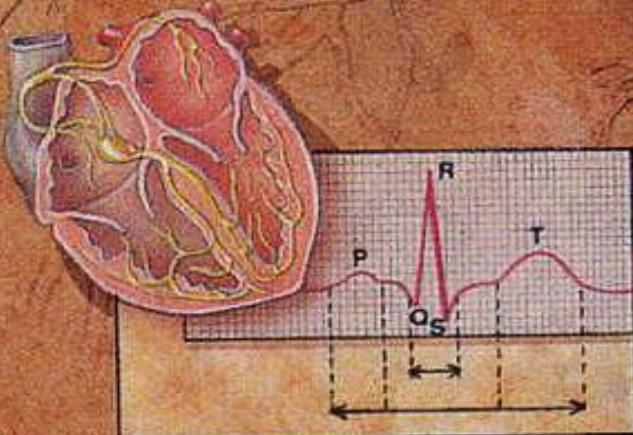


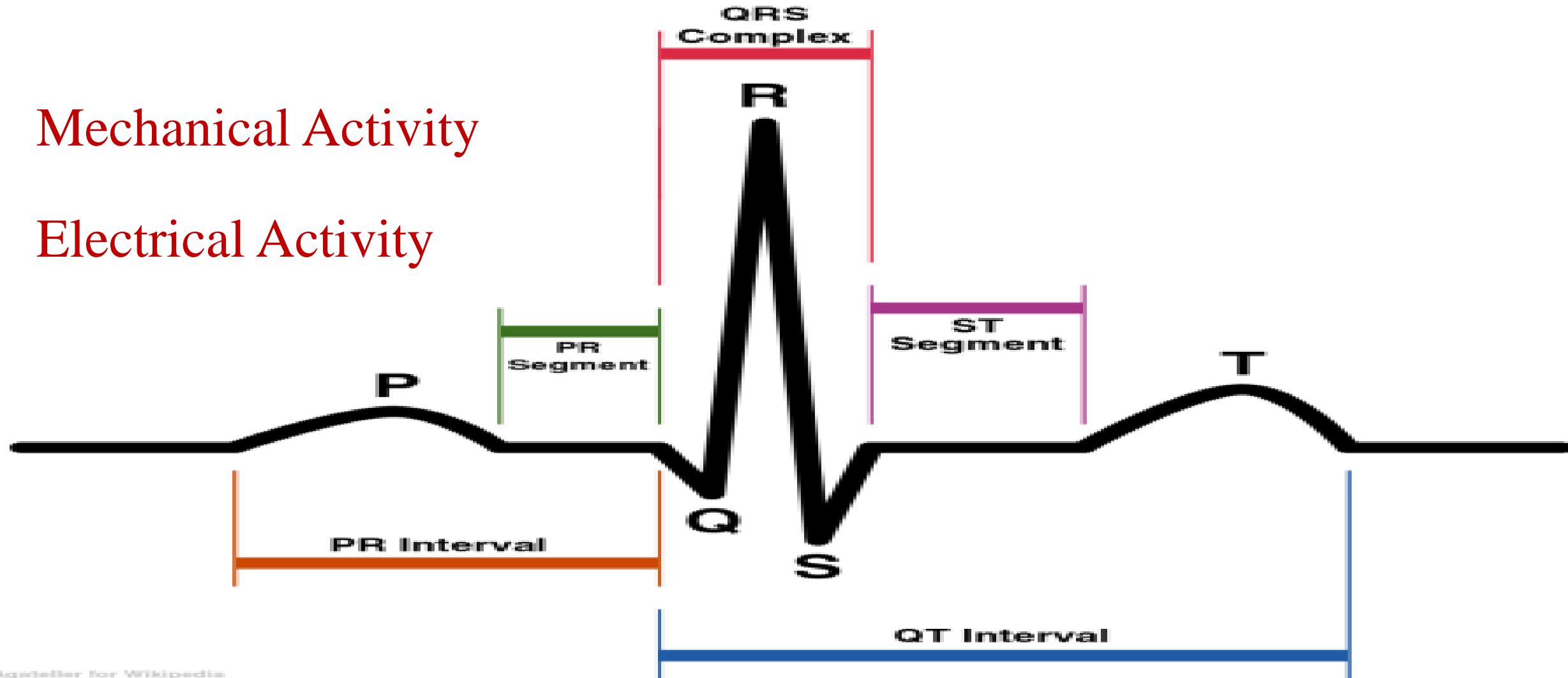
ECG INTERPRETATION



Heart Activity

Mechanical Activity

Electrical Activity

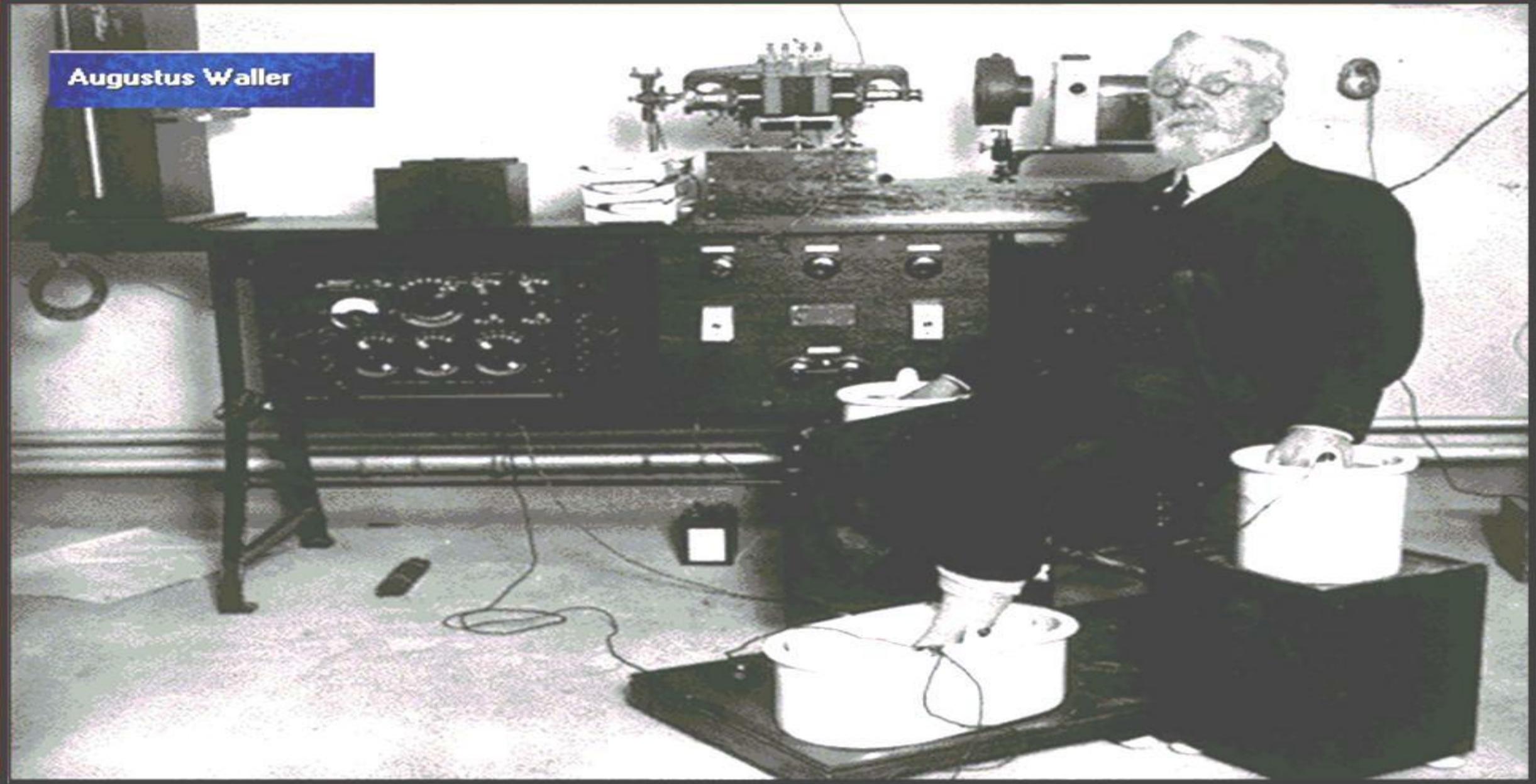


ECG

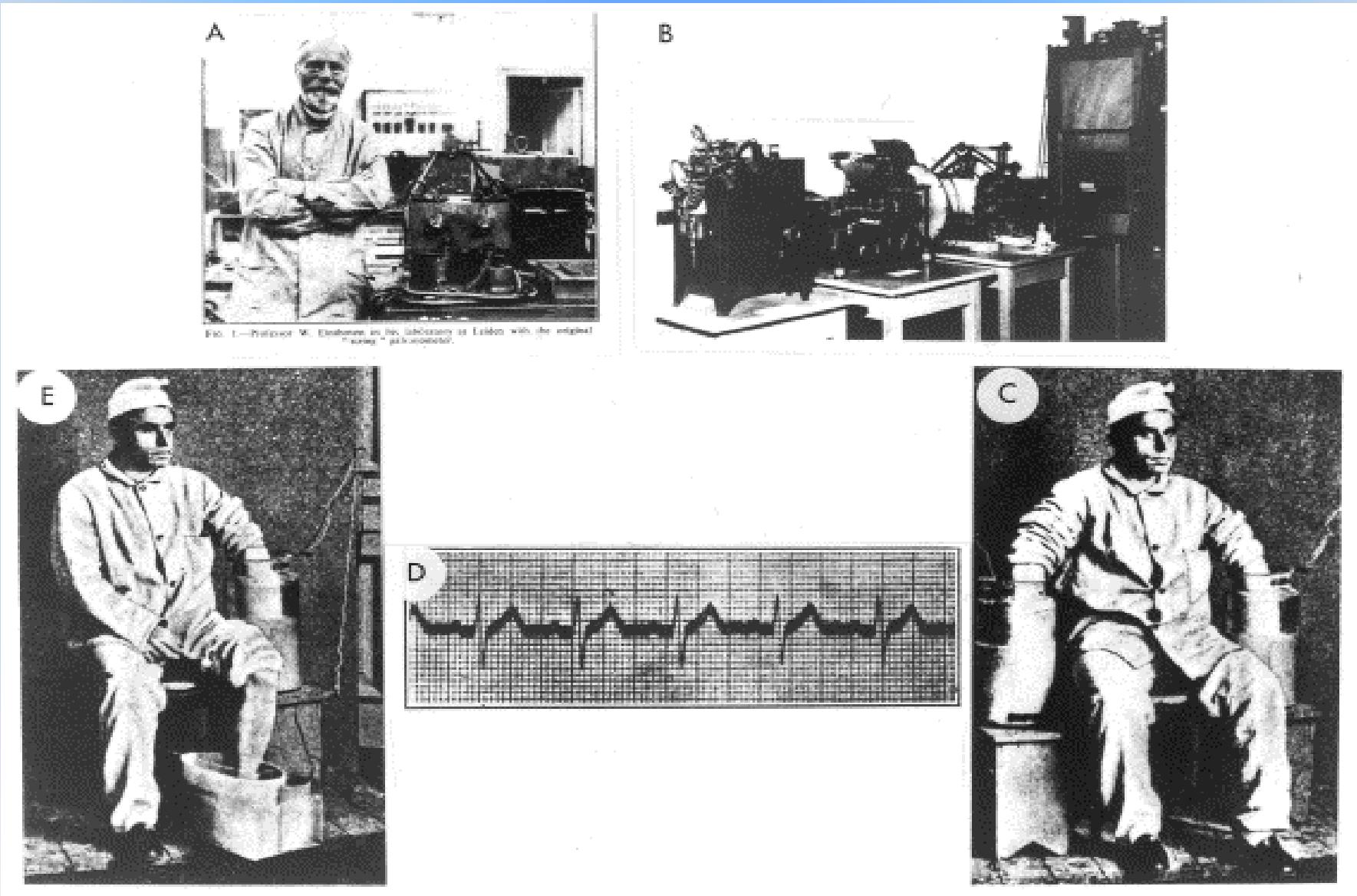
*A graphic recording of electrical potentials
generated by the heart*

A noninvasive, inexpensive and highly versatile test

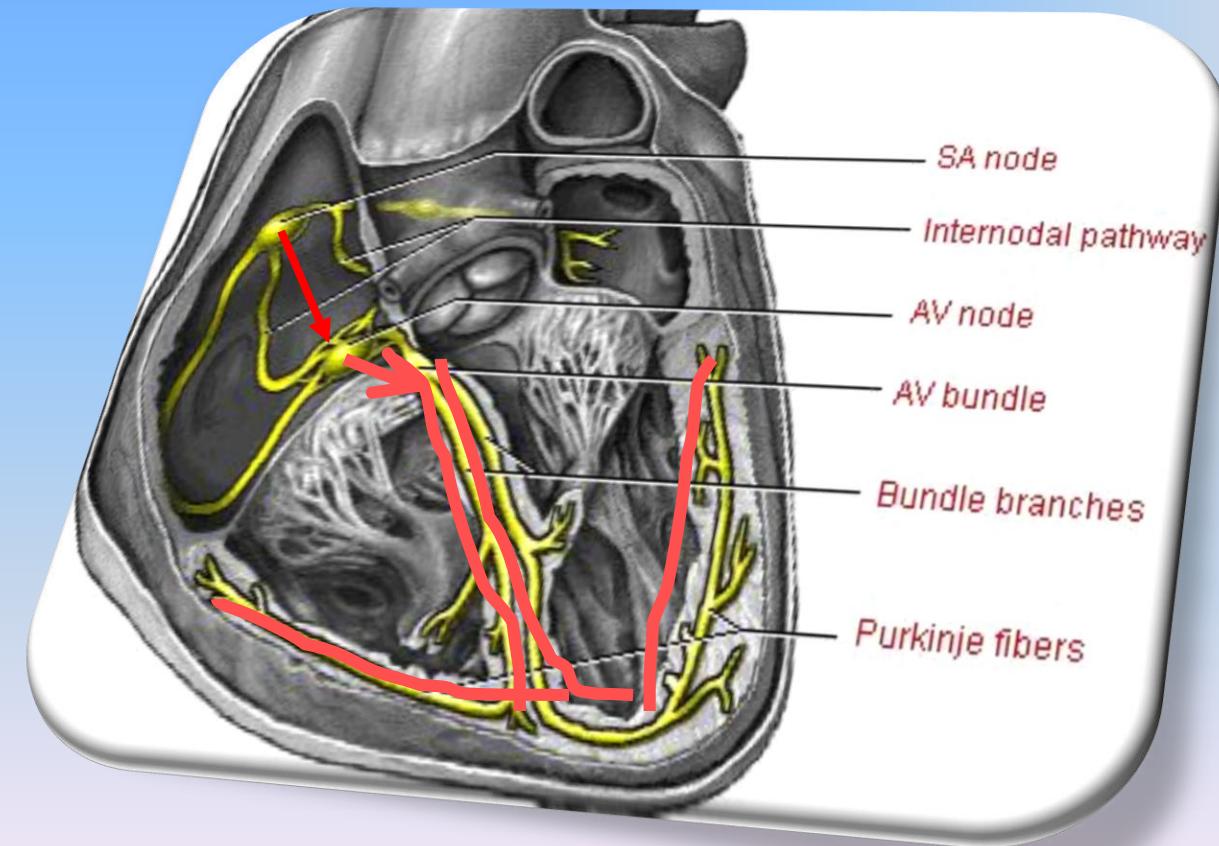
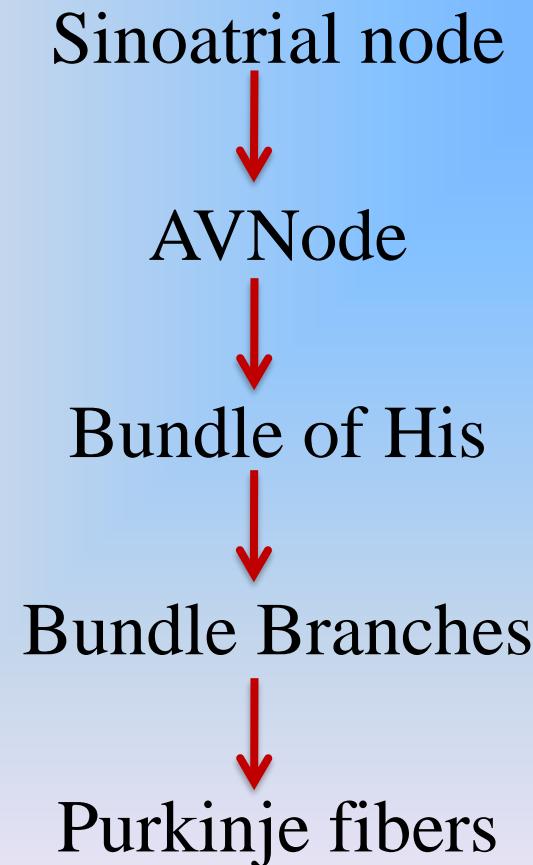
Augustus Waller



