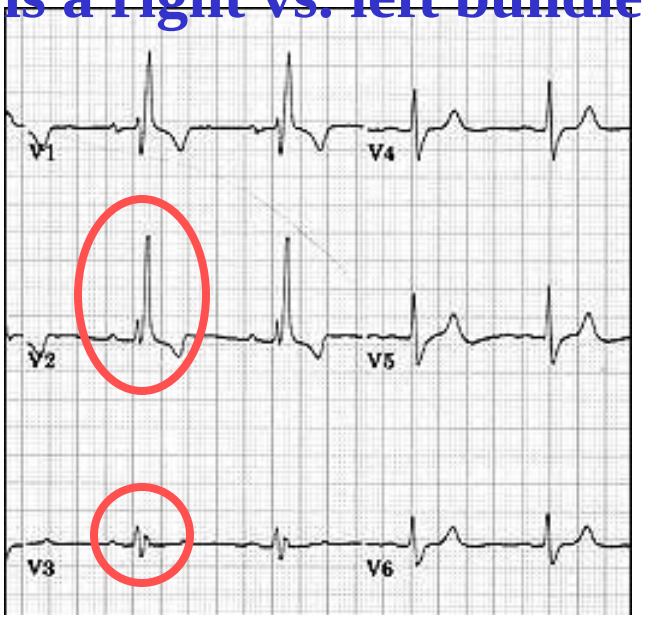
Therefore, a conduction block of the Bundle Branches would be reflected as a change in the QRS complex.



Bundle Branch Blocks

With Bundle Branch Blocks you will see two changes on the ECG.

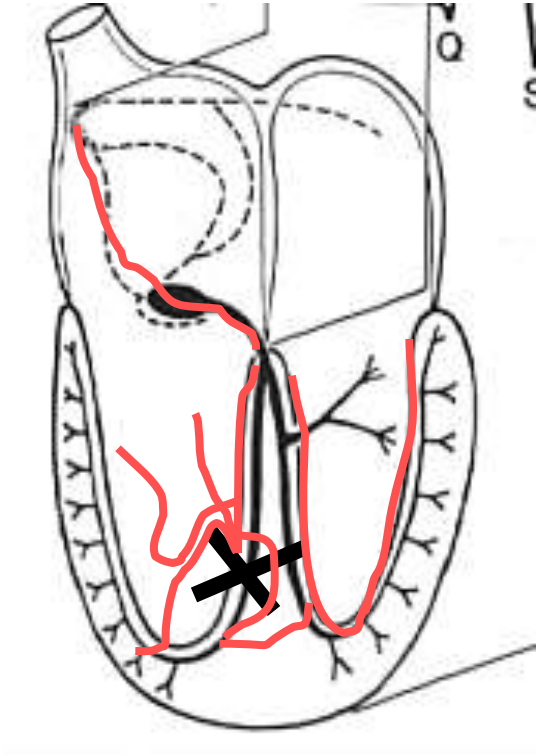
1. **QRS complex widens (> 0.12 sec).**
2. **QRS morphology changes (varies depending on ECG lead, and if it is a right vs. left bundle branch block).**



Bundle Branch Blocks

Why does the QRS complex widen?

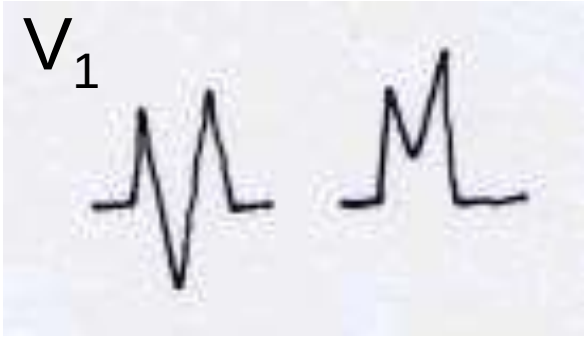
When the conduction pathway is blocked it will take longer for the electrical signal to pass throughout the ventricles.