Inthoven



Normal Impulse Conduction



Characteristic of the heart cells

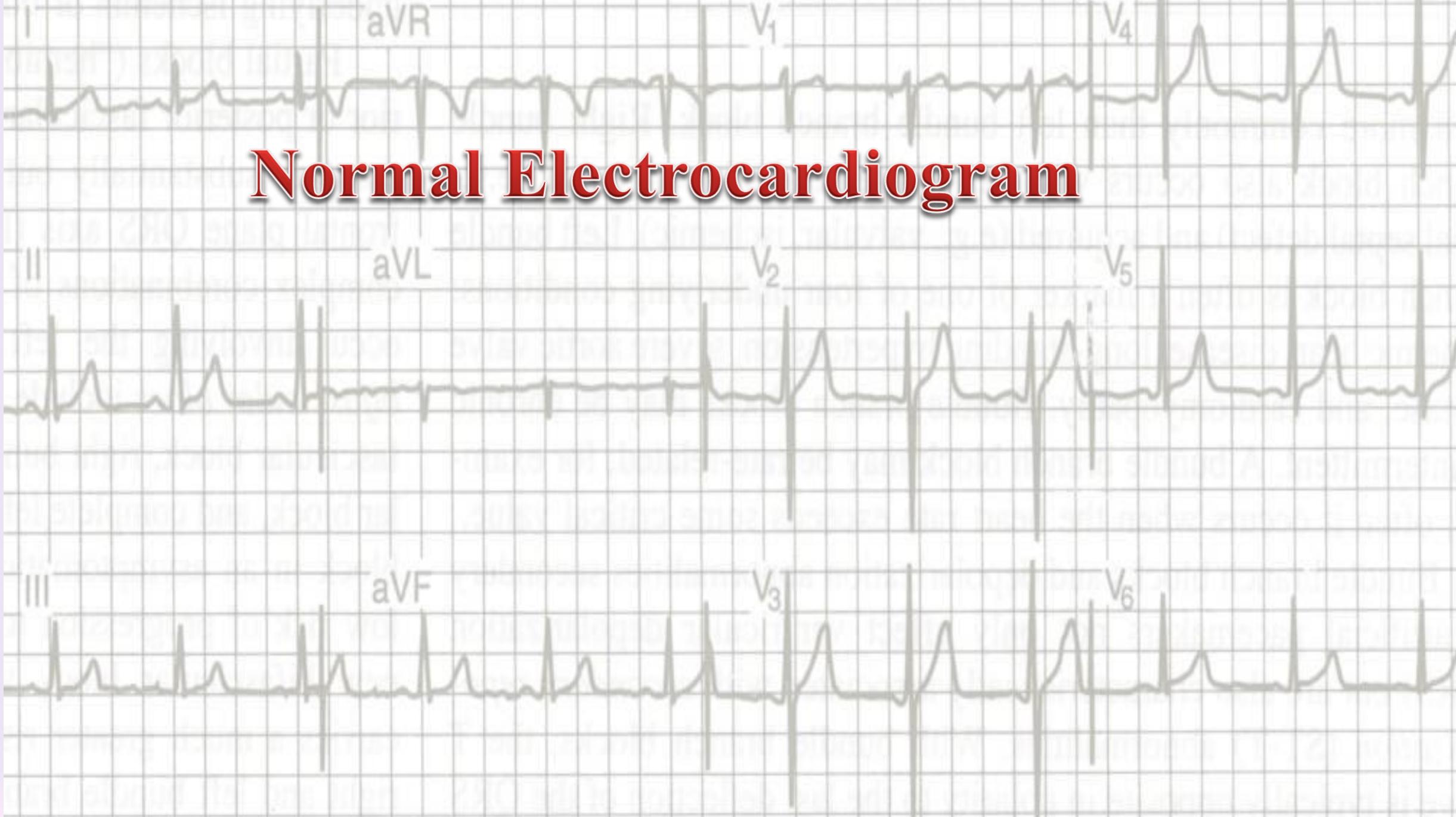
Automaticity

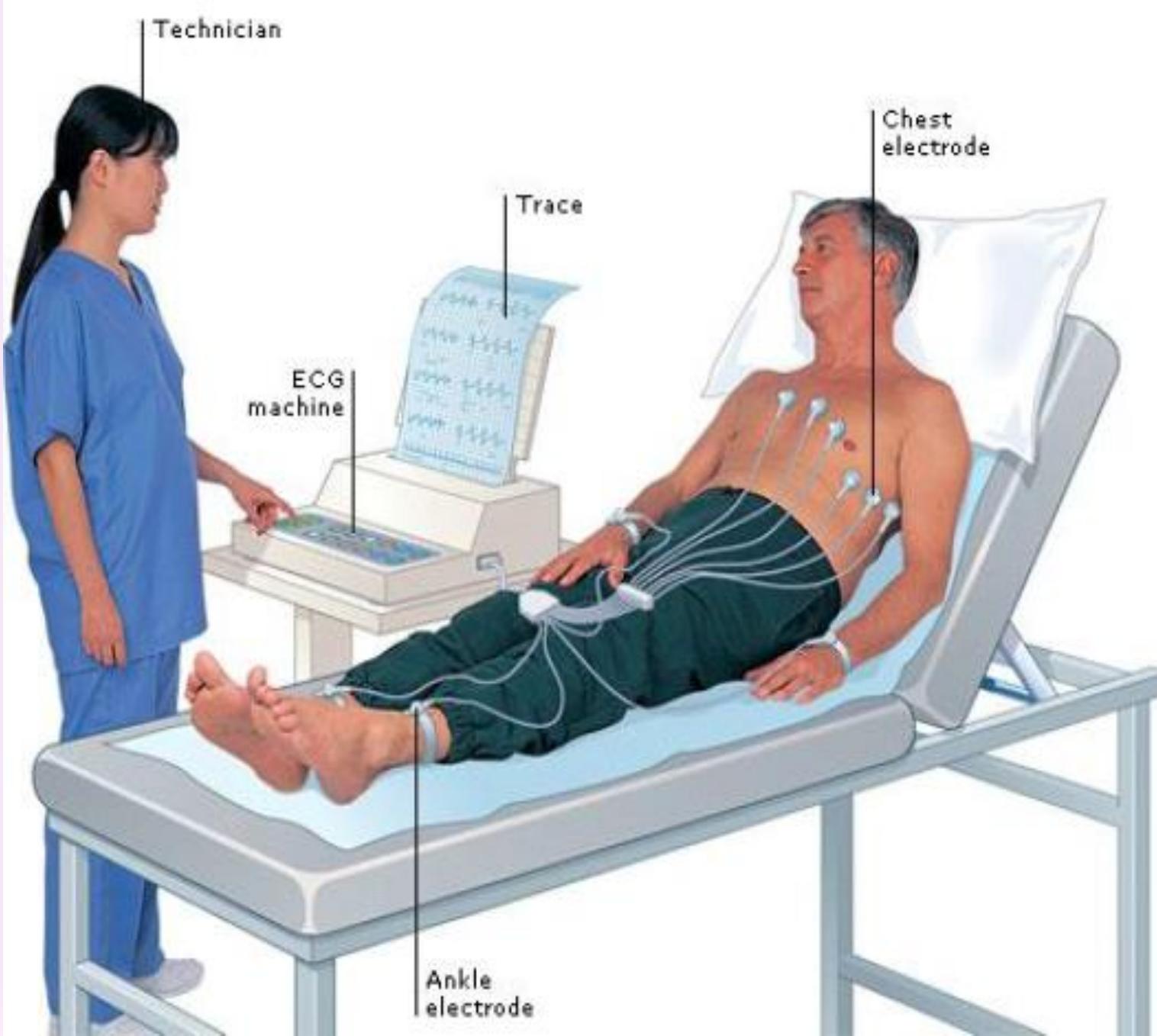
Excitability

Conductivity

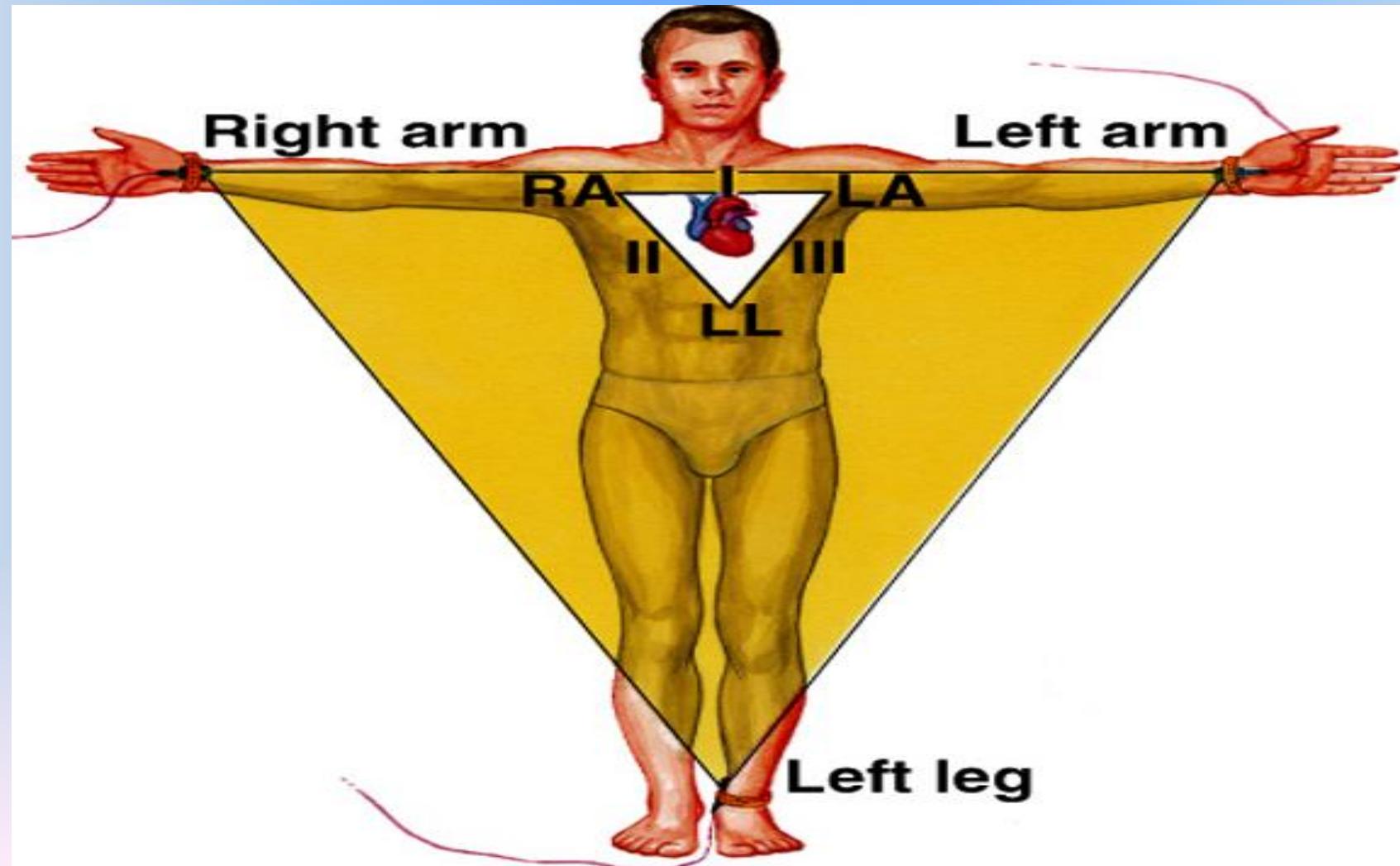
Contractility

Normal Electrocardiogram

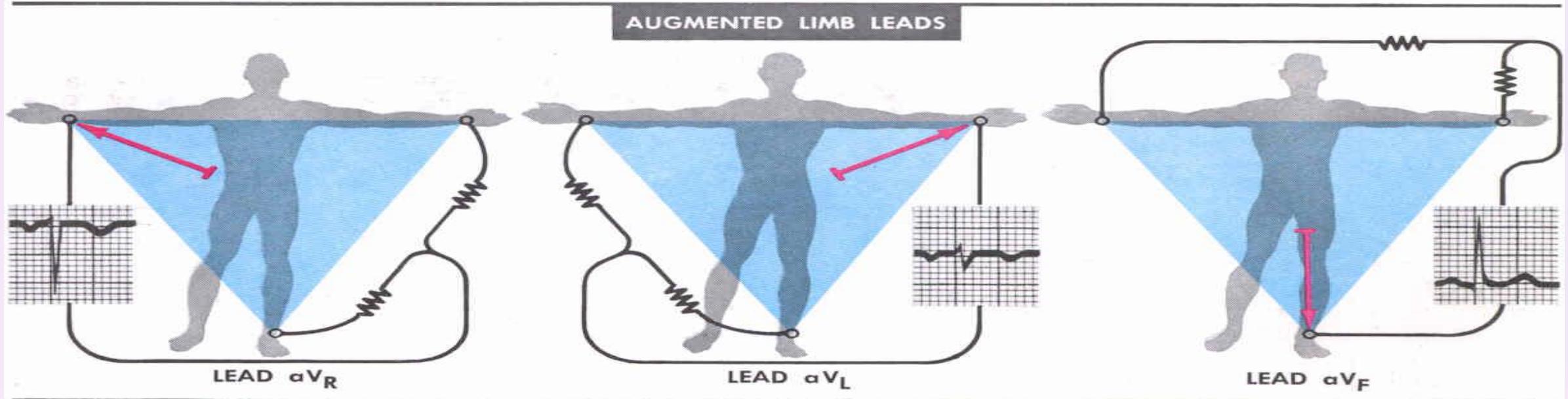
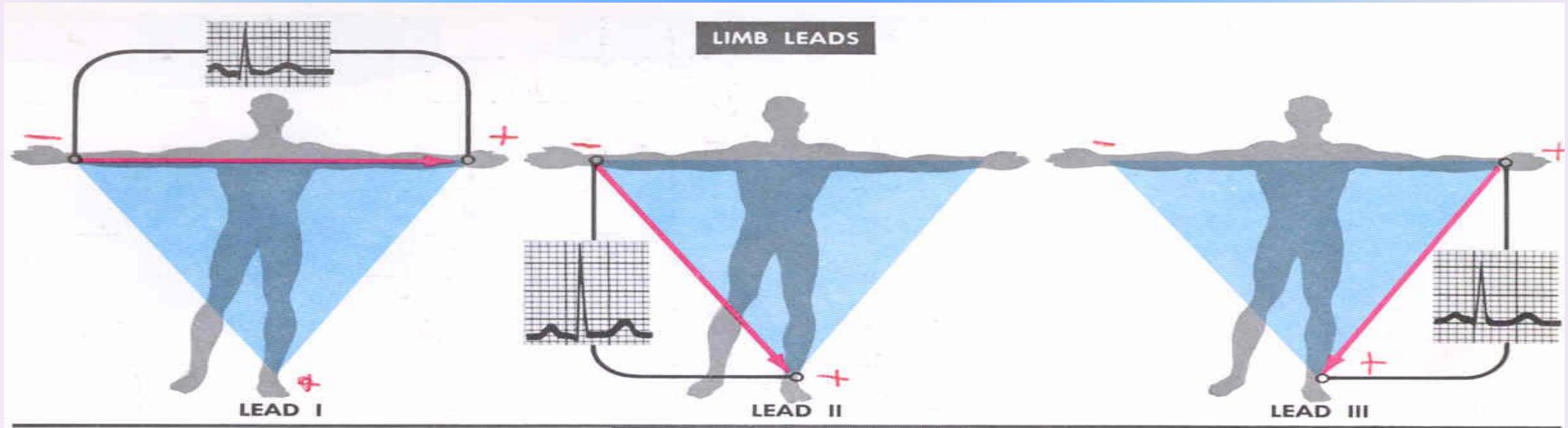




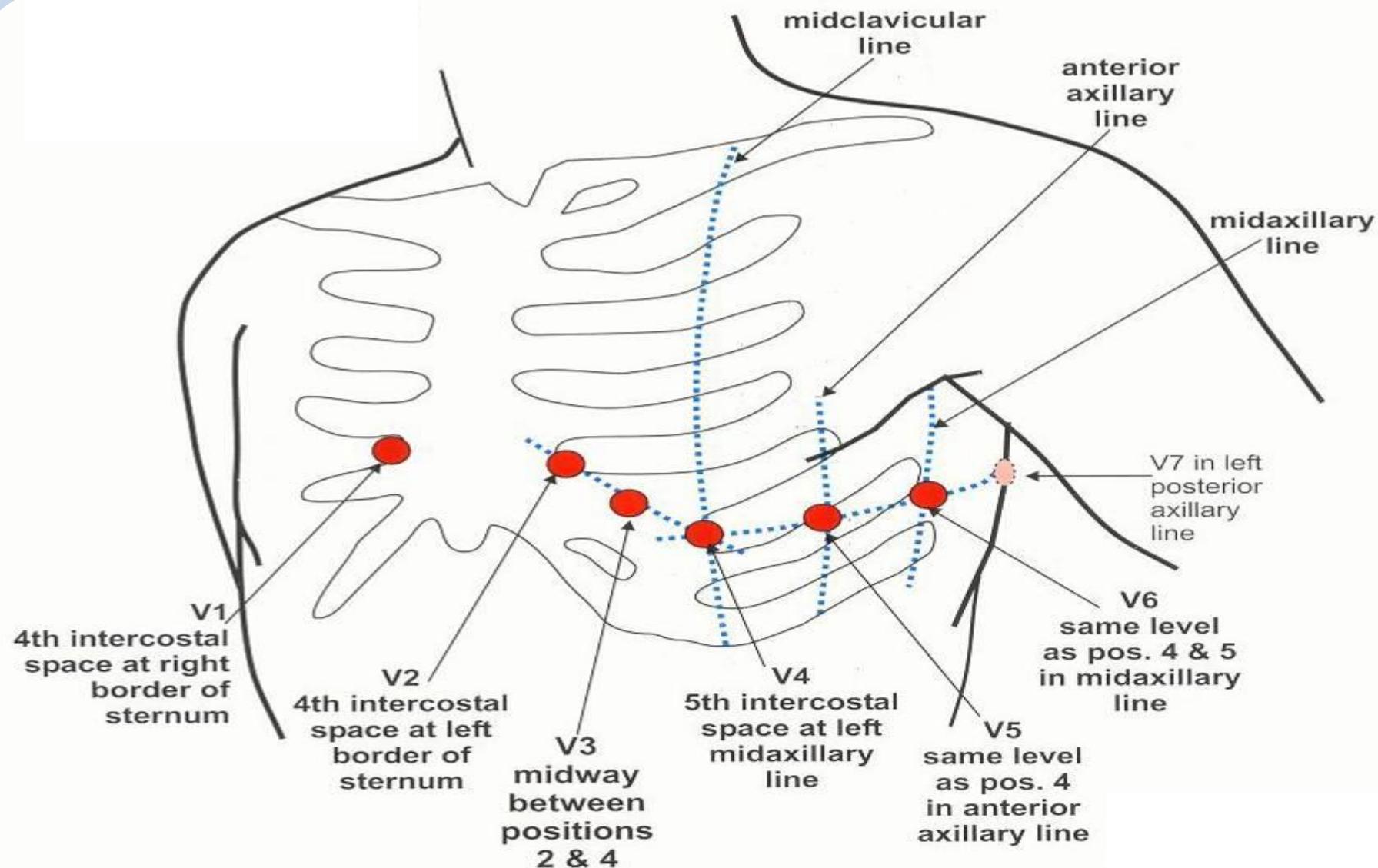
سیستم دوازده لیدی ثبت فعالیت الکتریکی قلب

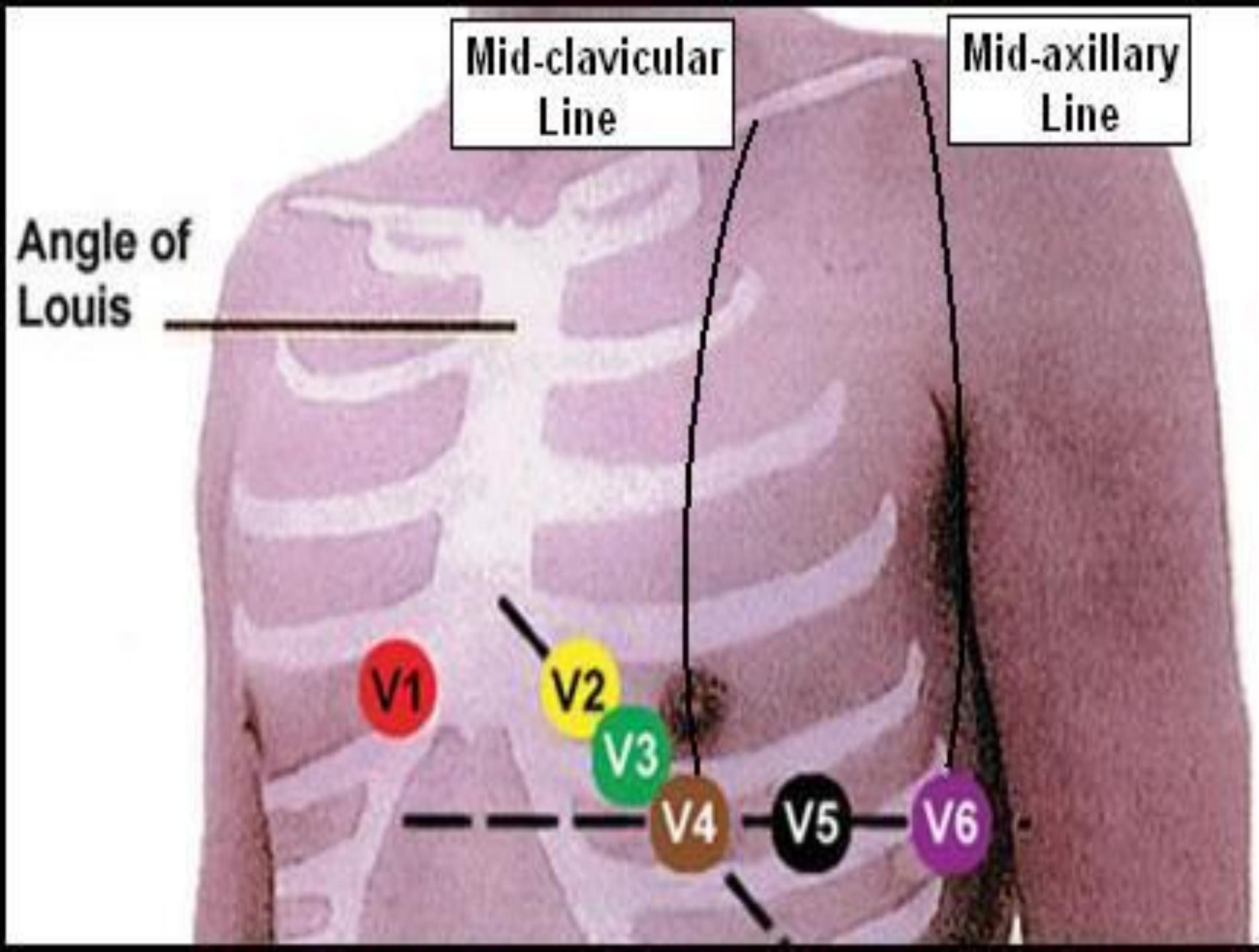


Limb Leads

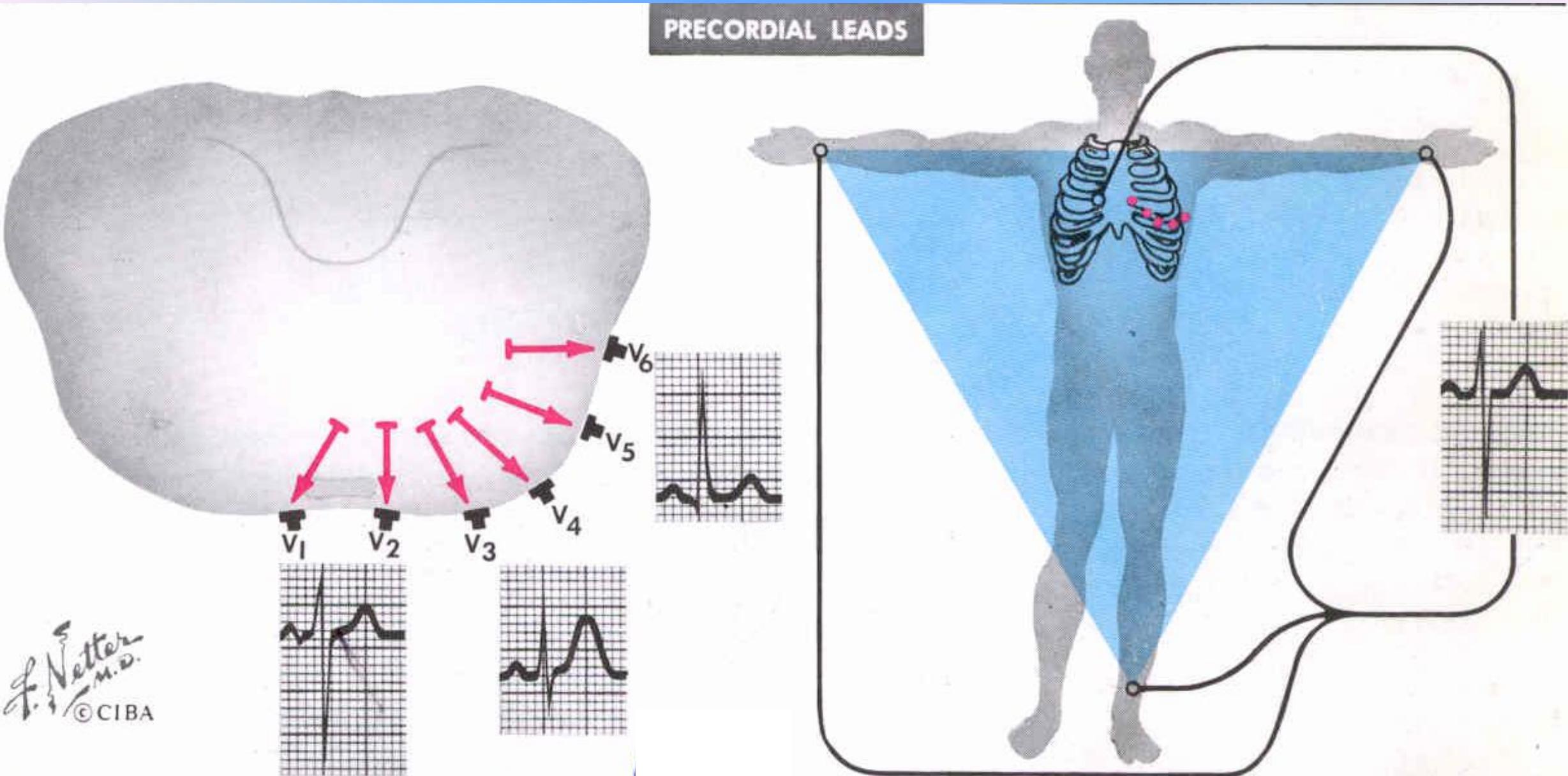


Position of Precordial Electrodes





Precordial Leads

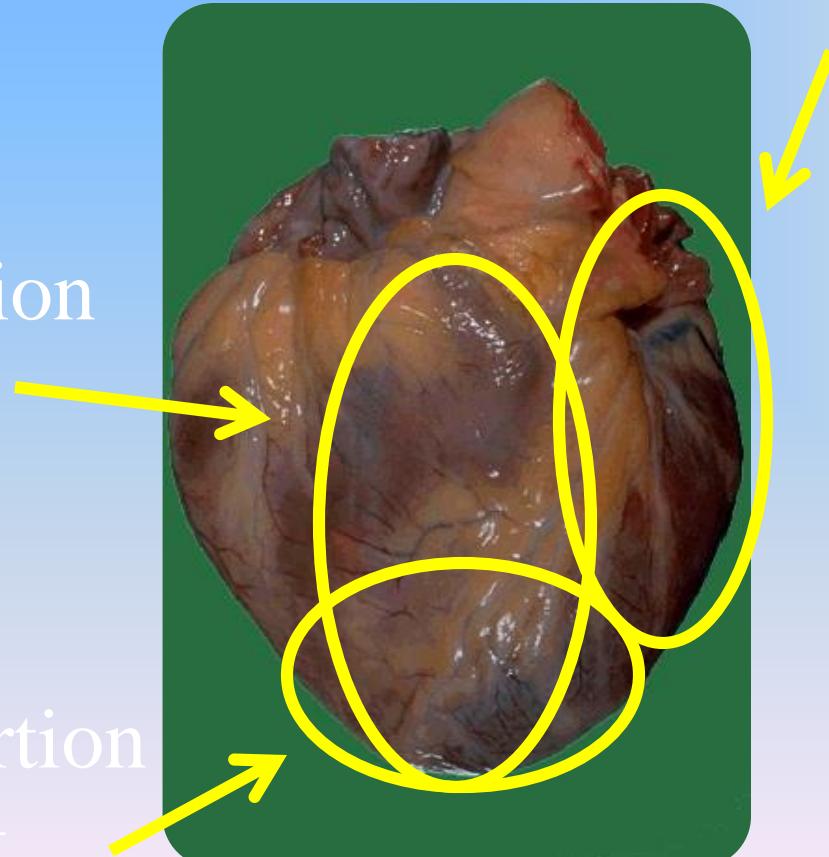


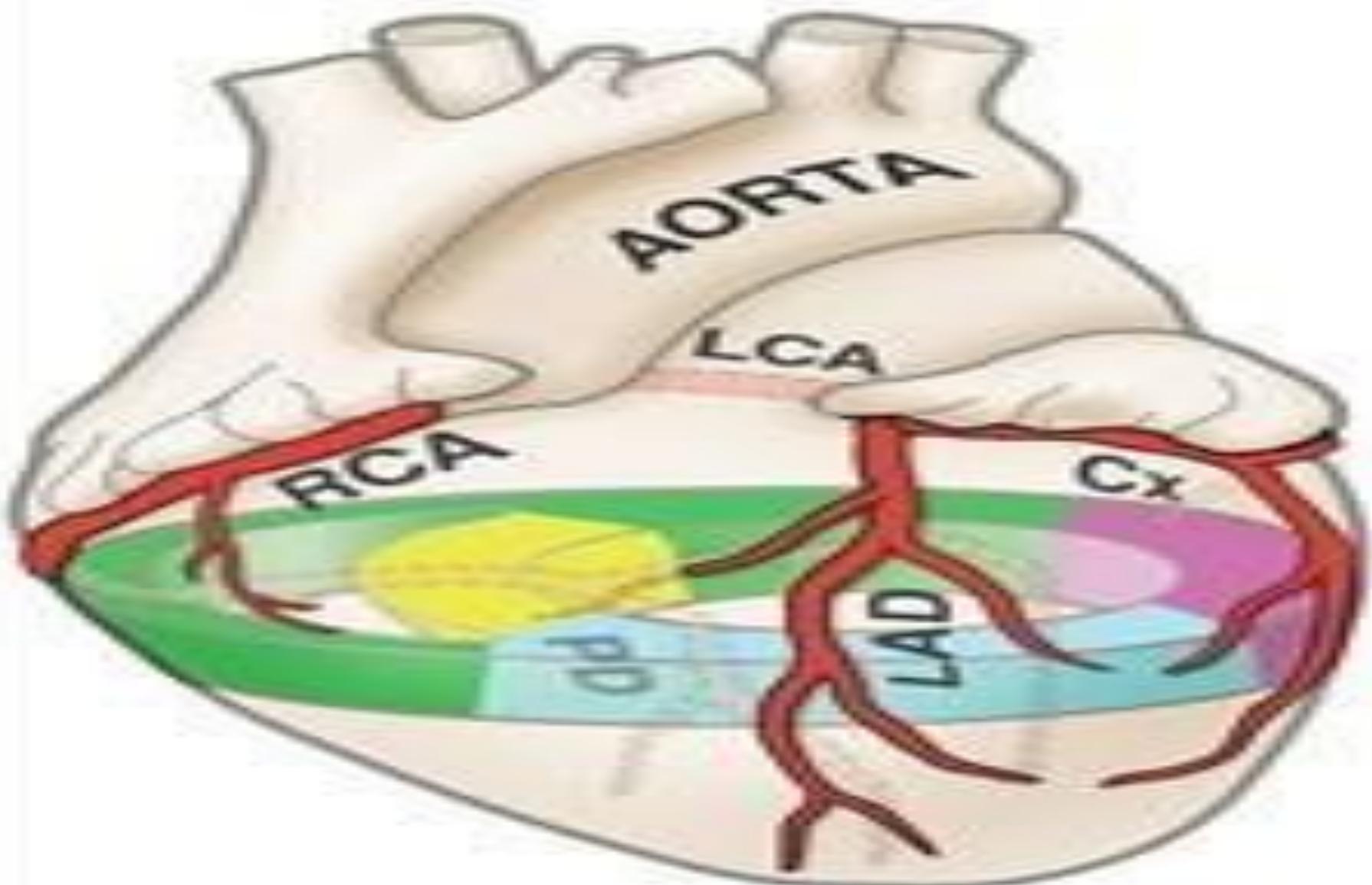
Views of the Heart

Lateral portion
of the heart

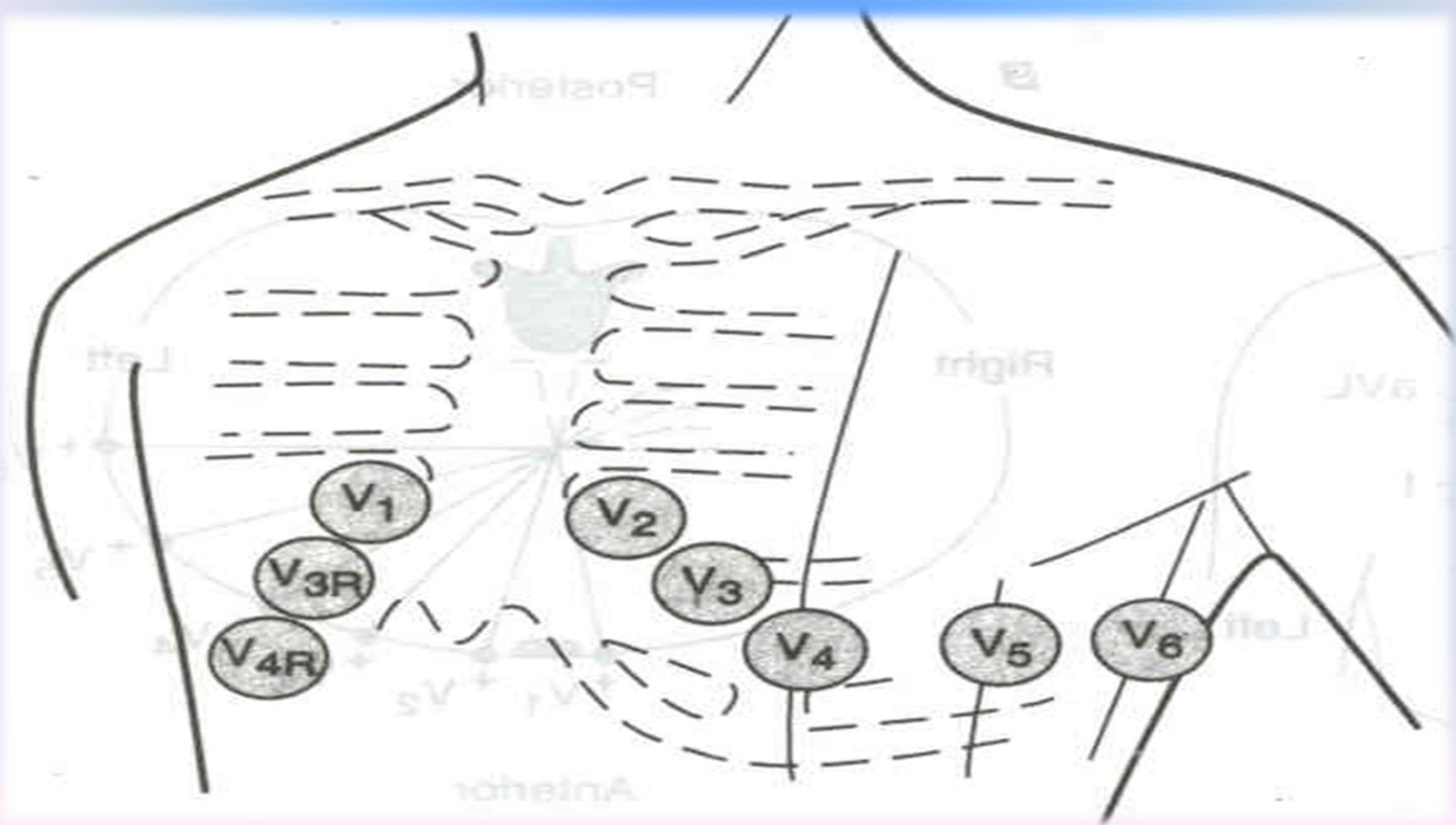
Anterior portion
of the heart

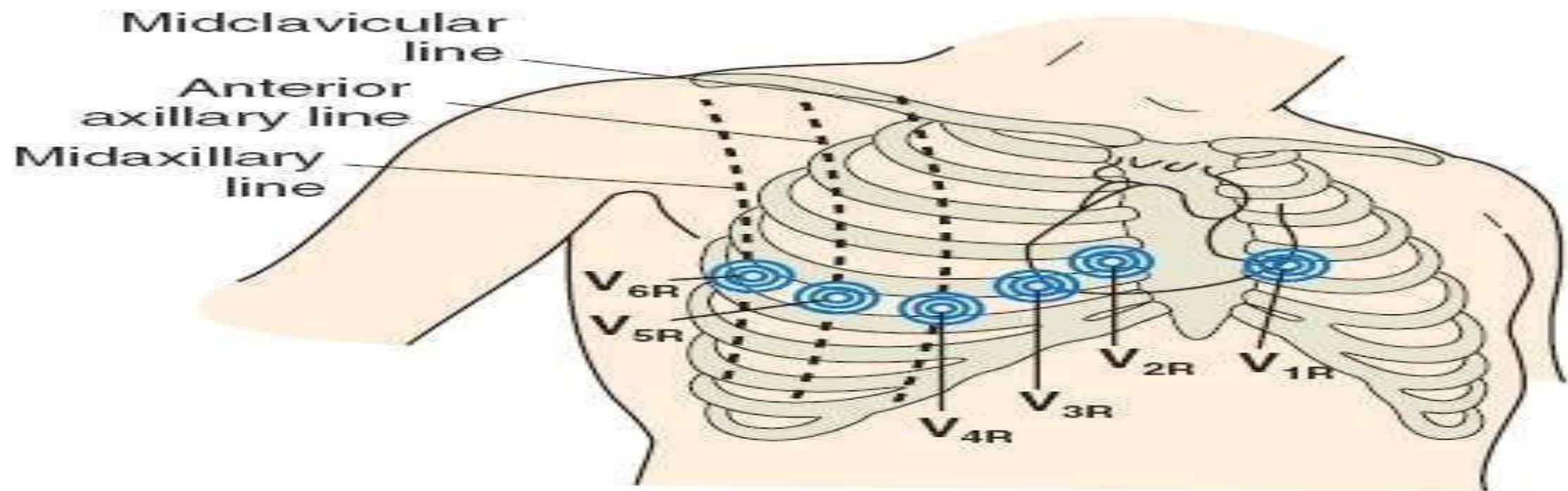
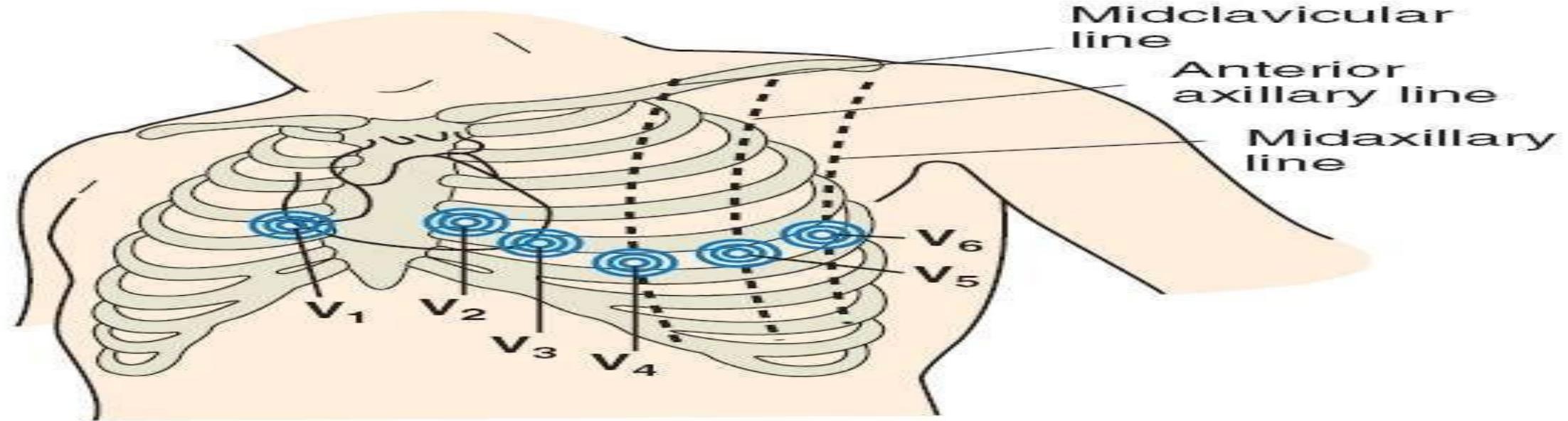
Inferior portion
of the heart