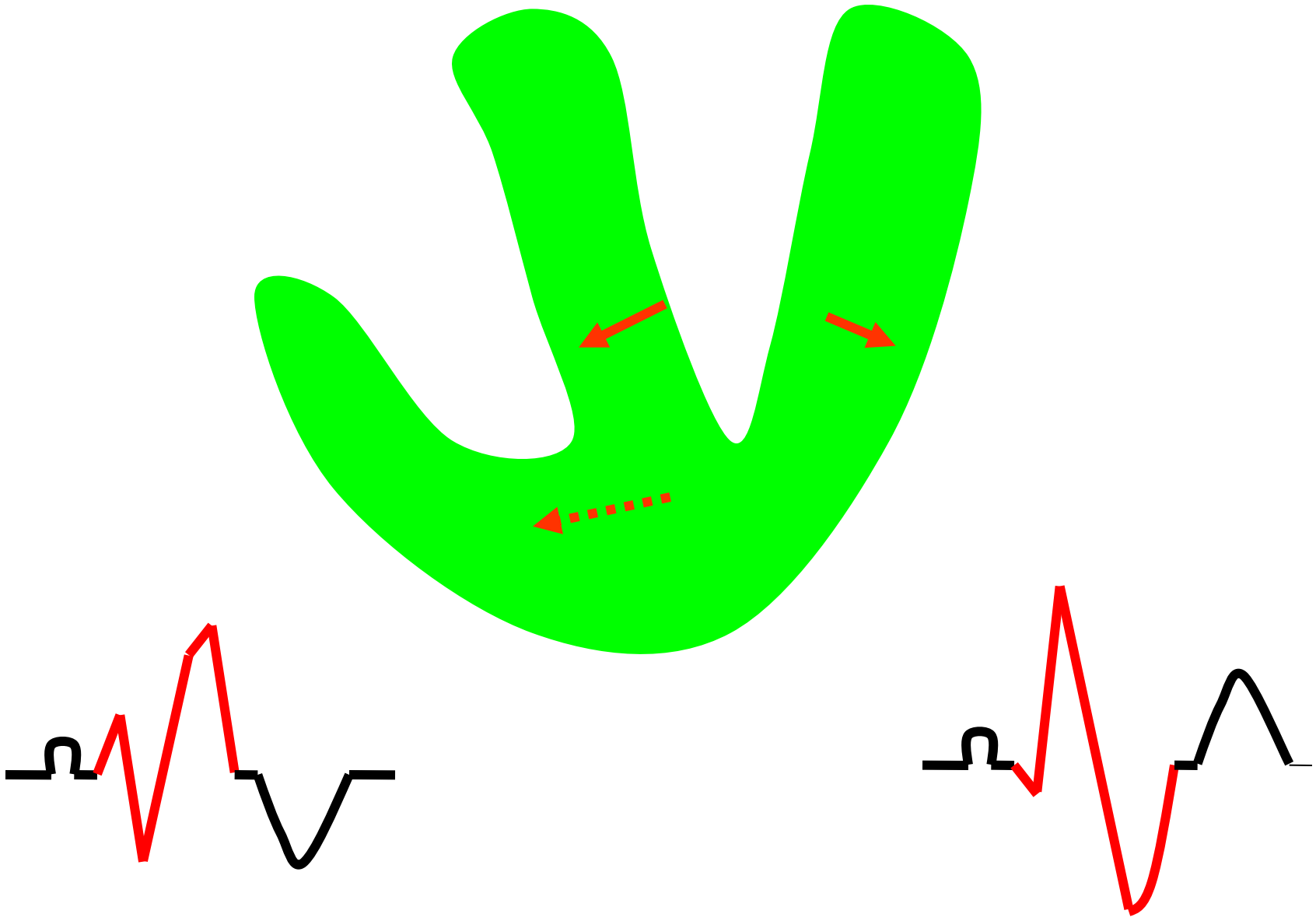
Right Bundle Branch Blocks

What QRS morphology is characteristic?

For RBBB the wide QRS complex assumes a unique, virtually diagnostic shape in those leads overlying the right ventricle (V_1 and V_2).



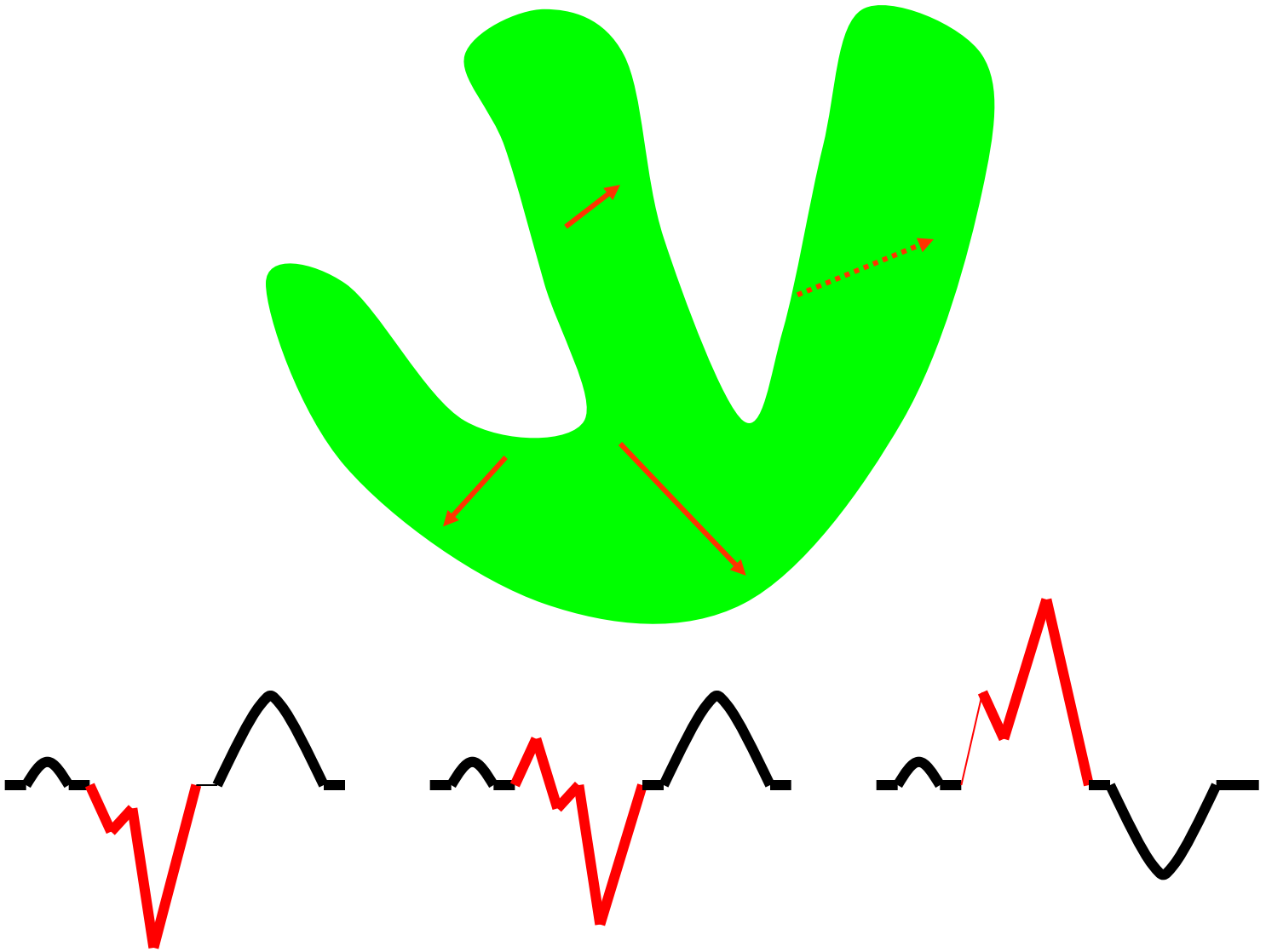
"Rabbit Ears"



ECG criteria for RBBB

- (1) QRS duration exceeds 0.12 seconds
- (2) RSR complex in V1
- (3) Delayed S wave in I, V5, V6
- (4) ST/T must be opposite in direction to the terminal QRS

  (is secondary to the block and does not predispose primary ST/T changes)



ECG criteria for LBBB

(1)Prolonged QRS complexes, greater than 0.12 seconds

(2)Wide, notched QRS (M shaped) I, AVL, V5, V6

(3)Wide, notched QS complexes are seen in V1 (due to spread of activation away from the electrode through septum + LV)