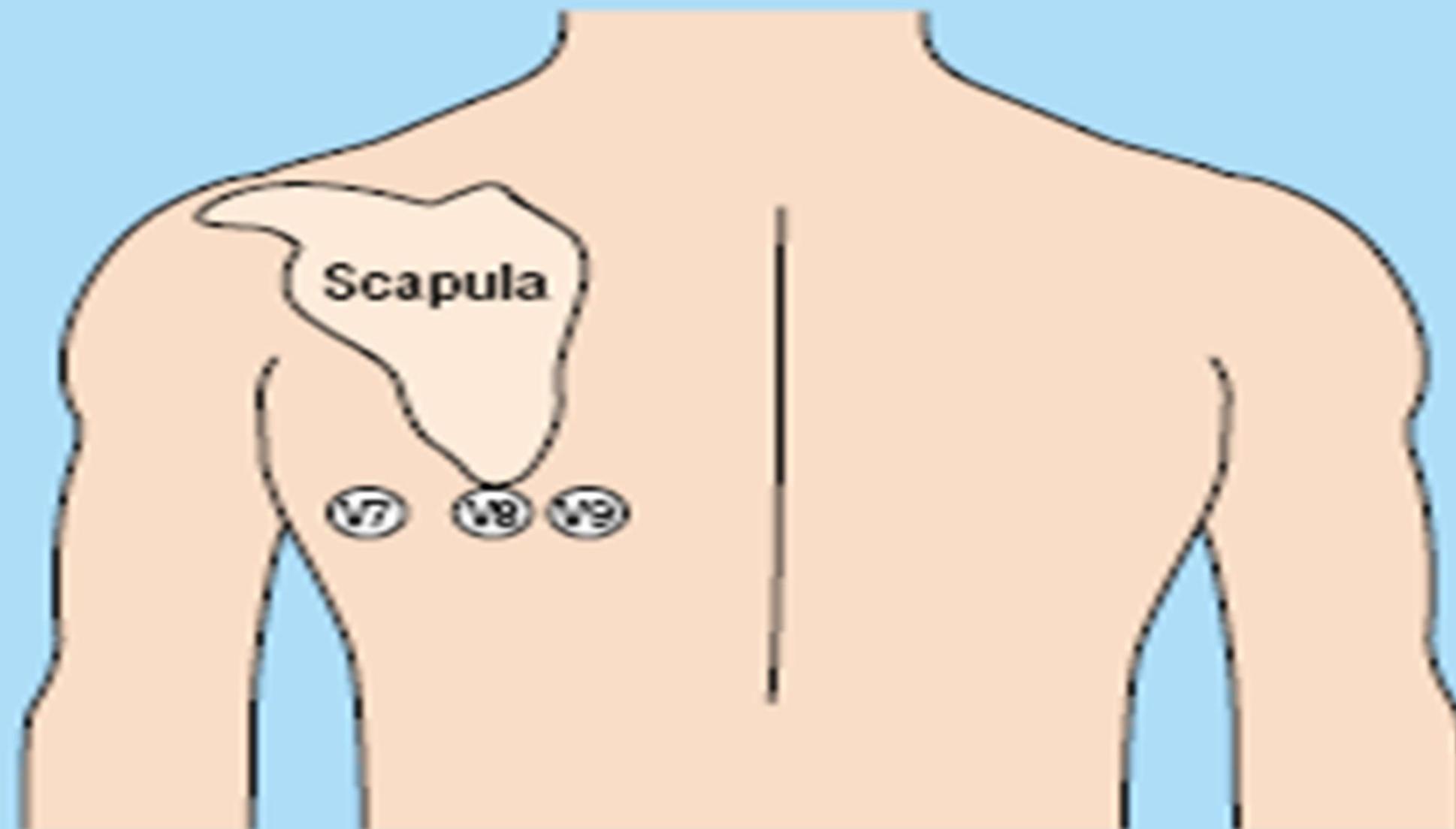


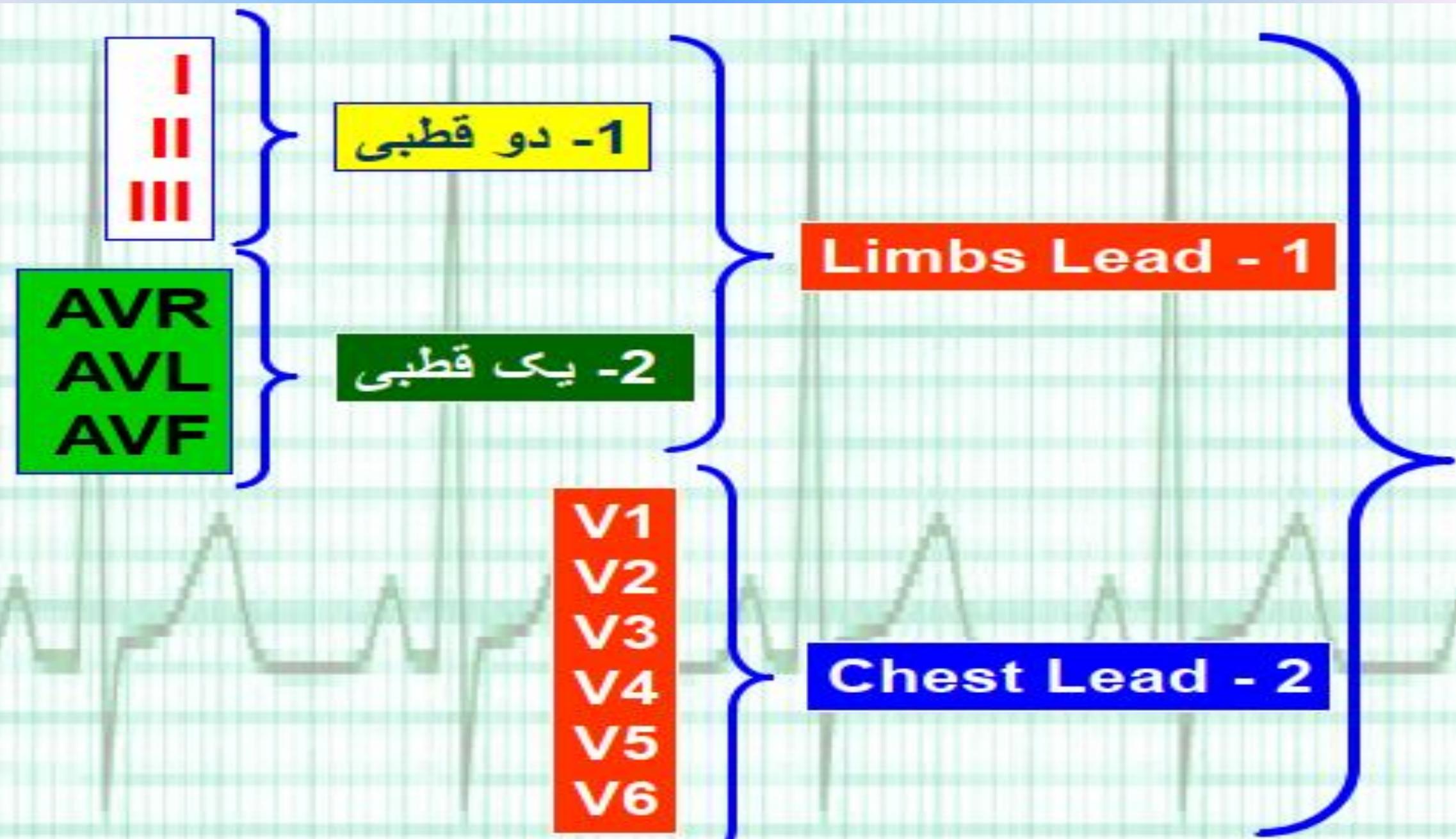
Right EKG

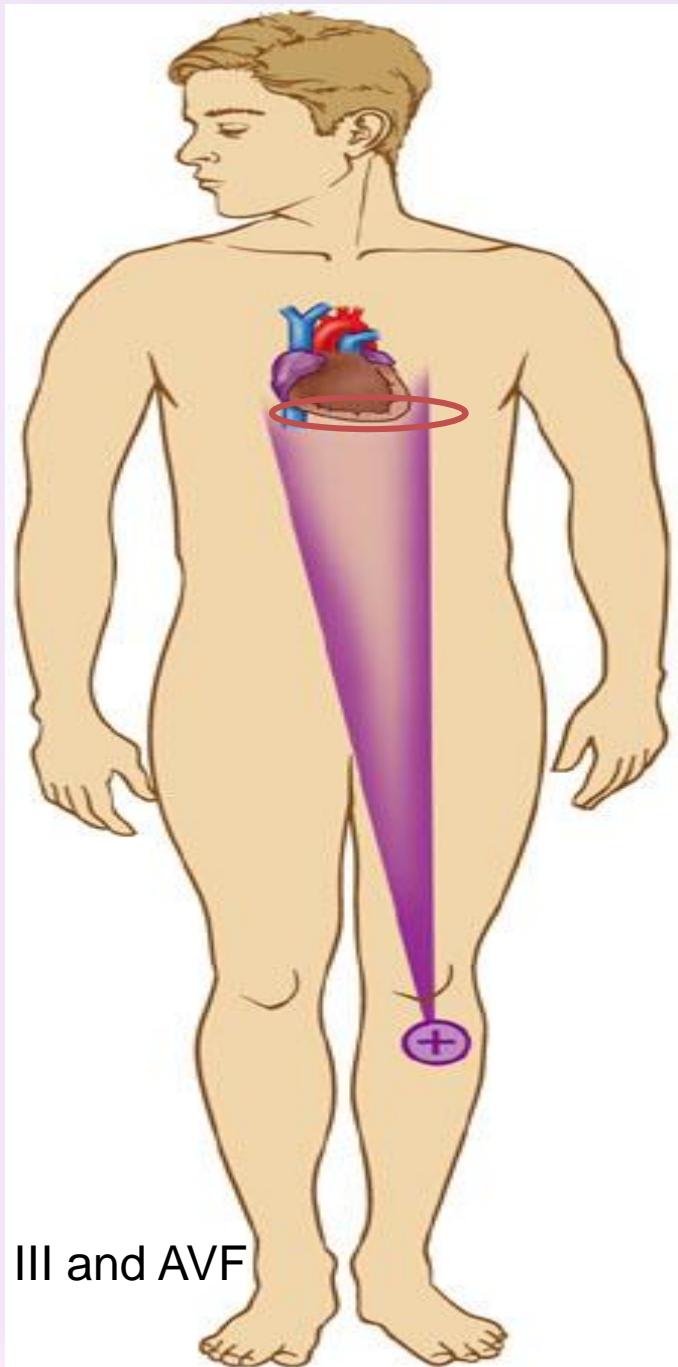




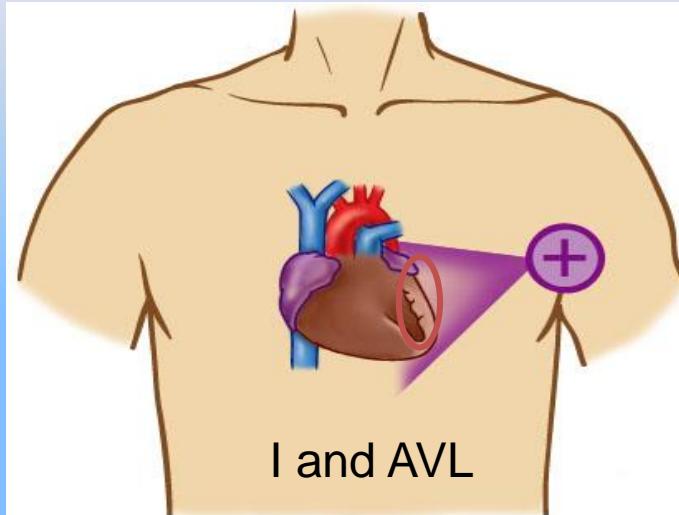
Posterior lead



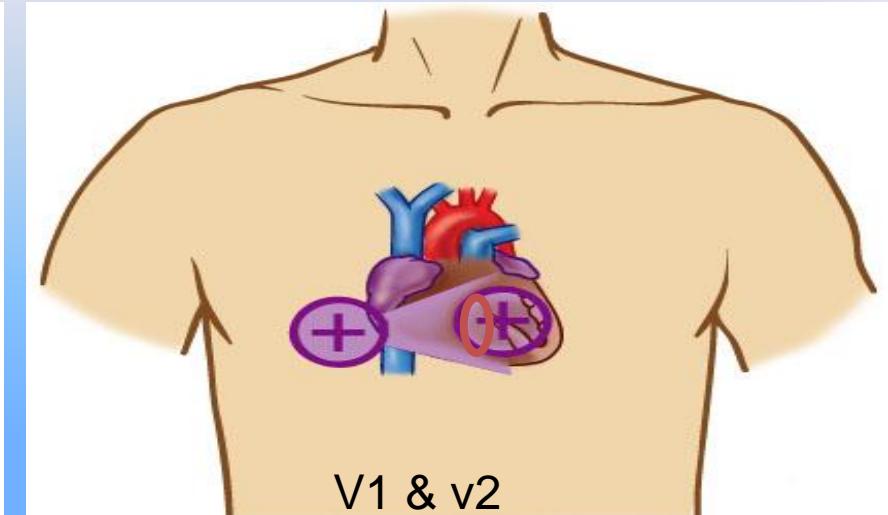




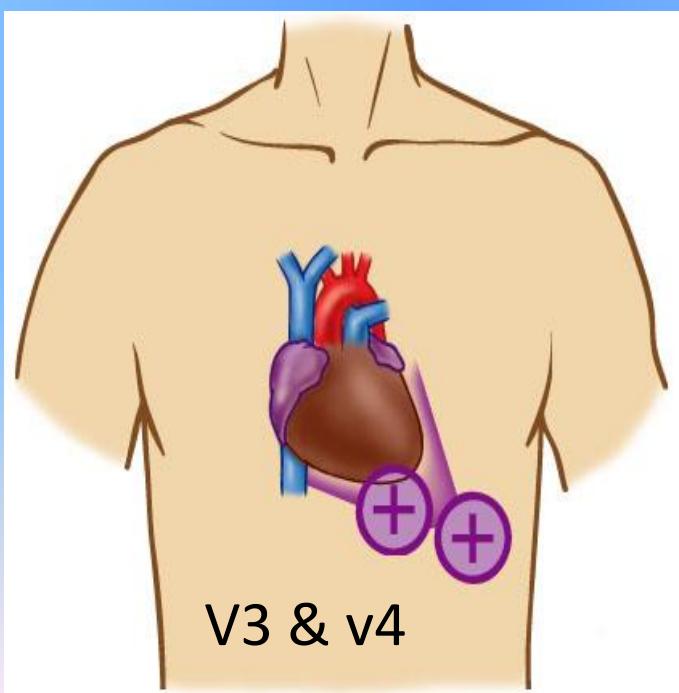
II, III and AVF



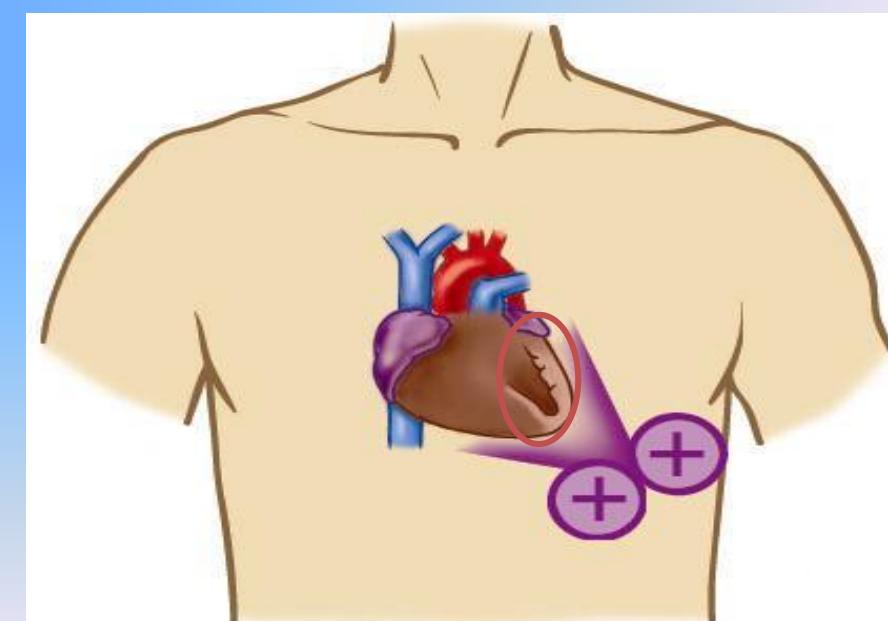
I and AVL



V1 & v2



V3 & v4



V5 & v6

The ECG Paper

Horizontally

One small box - 0.04 s

One large box - 0.20 s

Vertically

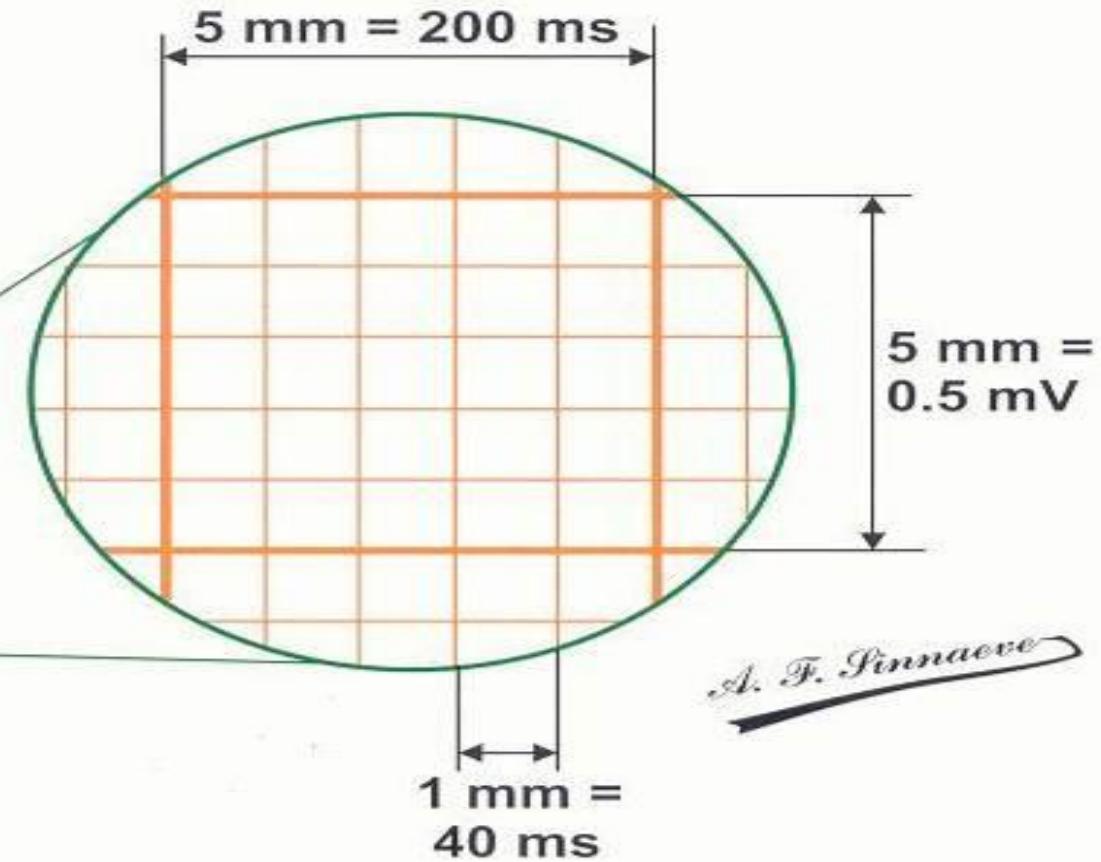
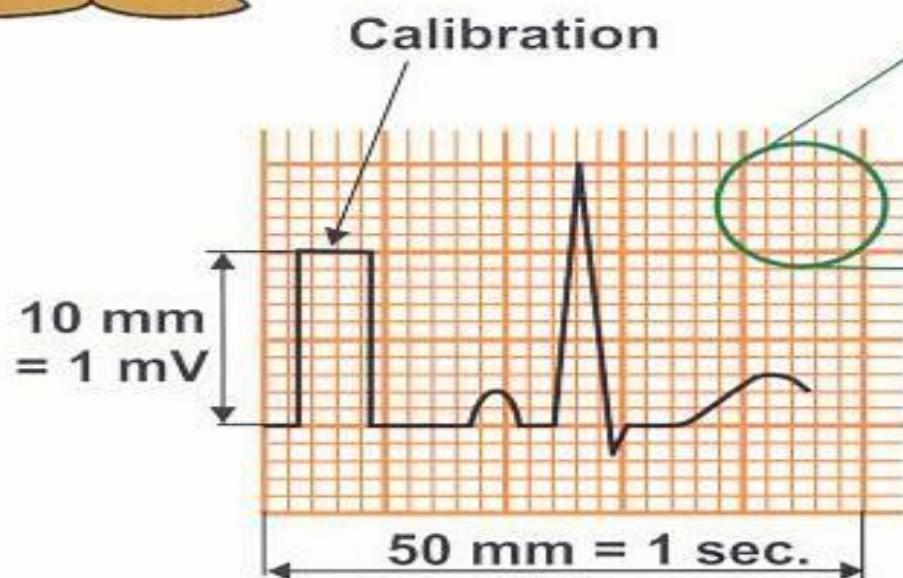
One large box - 0.5 mV



TIMING INTERVALS VERSUS RATE

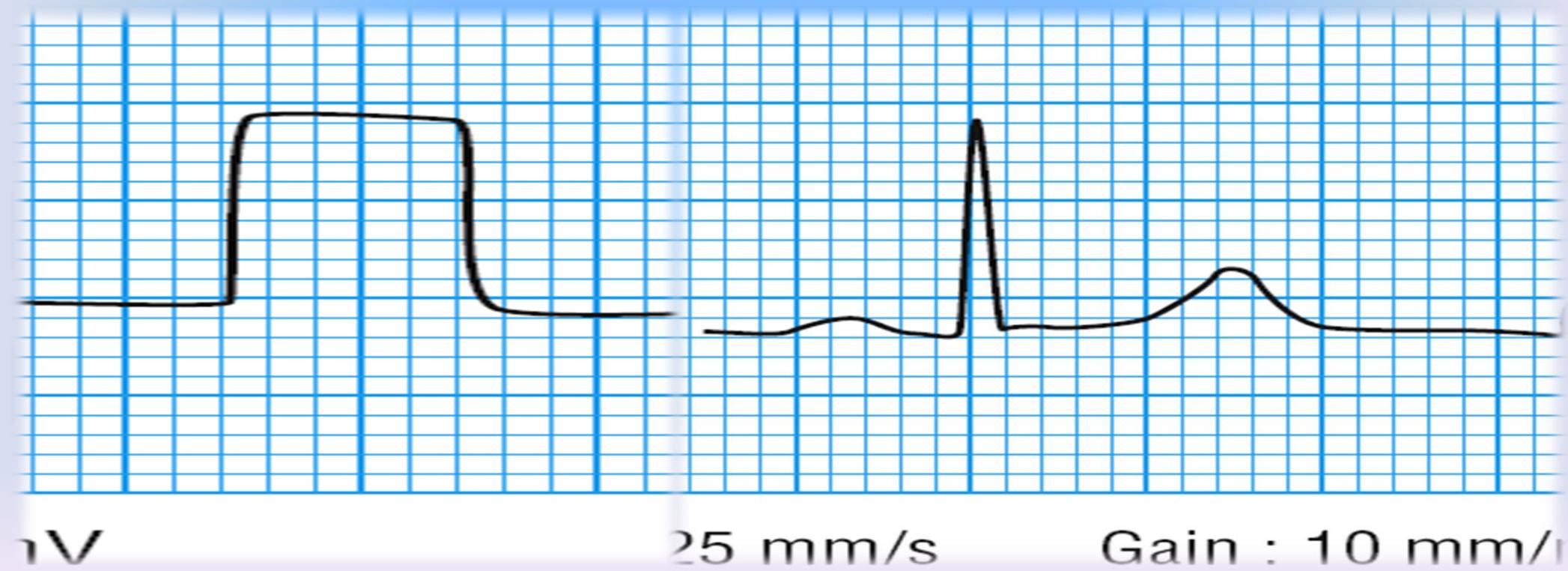


This is elementary !
Everybody should
know that !!!



The paper speed is normally 25 mm/s,
thus 1 mm on the paper corresponds
with $1/25 \text{ s} = 0.04 \text{ s} = 40 \text{ ms}$

Standard calibration signal



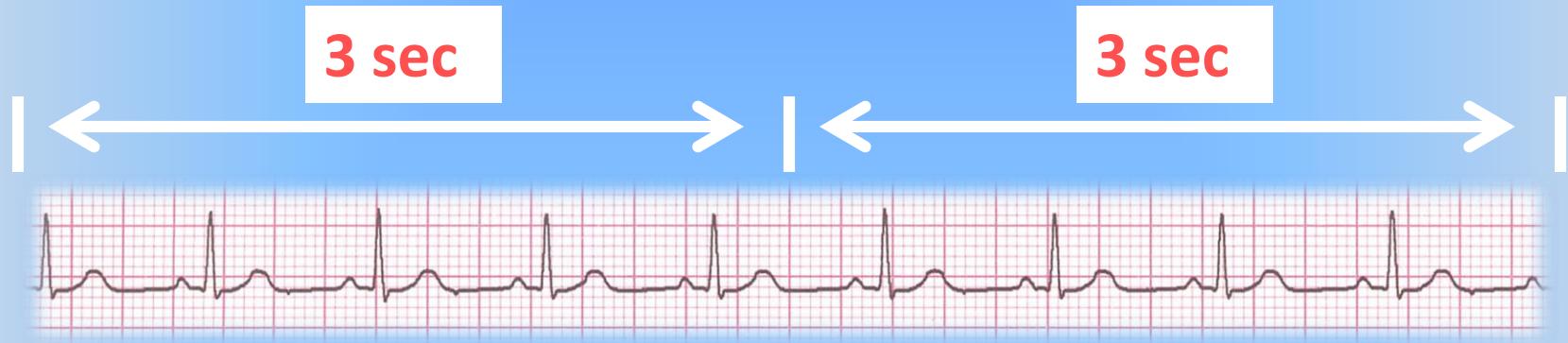
25 mm VS 50 mm



Amplitude



The ECG Paper

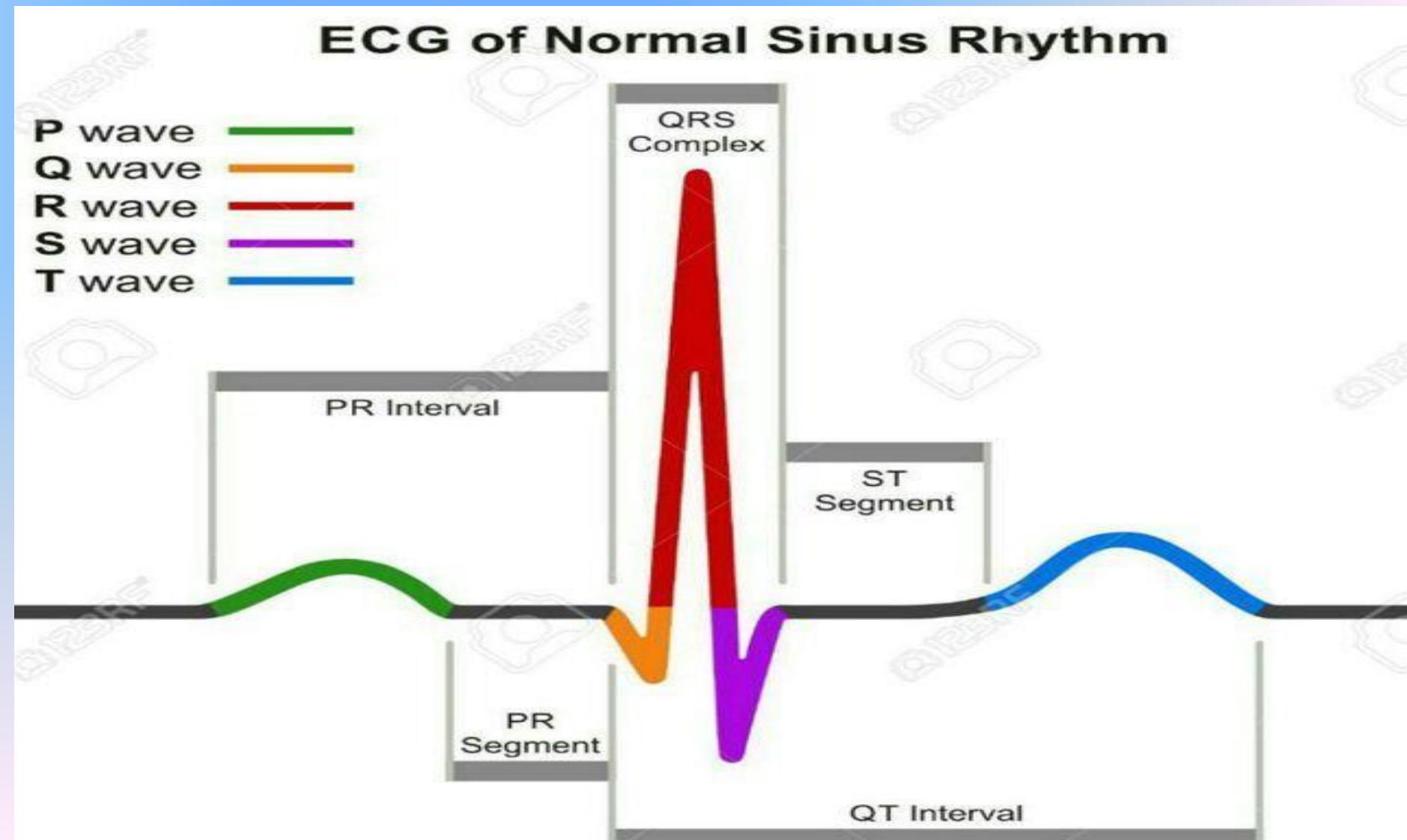


Every 3 seconds **(15 large boxes)** is marked by a vertical line.

This helps when calculating the heart rate.