(4)In V2, V3 small r wave is seen due to activation of paraseptal region

PVCs

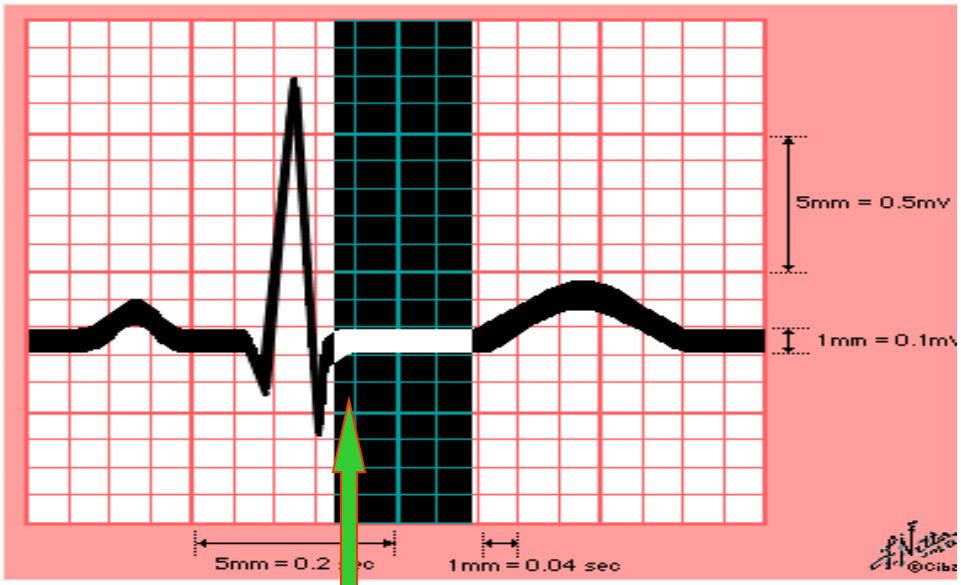
- Etiology: One or more ventricular cells are depolarizing and the impulses are abnormally conducting through the ventricles.

VENTRICULAR HYPER TROPHY

Electrocardiographic Waves, Intervals and Segments

*** ST SEGMENT**

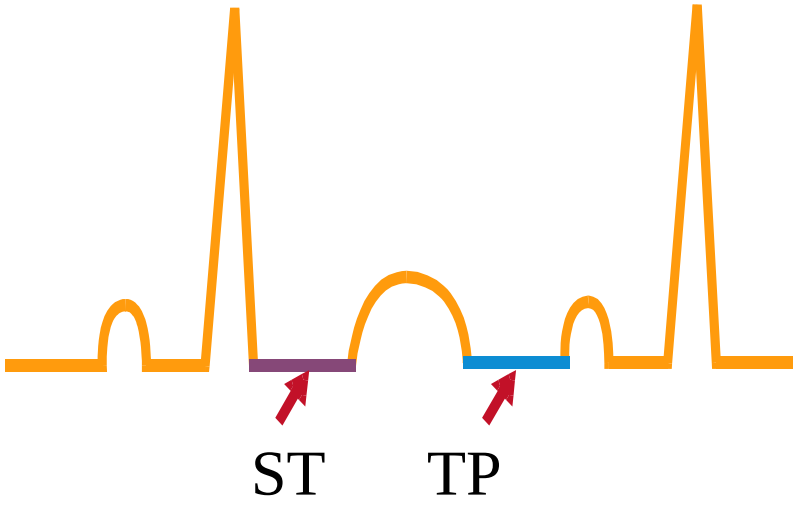
The ST segment runs from the return of the QRS to the base-line until the first upward or downward deflection of the T wave. While the duration of the ST segment is not generally of clinical significance, it is an exceedingly important portion of the ECG because of shifts up or down from the baseline. These shifts may be associated with ischemic heart disease, pericarditis, or other conditions. Note that such shifts are generally measured at a point 0.08 second (80 msec), or two small boxes, after the end of the QRS complex.



J -Point

Isoelectric line

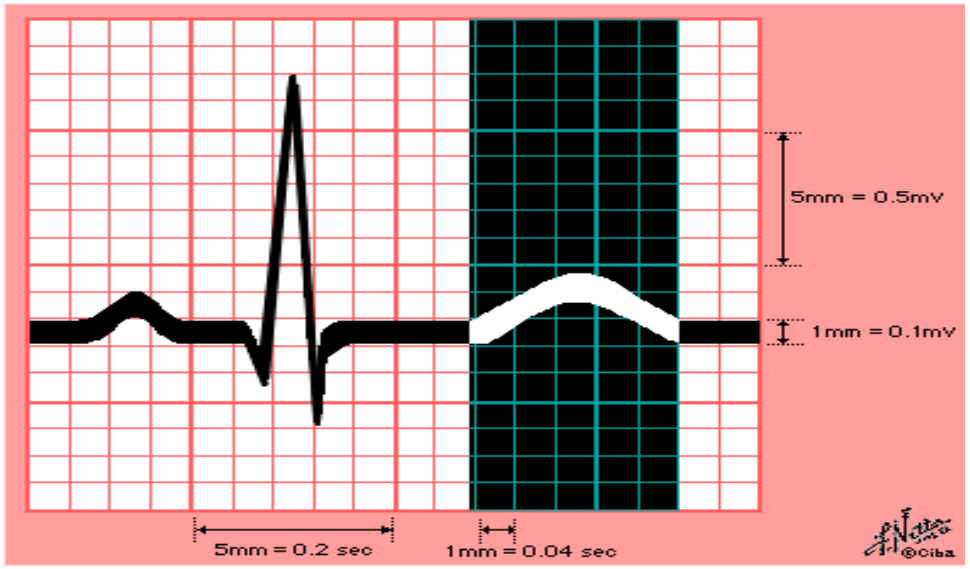
Look for elevation/depression of ST compare with TP line



Electrocardiographic Waves, Intervals and Segments

* T WAVE

The T wave shows the wave of repolarization.



Characteristics

-follow S wave & ST segment

-Amplitude -5 mm or less in L1,2,3

-10 mm or less in V1- V6

-Duration : not usually mesured

Configuration : Rounded & smmooth

Deflection

- Normally upright in L1,2,V1 –V6
- May inverted in aVR

- In remaining leads direction variable

ST Elevation Infarction

Here's a diagram depicting an evolving infarction:

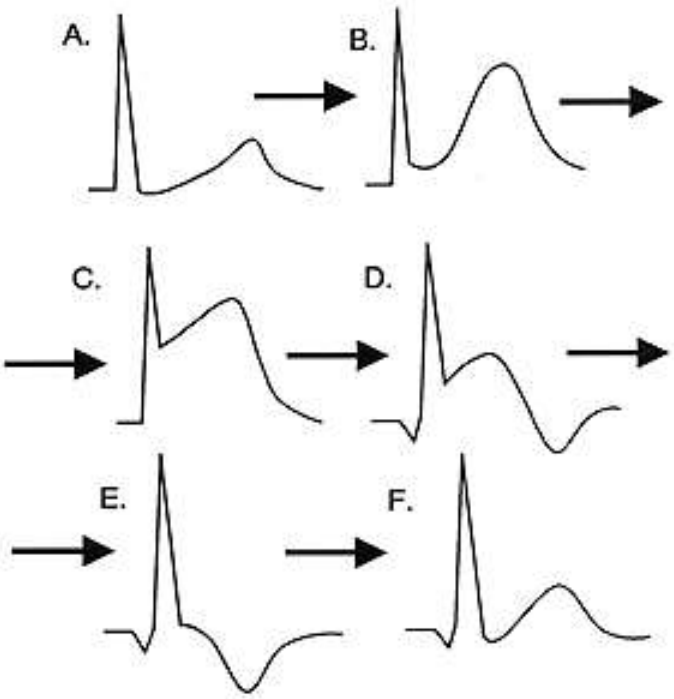
A. Normal ECG prior to MI

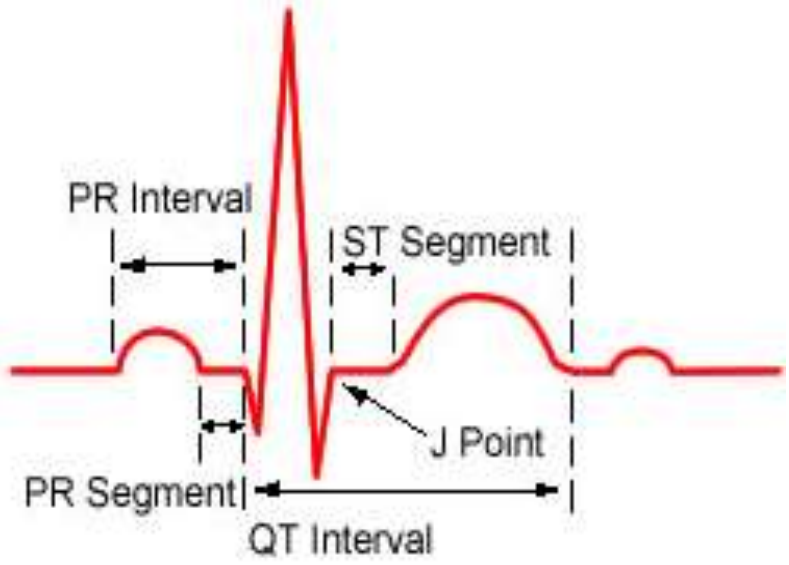
B. Ischemia from coronary artery occlusion results in ST depression (not shown) and peaked T-waves

C. Infarction from ongoing ischemia results in marked ST elevation

D/E. Ongoing infarction with appearance of pathologic Q-waves and T-wave inversion

F. Fibrosis (months later) with persistent Q- waves, but normal ST segment and T- waves





Q T interval represents time necessary for the ventricular depolarisation & repolarisation

QT interval = QRS + ST+ T waves time

Duration varies according to age,sex, & HR

$\leq$ 0.44 sec

Supraventricular Arrhythmias

- *Atrial Fibrillation*
- *Atrial Flutter*
- *Paroxysmal Supraventricular Tachycardia*

Rhythm #5

- Rate? 100 bpm
- Regularity? irregularly irregular
- P waves? none
- PR interval? none
- QRS duration? 0.06 s

Interpretation? *Atrial Fibrillation*

Atrial Fibrillation

- Deviation from NSR
  - No organized atrial depolarization, so no normal P waves (impulses are not originating from the sinus node).
  - Atrial activity is chaotic (resulting in an irregularly irregular rate).
  - Common, affects 2-4%, up to 5-10% if > 80 years old

Atrial Fibrillation

- Etiology: Recent theories suggest that it is due to multiple re-entrant wavelets conducted between the R & L atria. Either way, impulses are formed in a totally unpredictable fashion. The AV node allows some of the impulses to pass through at variable intervals (so rhythm is irregularly irregular).

Rhythm #6

- Rate? 70 bpm
- Regularity? regular
- P waves? flutter waves
- PR interval? none
- QRS duration? 0.06 s

Interpretation? *Atrial Flutter*

Atrial Flutter

- Deviation from NSR
  - No P waves. Instead flutter waves (note "sawtooth" pattern) are formed at a rate of 250 - 350 bpm.
  - Only some impulses conduct through the AV node (usually every other impulse).

Atrial Flutter

- Etiology: Reentrant pathway in the right atrium with every 2nd, 3rd or 4th impulse generating a QRS (others are blocked in the AV node as the node repolarizes).

Rhythm #7

- Rate? 74 → 148 bpm
- Regularity? Regular → regular
- P waves? Normal → none
- PR interval? 0.16 s → none
- QRS duration? 0.08 s

Interpretation? *Paroxysmal Supraventricular Tachycardia (PSVT)*

PSVT

- Deviation from NSR
  - The heart rate suddenly speeds up, often triggered by a PAC (not seen here) and the P waves are lost.