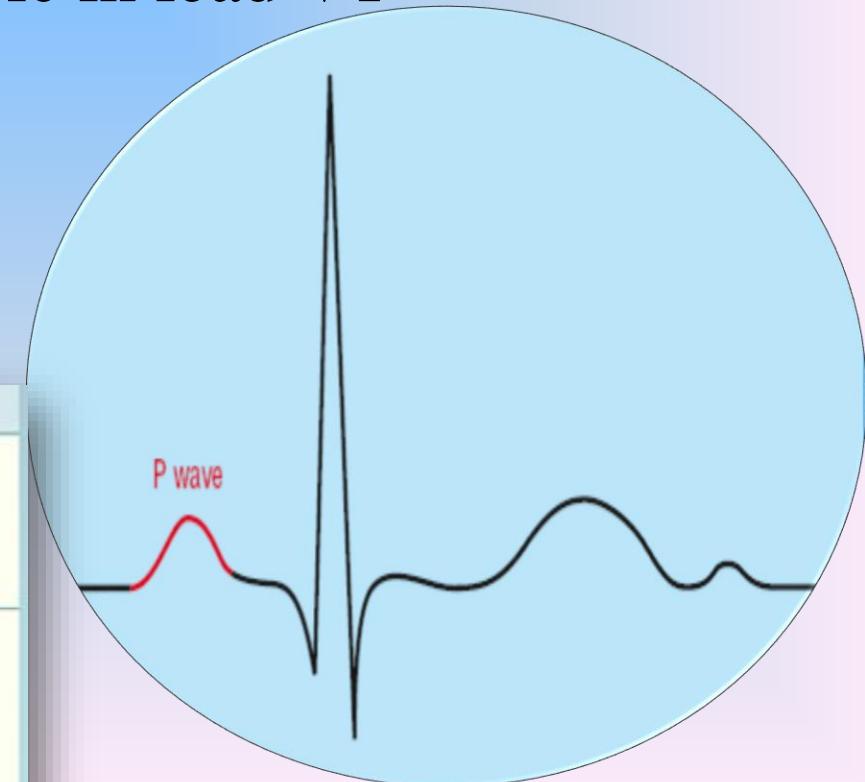
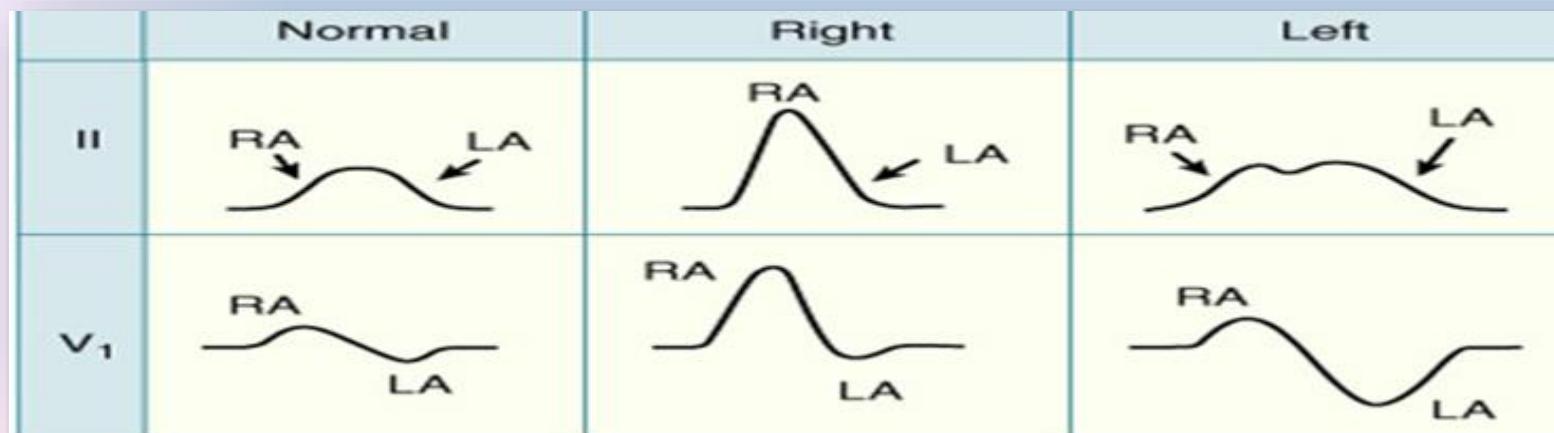
Evaluate of the EKG

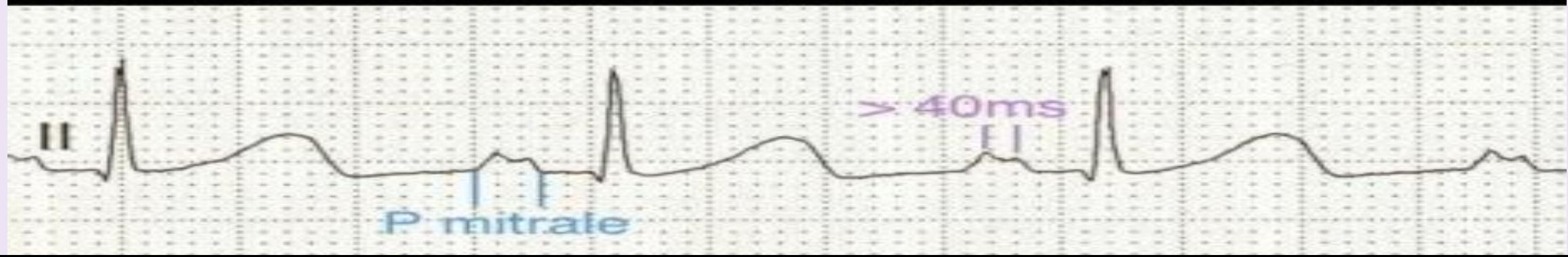
- 1) P Wave
- 2) PR Interval
- 3) QRS Shape
- 4) ST Segment
- 5) T Wave
- 6) Uwave
- 7) QTc Interval
- 8) HR Rate
- 9) Regularity
- 10) Rhytm



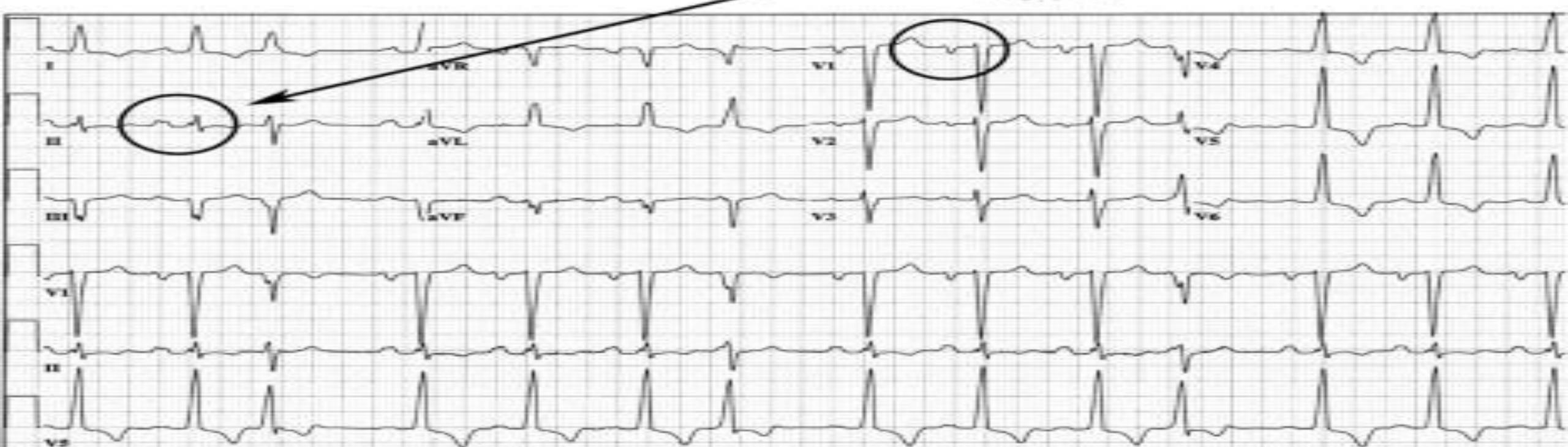
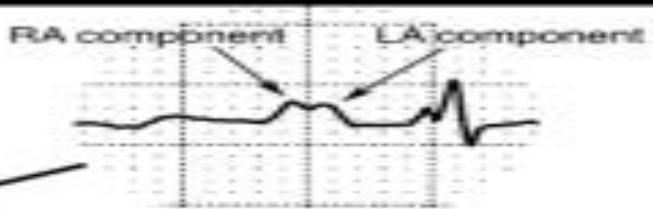
Characteristics of the P wave

- Positive in leads I and II & inverted in lead AVR
- In lead III it may be upright, biphasic
- Best seen in leads II and V1 Commonly biphasic in lead V1
- < 3 small squares in duration
- < 2.5 small squares in amplitude limb lead





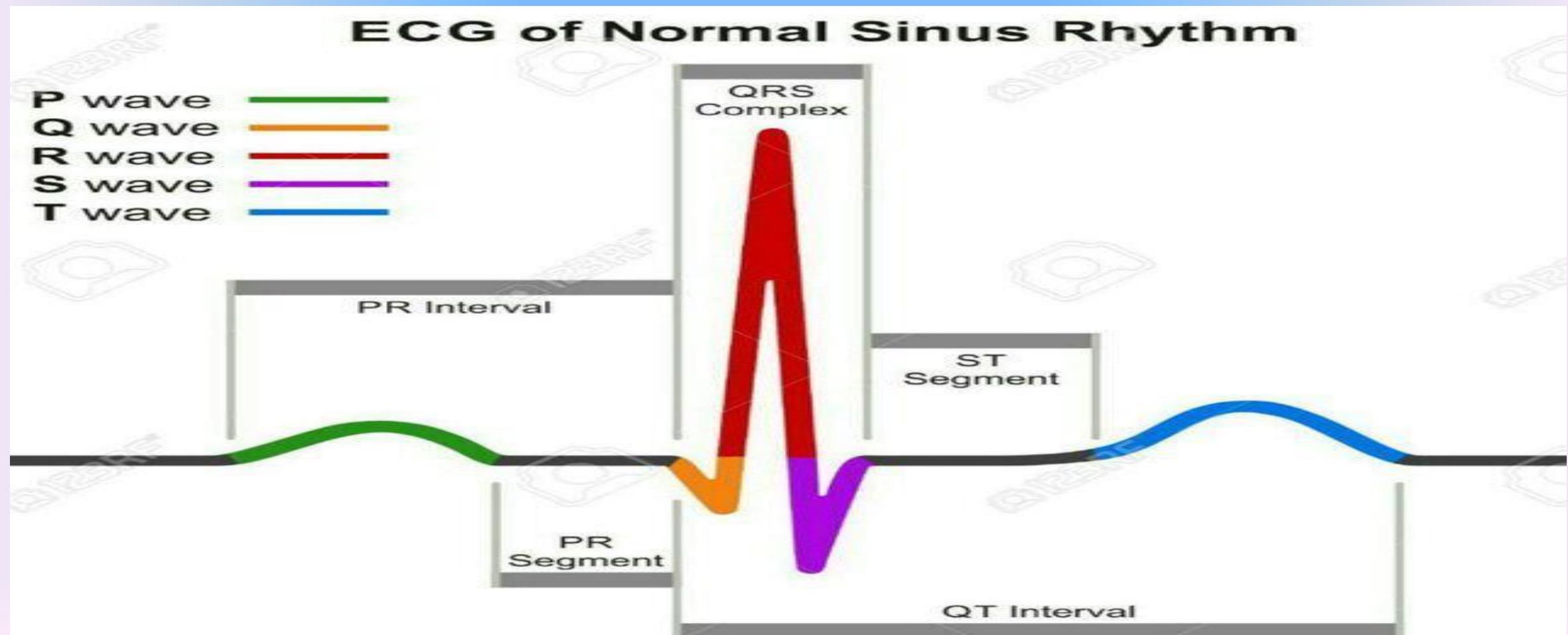
Left atrial abnormality. There is a broad, double-humped P wave in Lead II, and the terminal negative portion of the P wave in V₁ is more than 40 msec wide and 0.1 mV deep.



The PR Interval

0.12-0.20 s

(3 to 5 small squares)

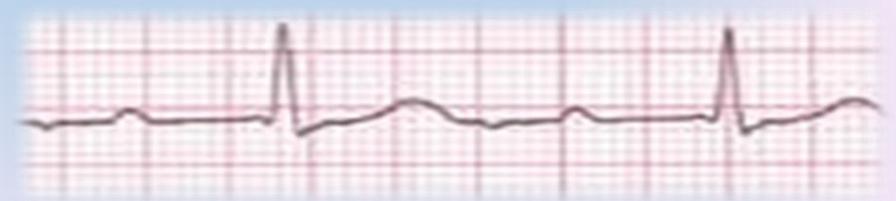


PR Interval

< 0.12 s	0.12-0.20 s	> 0.20 s
high catecholamine states wolff-Parkinson-White	Normal	AV nodal blocks



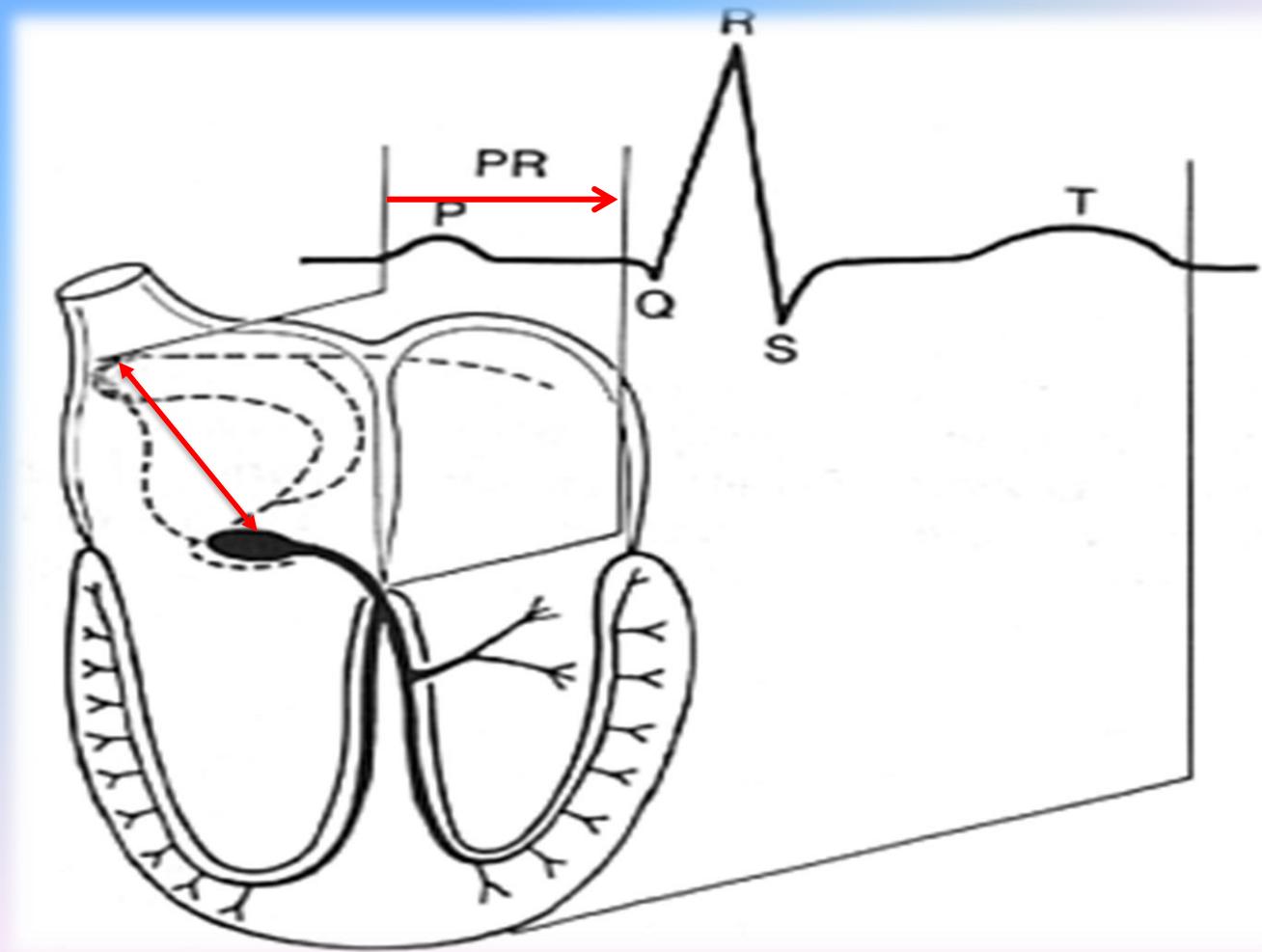
Wolff-Parkinson-White



1st Degree AV Block

The PR Interval

Atrial depolarization
+
delay in AV junction
(AV node/Bundle of His)

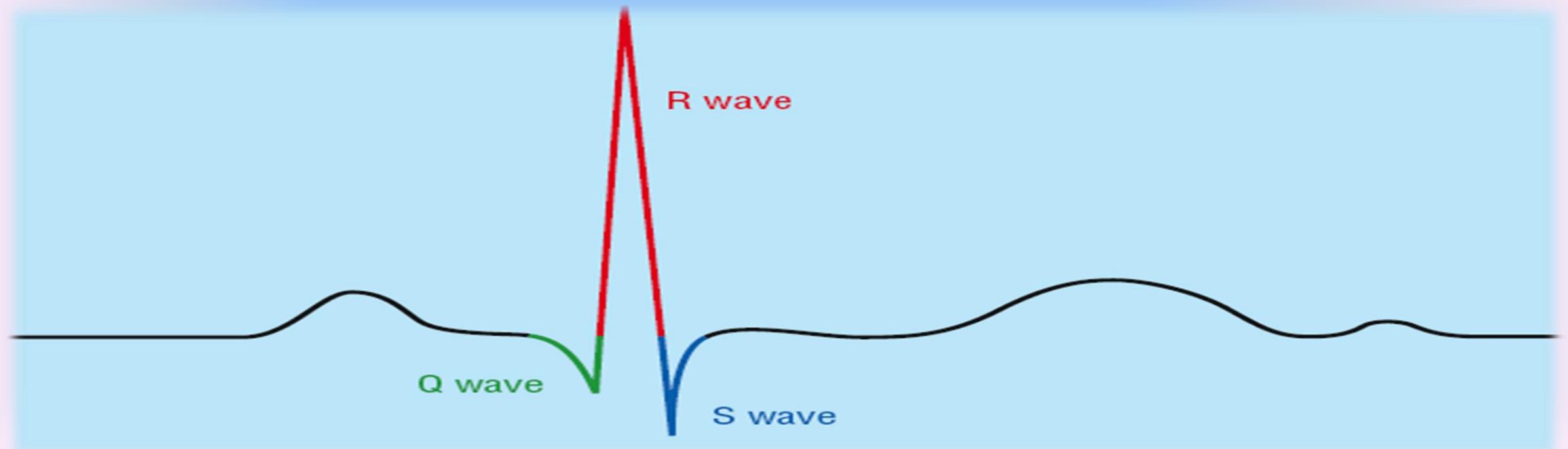


QRS complexes

Q wave: Any initial negative deflection

R wave: Any positive deflection

S wave: Any negative deflection after an R wave



QRS Characteristics

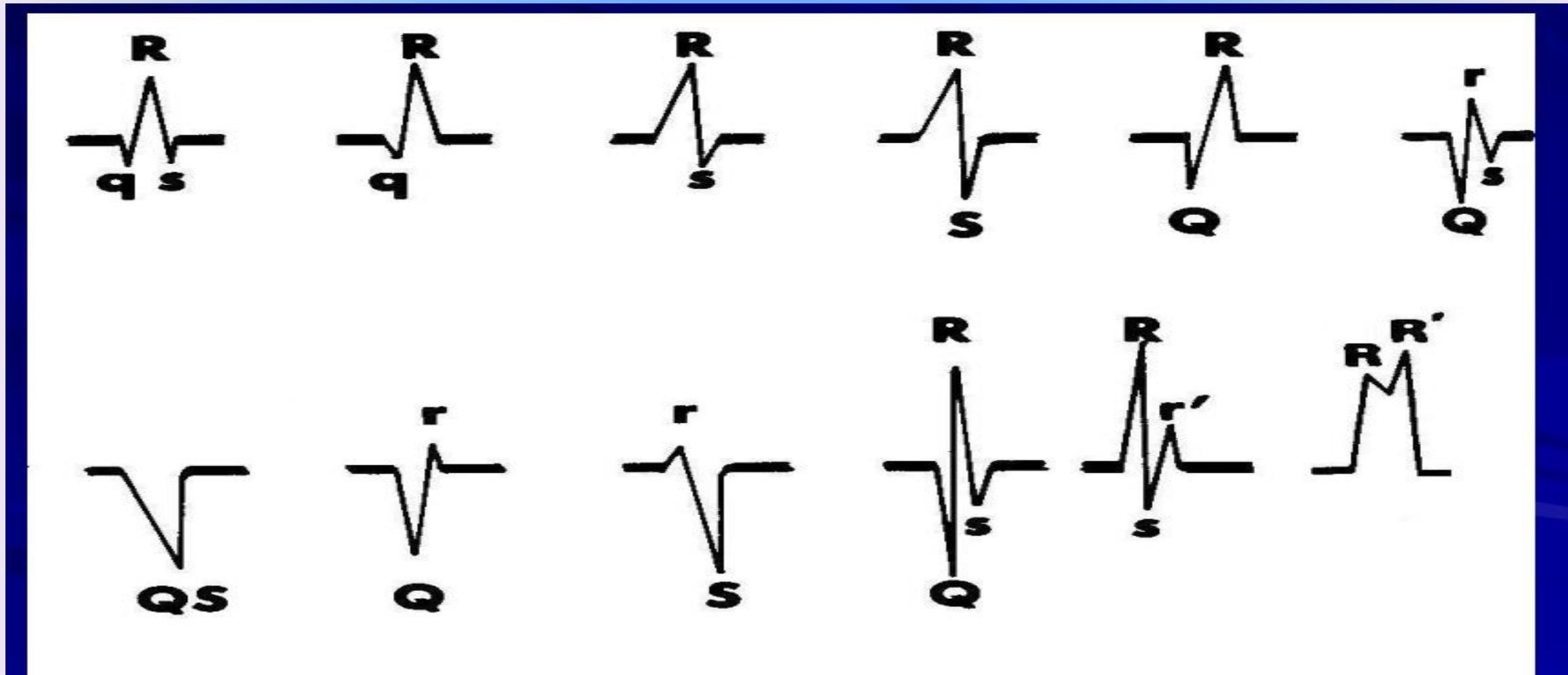
Between **0.06 and 0.10** second

Limb lead 1 mm

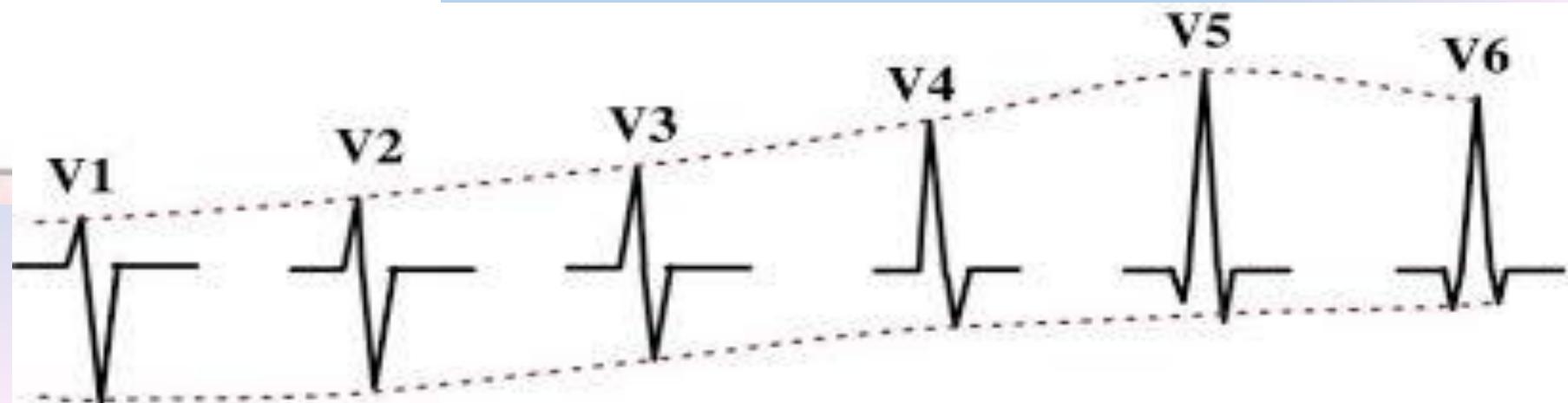
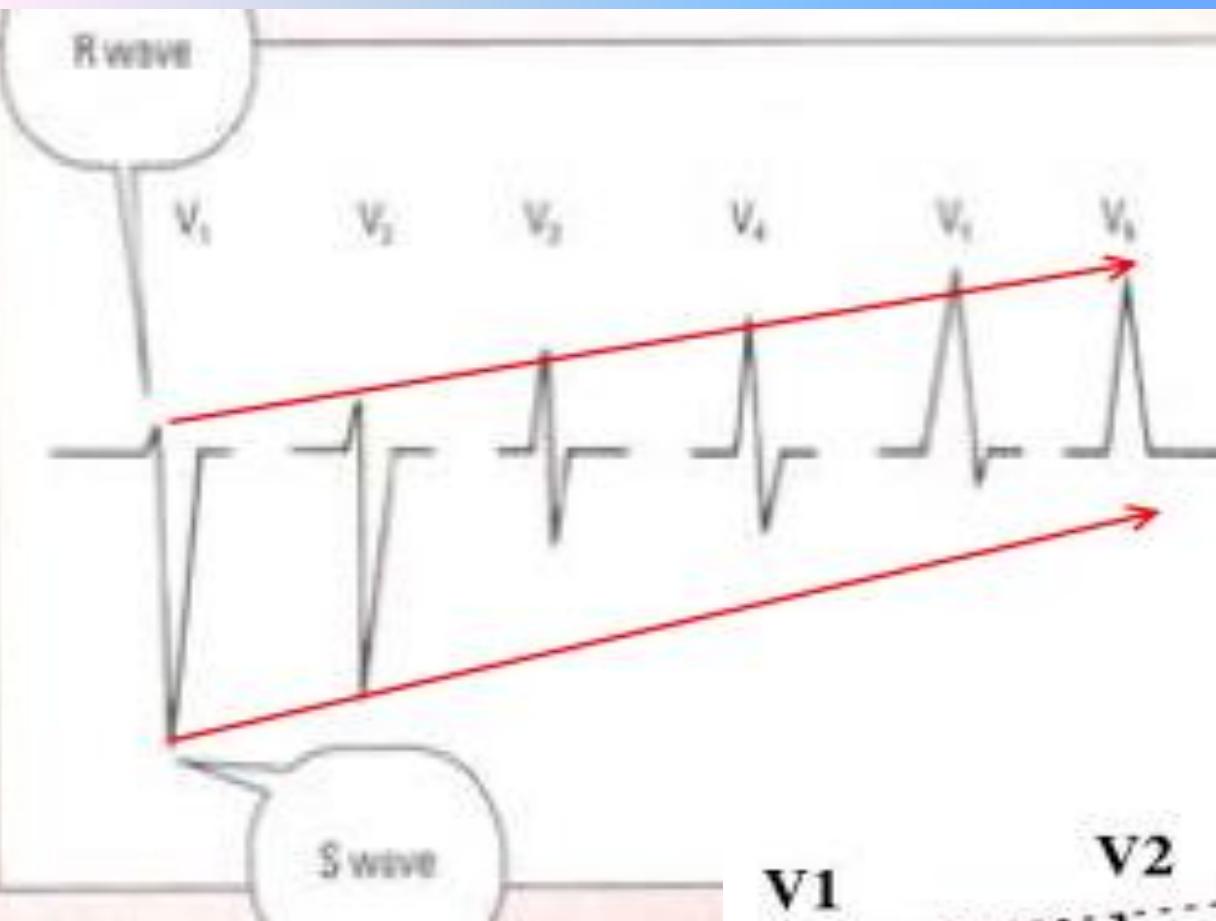
Precordial lead 25 mm



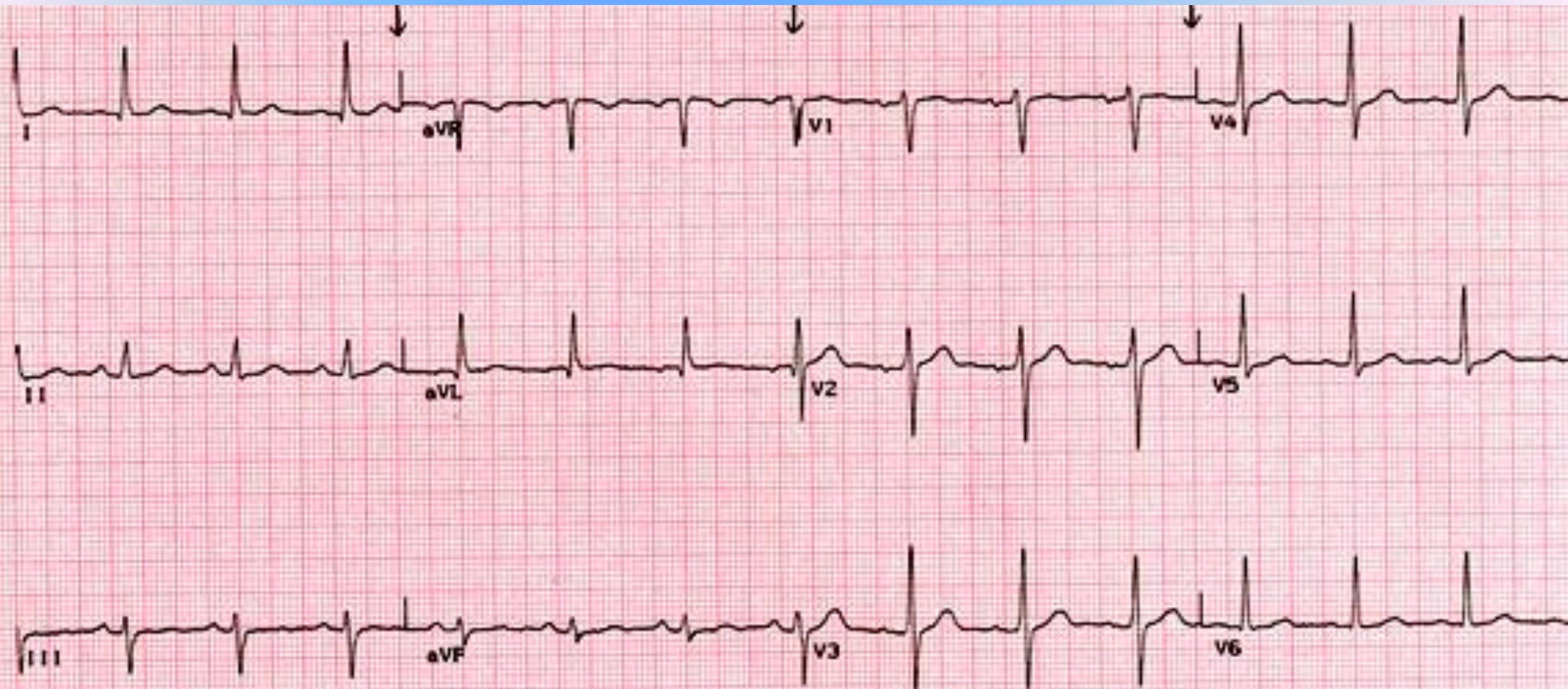
QRS Morphology



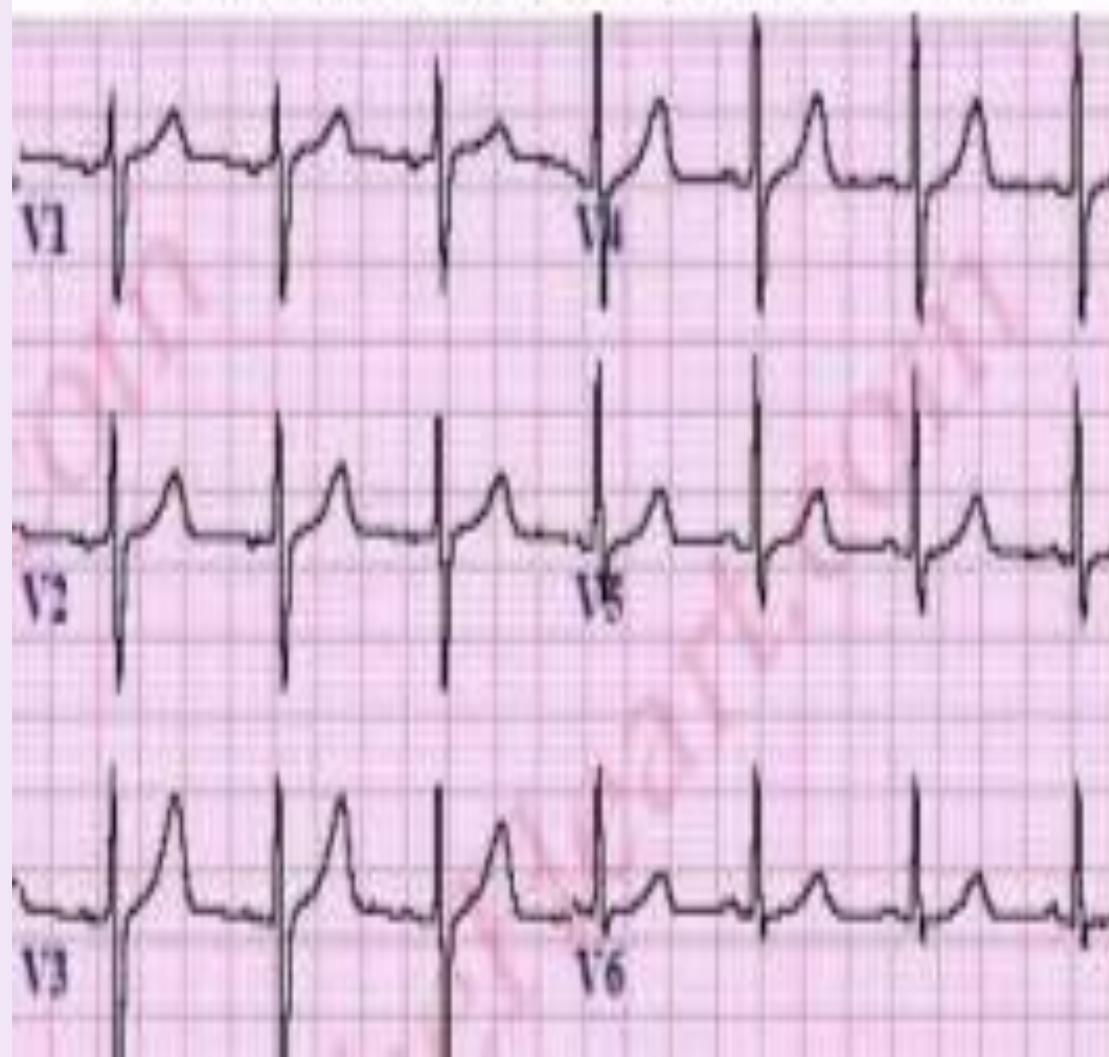
R Wave Progression



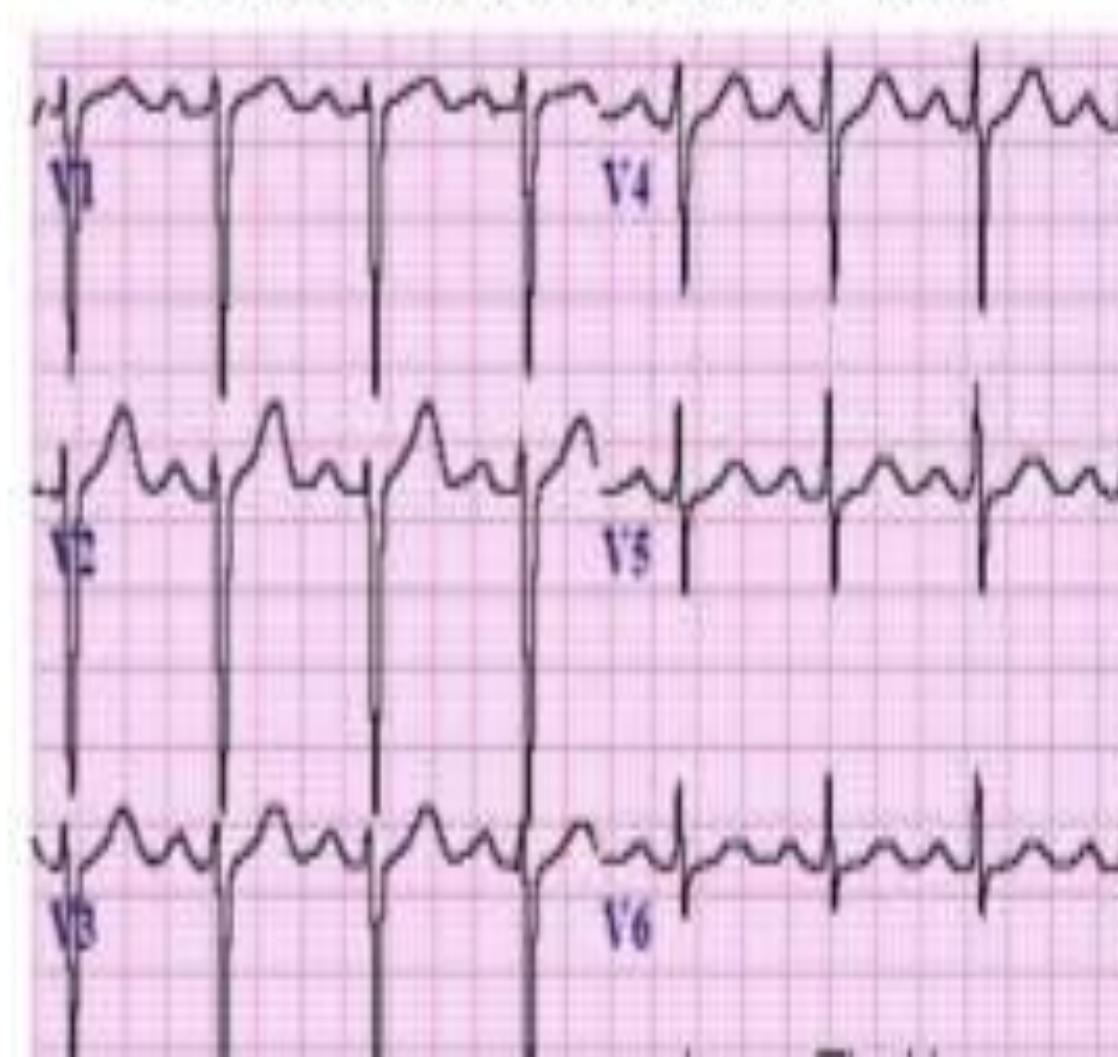
R Progression

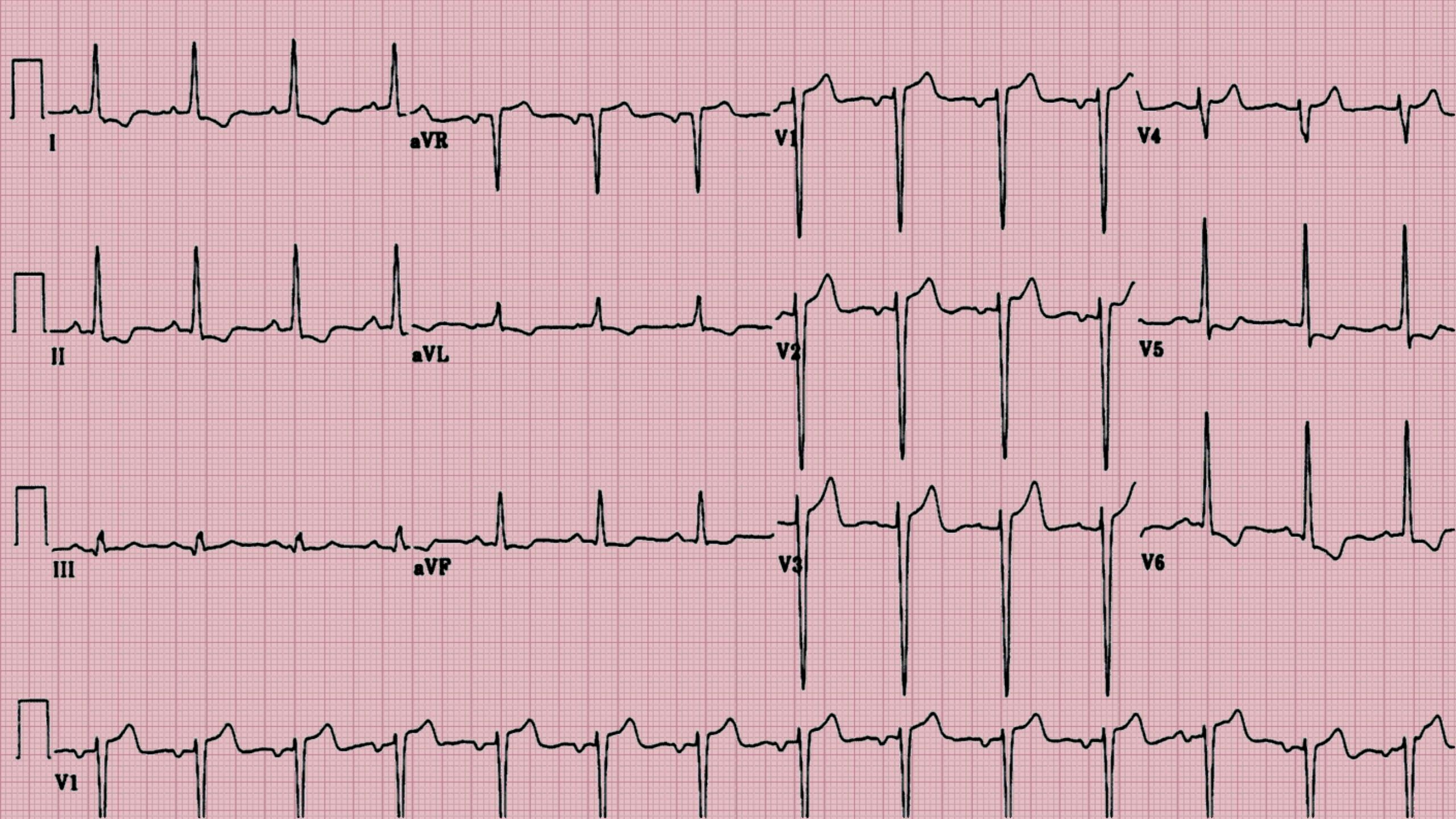


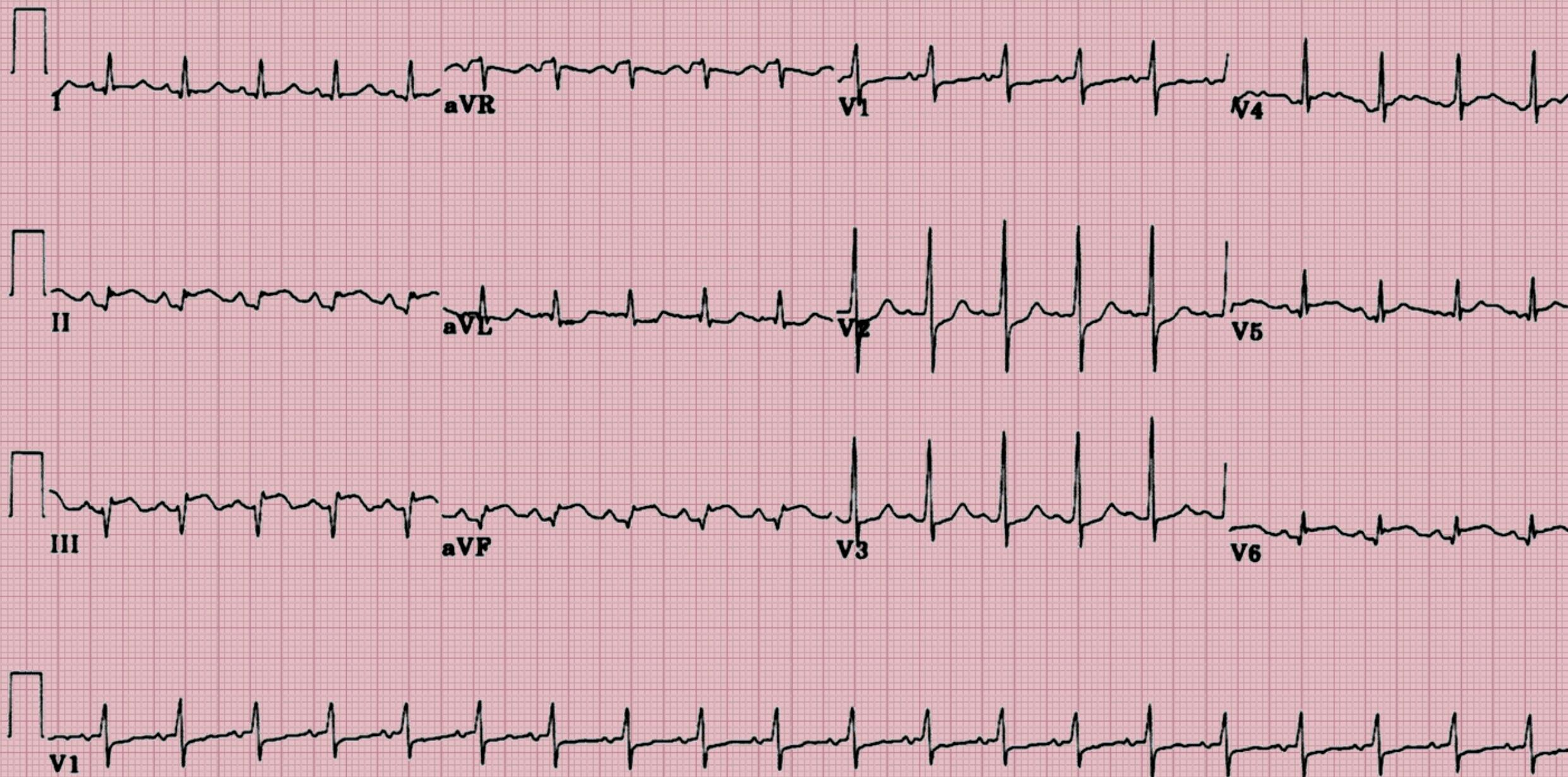
Normal R wave progression



Poor R wave progression



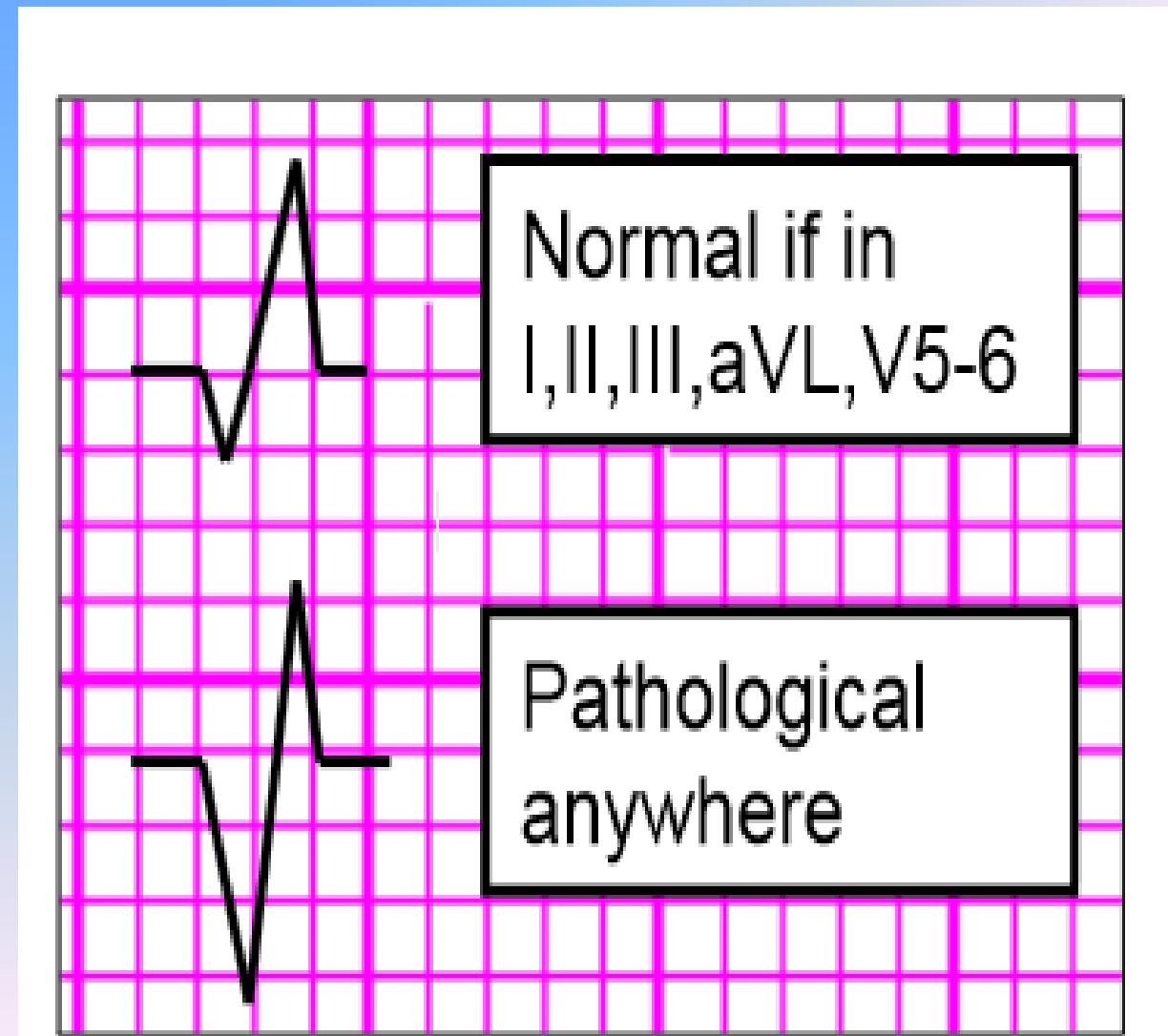


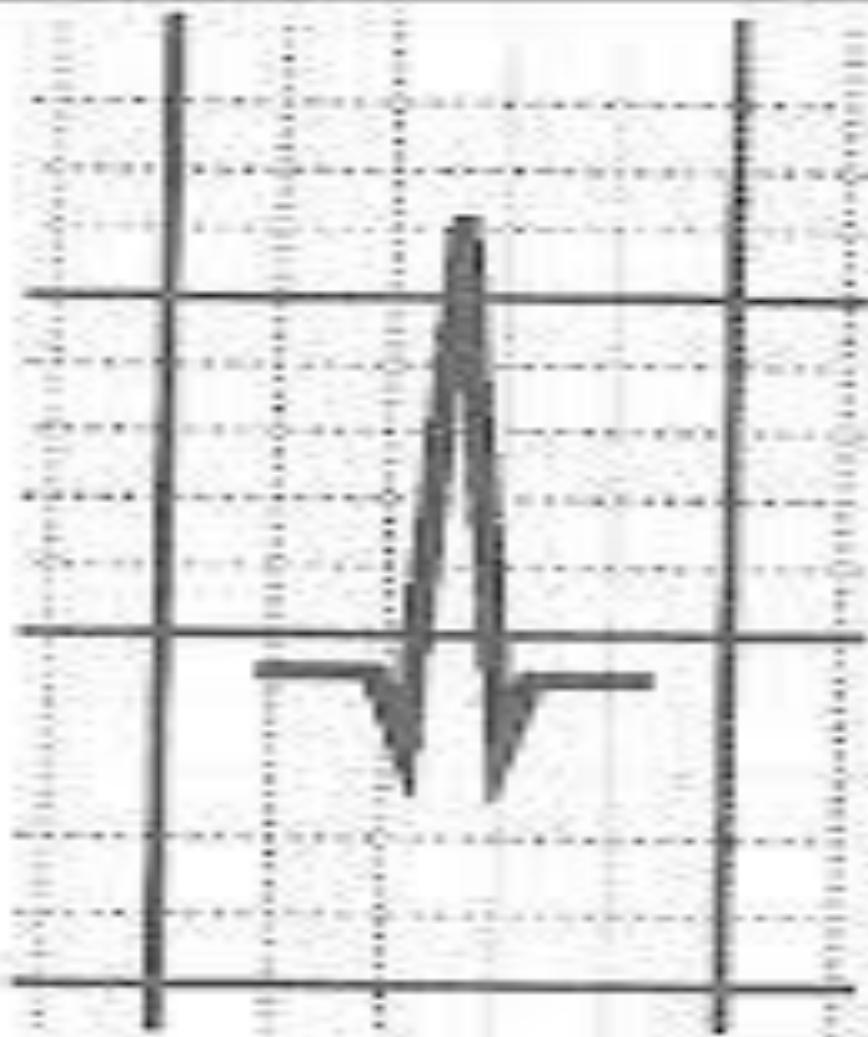


25mm/s 10mm/mV 100Hz 005A 12SL 78 CID: 10