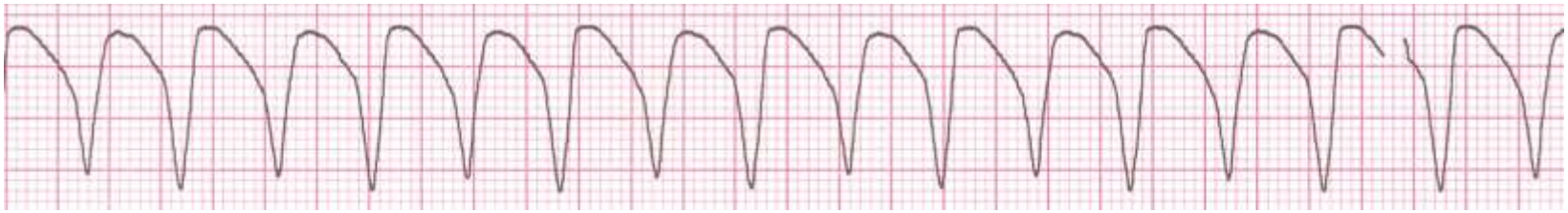
PSVT

- Etiology: There are several types of PSVT but all originate above the ventricles (therefore the QRS is narrow).
- Most common: abnormal conduction in the AV node (reentrant circuit looping in the AV node).

Ventricular Arrhythmias

- *Ventricular Tachycardia*
- *Ventricular Fibrillation*

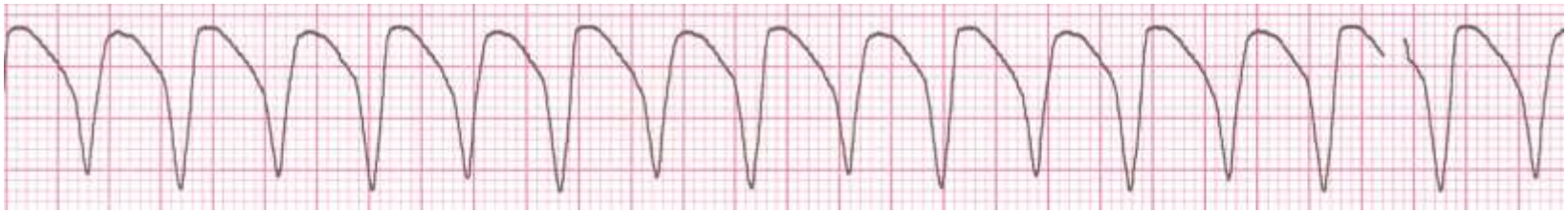
Rhythm #8



- Rate? 160 bpm
- Regularity? regular
- P waves? none
- PR interval? none
- QRS duration? wide (> 0.12 sec)

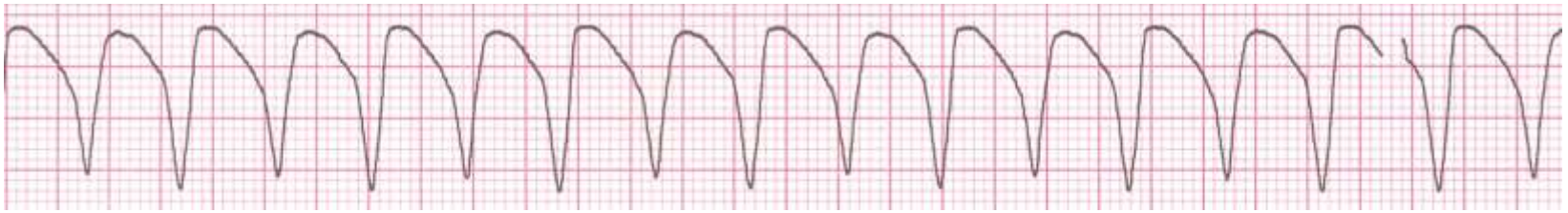
Interpretation? *Ventricular Tachycardia*

Ventricular Tachycardia



- Deviation from NSR
  - Impulse is originating in the ventricles (no P waves, wide QRS).

Ventricular Tachycardia



- Etiology: There is a re-entrant pathway looping in a ventricle (most common cause).

- Ventricular tachycardia can sometimes generate enough cardiac output to produce a pulse; at other times no pulse can be felt.

Rhythm #9

- Rate? none
- Regularity? irregularly irreg.
- P waves? none
- PR interval? none
- QRS duration? wide, if recognizable

Interpretation? *Ventricular Fibrillation*

Ventricular Fibrillation

- Deviation from NSR
  - Completely abnormal.

Ventricular Fibrillation

- Etiology: The ventricular cells are excitable and depolarizing randomly.

- Rapid drop in cardiac output and death occurs if not quickly reversed