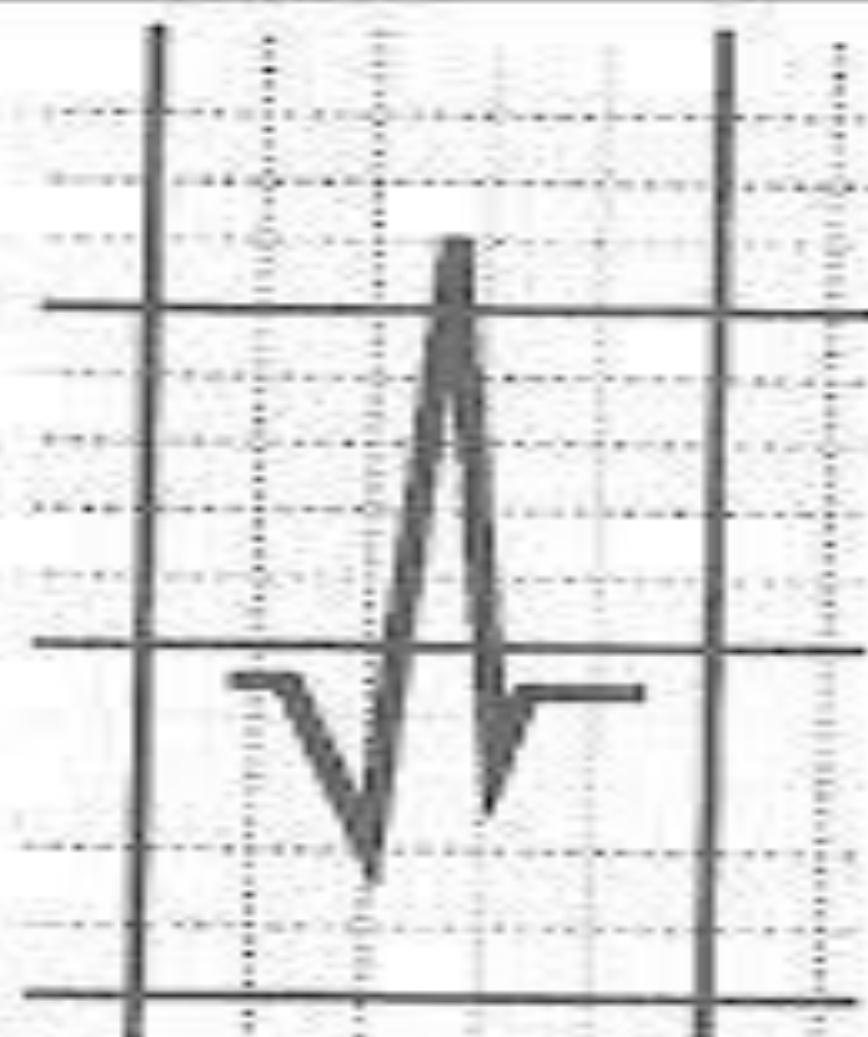
EID:204 EDT: 15:41 23-NOV-1993 ORDER:

Q Wave

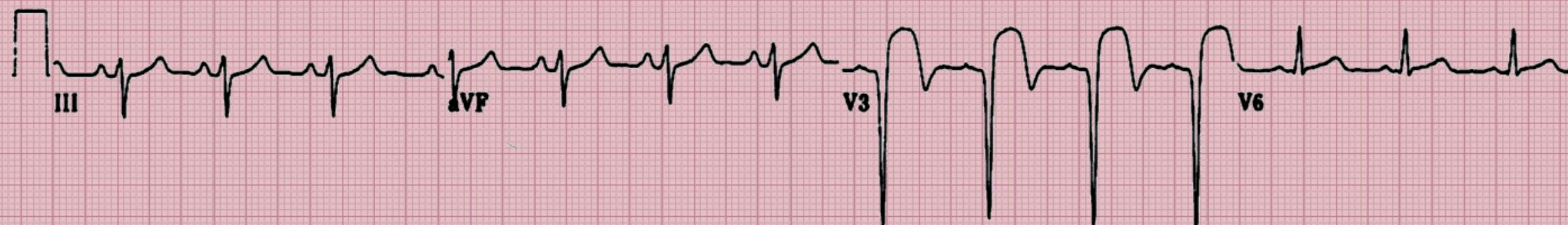




Non-pathologic
Q wave

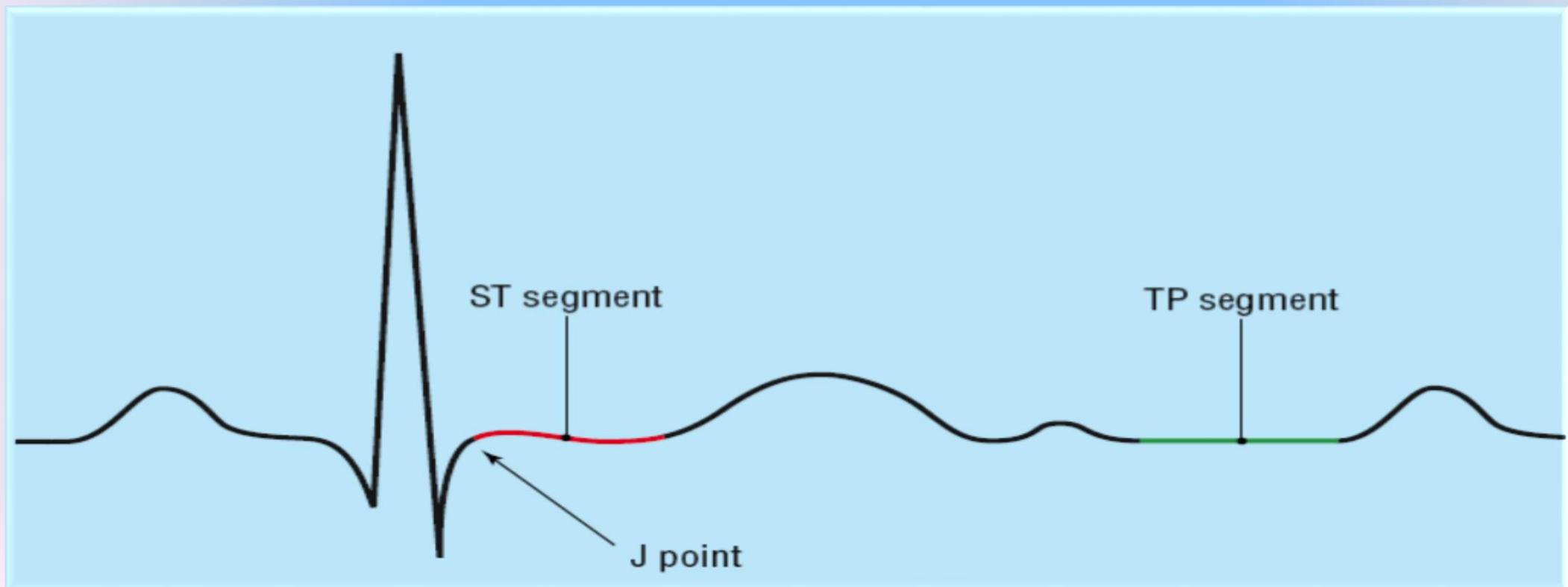


Pathologic
Q wave

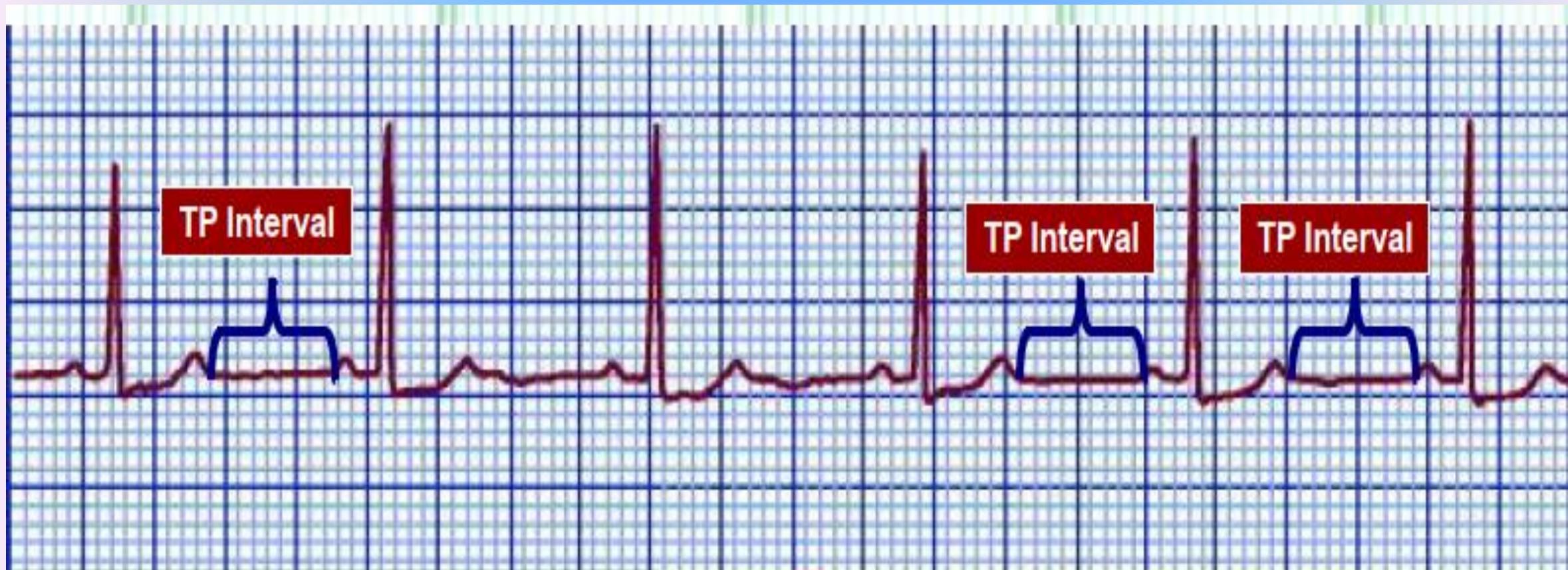


ST Segment

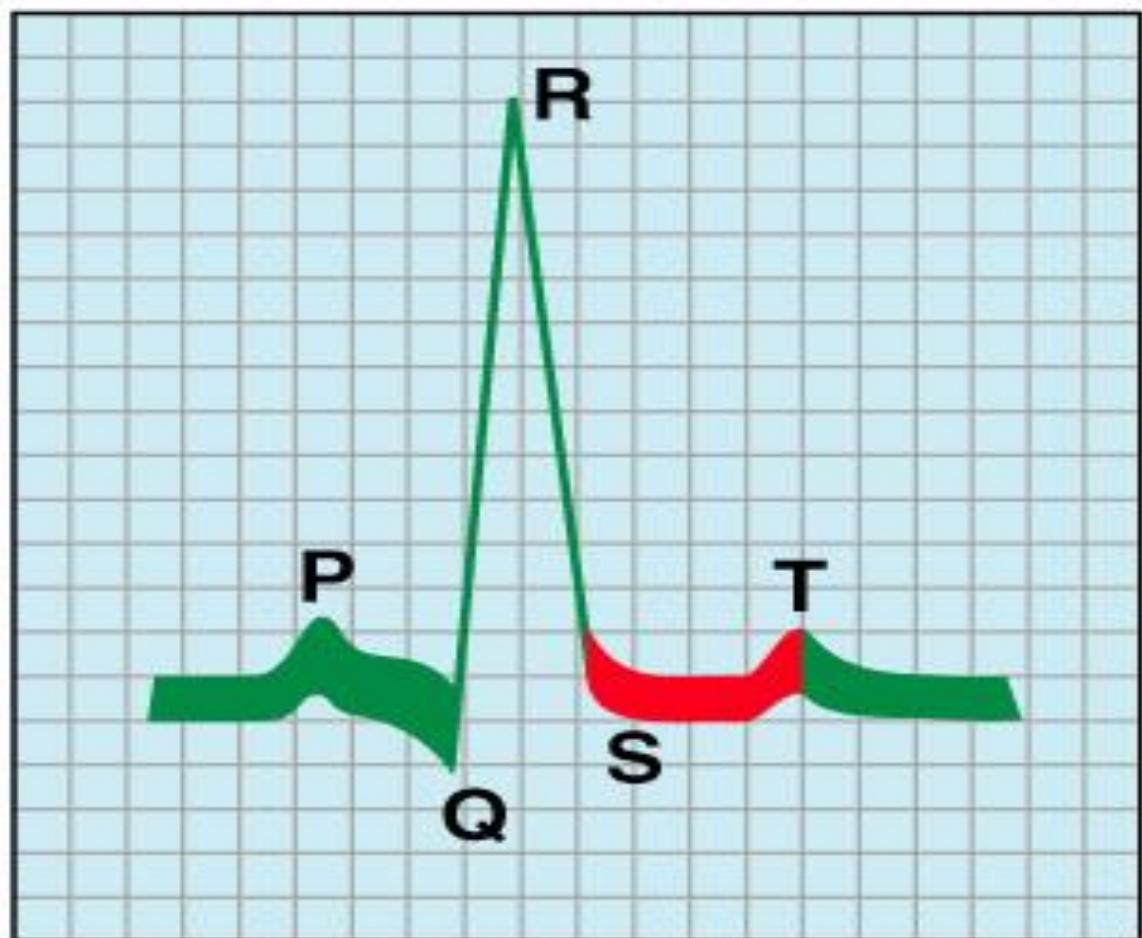
Duration: Max 0.20 Sec.



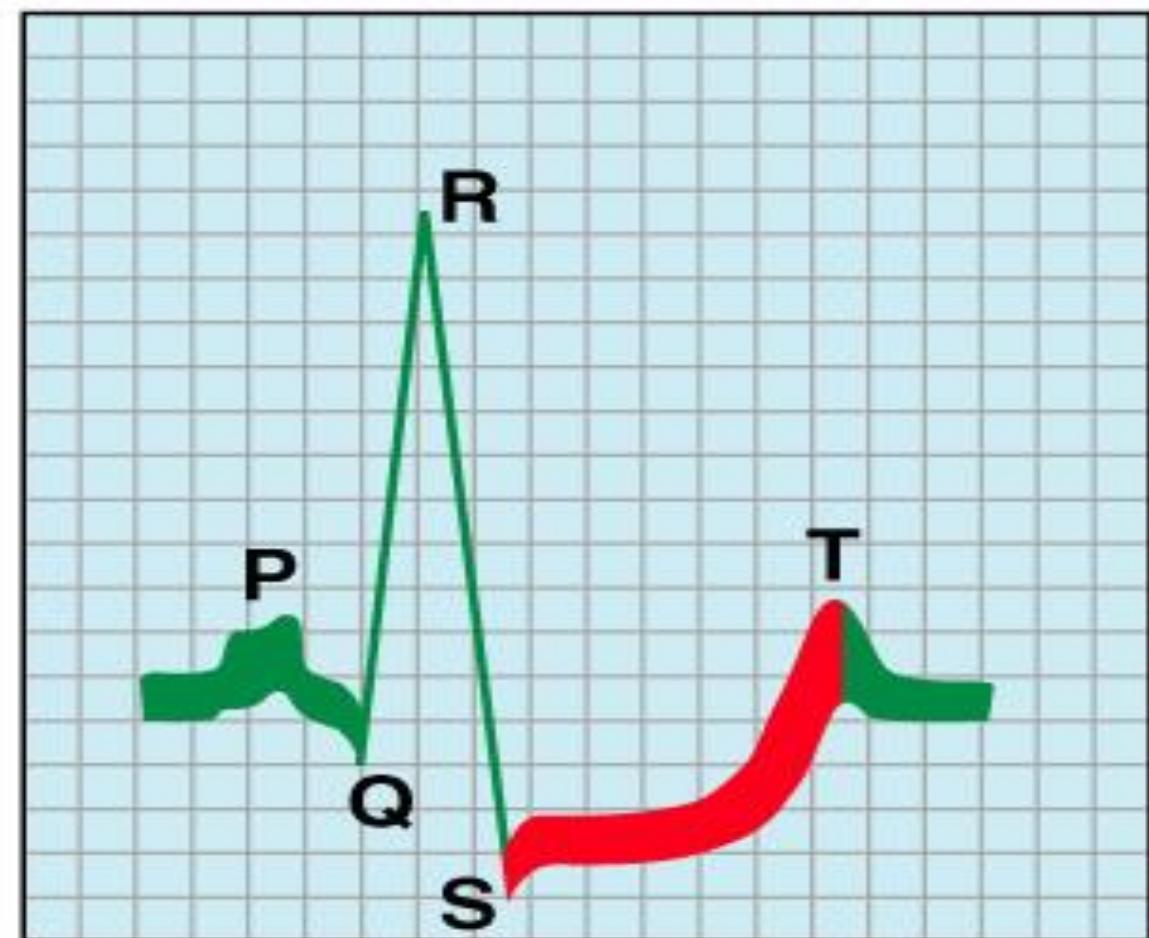
Isoelectric Line (TP interval)



ST Segment

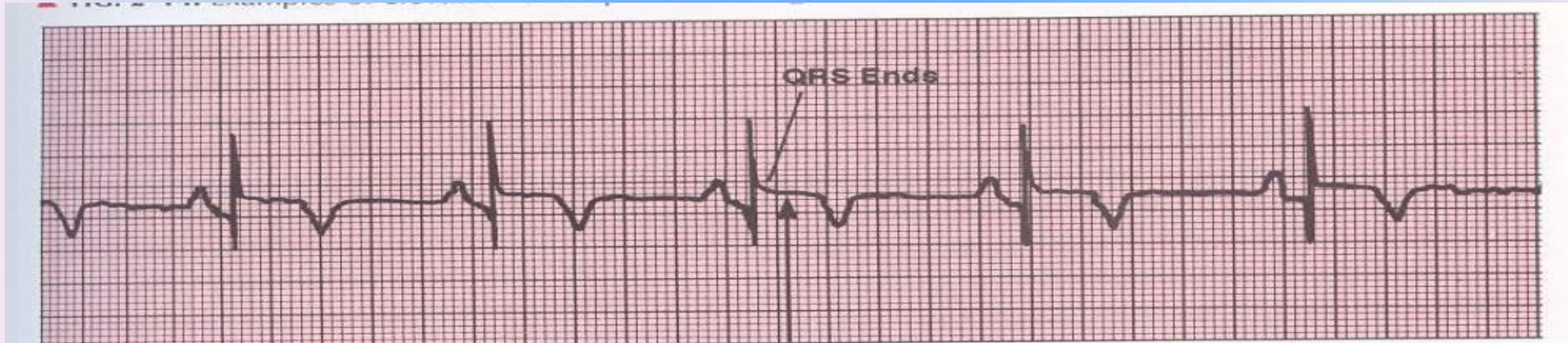


Normal



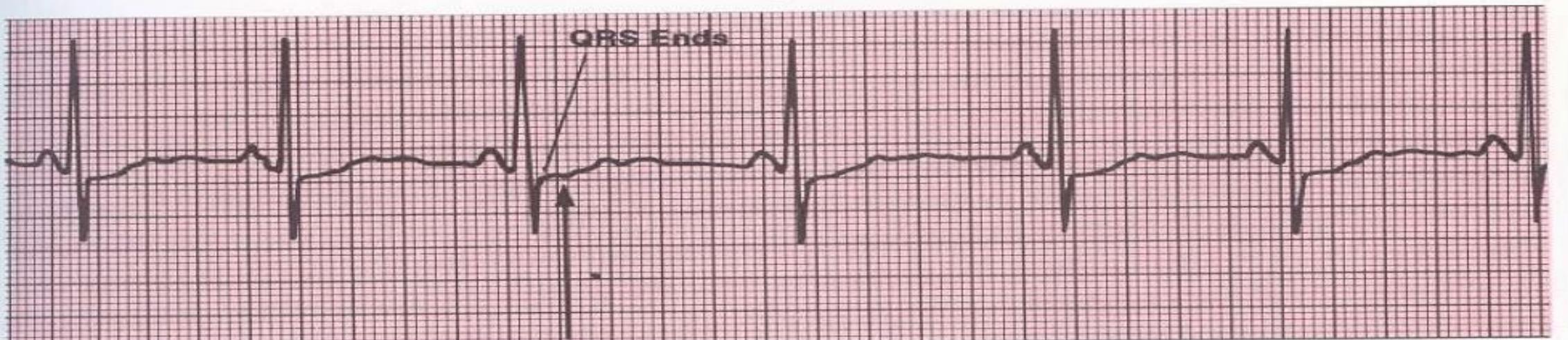
Ischemia

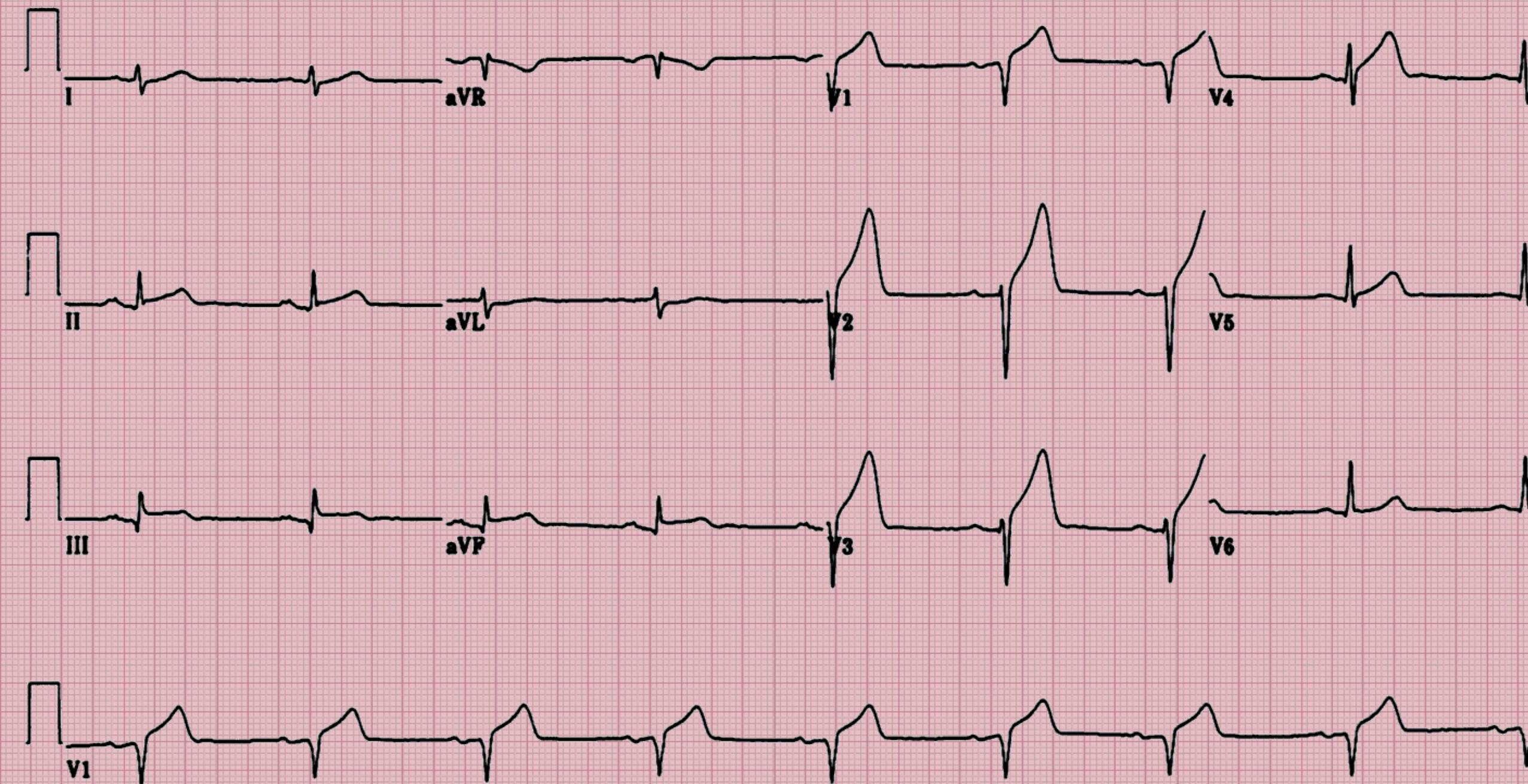
ST segment Change



A

Elevated ST
Segment







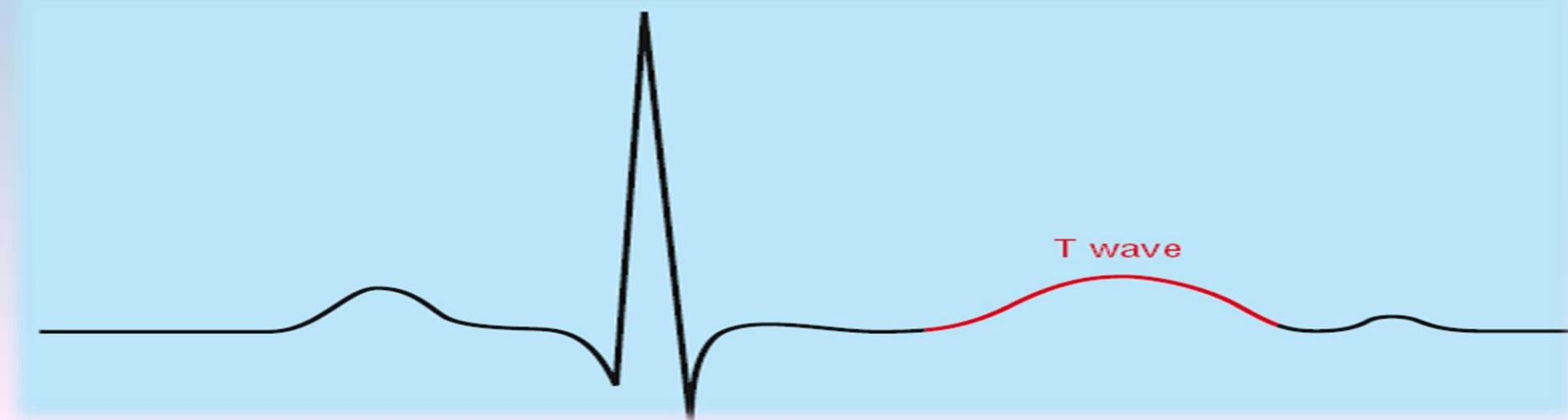
T Wave

ventricular repolarization

may be upright or inverted in leads III and aVL

T wave amplitude is normally less than 0.6 mV in all limb lead

And less than 9 mm precordial lead.

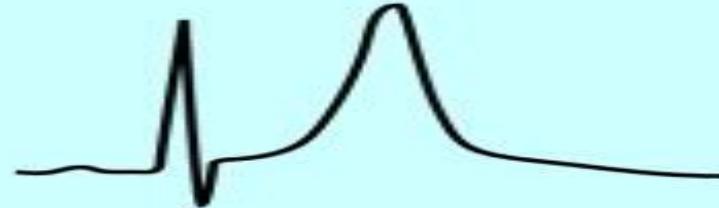


T wave changes

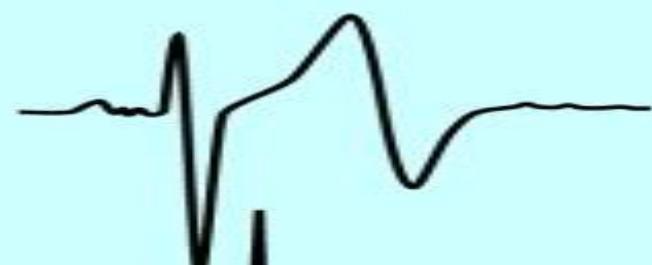
Normal



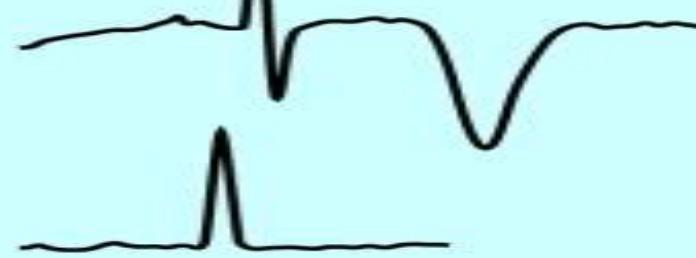
Tall T wave



Biphasic T wave



Inverted T wave



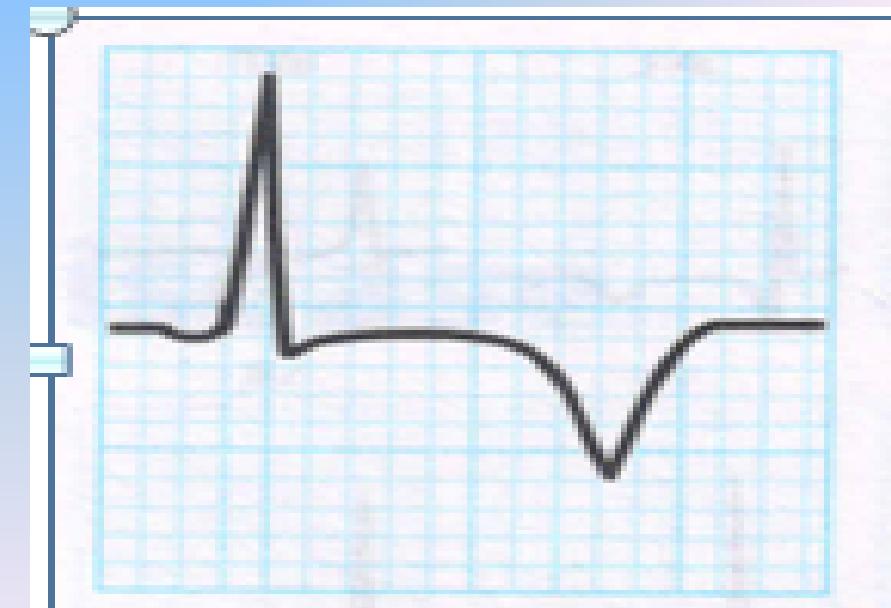
Flat T wave

Ischemic T Wave

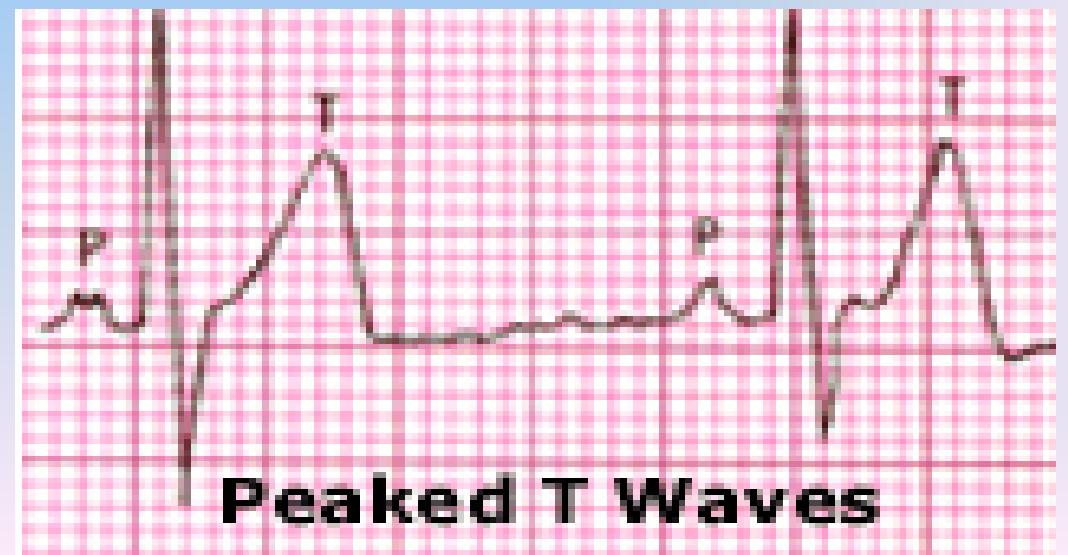
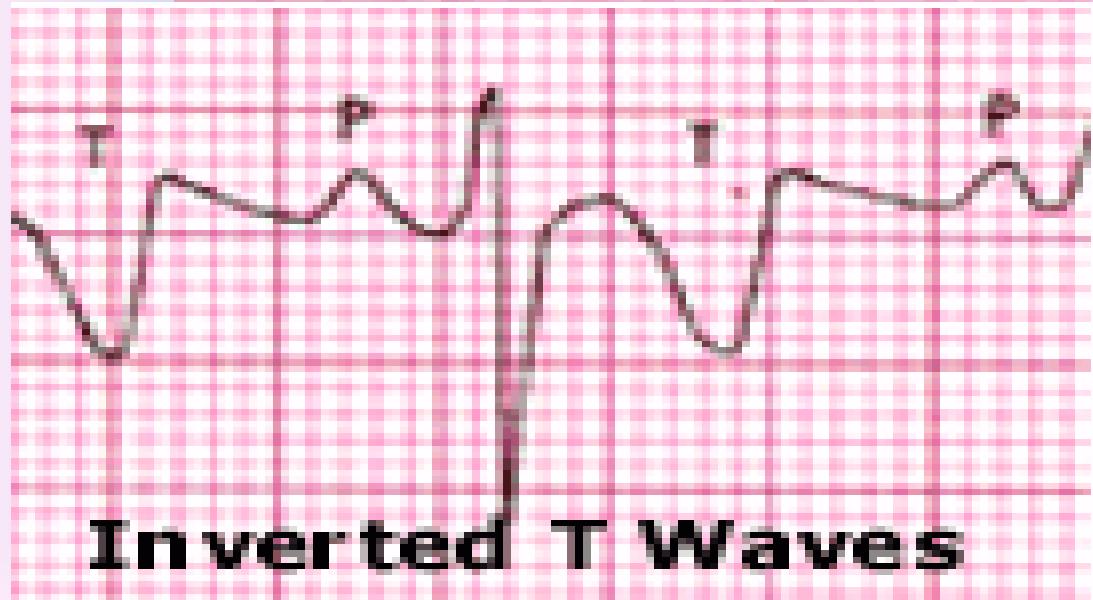
T waves that are deep and **symmetrically** inverted (arrowhead) strongly suggest myocardial ischaemia.

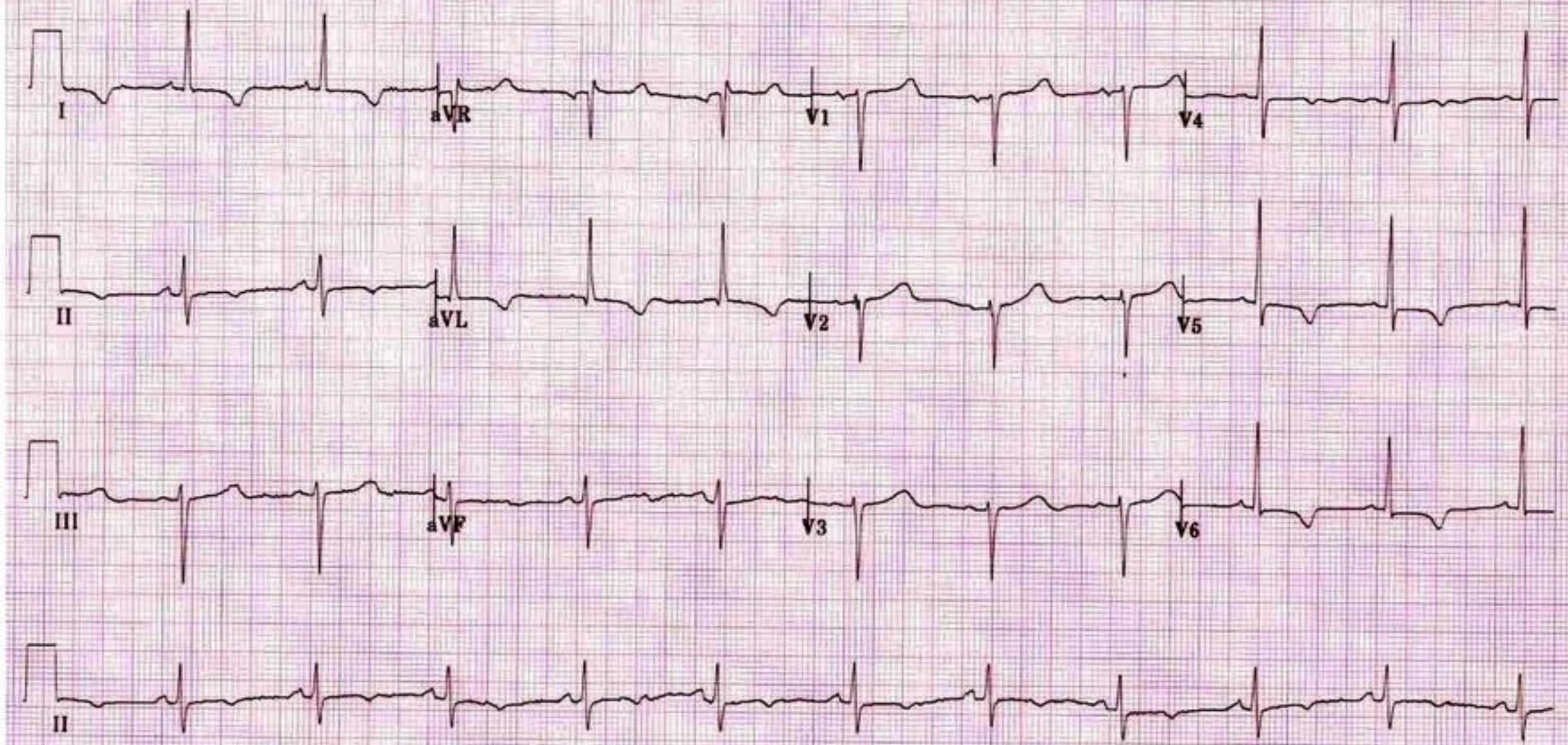
At least 1 mm deep

Present in ≥ 2 continuous leads that have



T Change





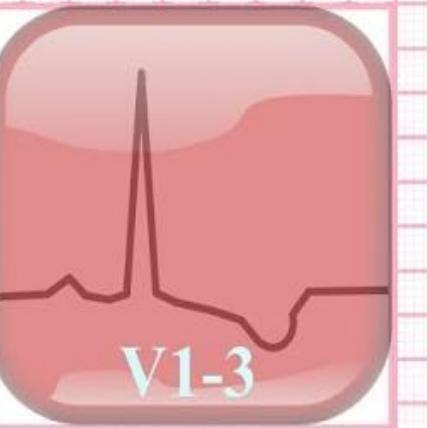
ST depression & T wave inversion causes



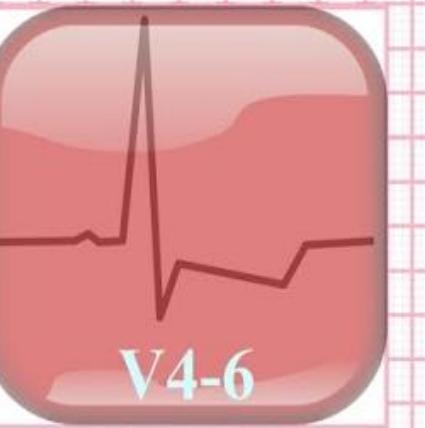
LVH with strain



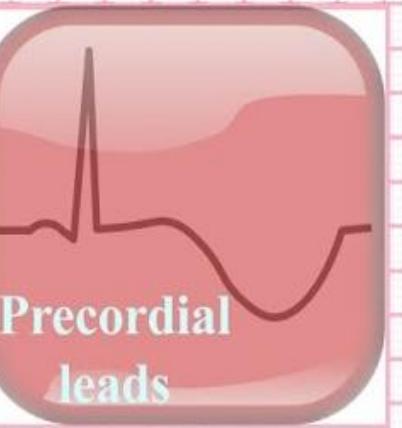
WPW with pre-excitation



RVH



Digitalis



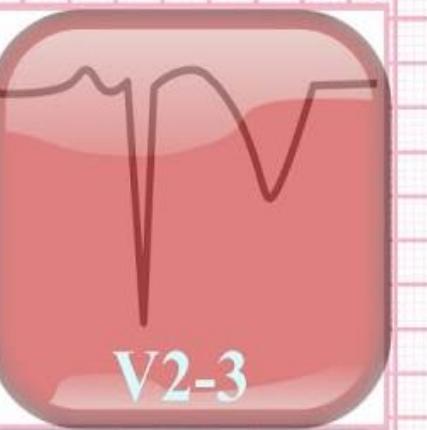
Subarachnoid Hemorrhage/CVA



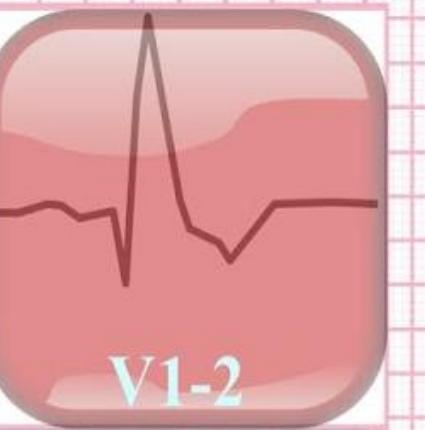
Posterior STEMI



Ischemia



Ischemia

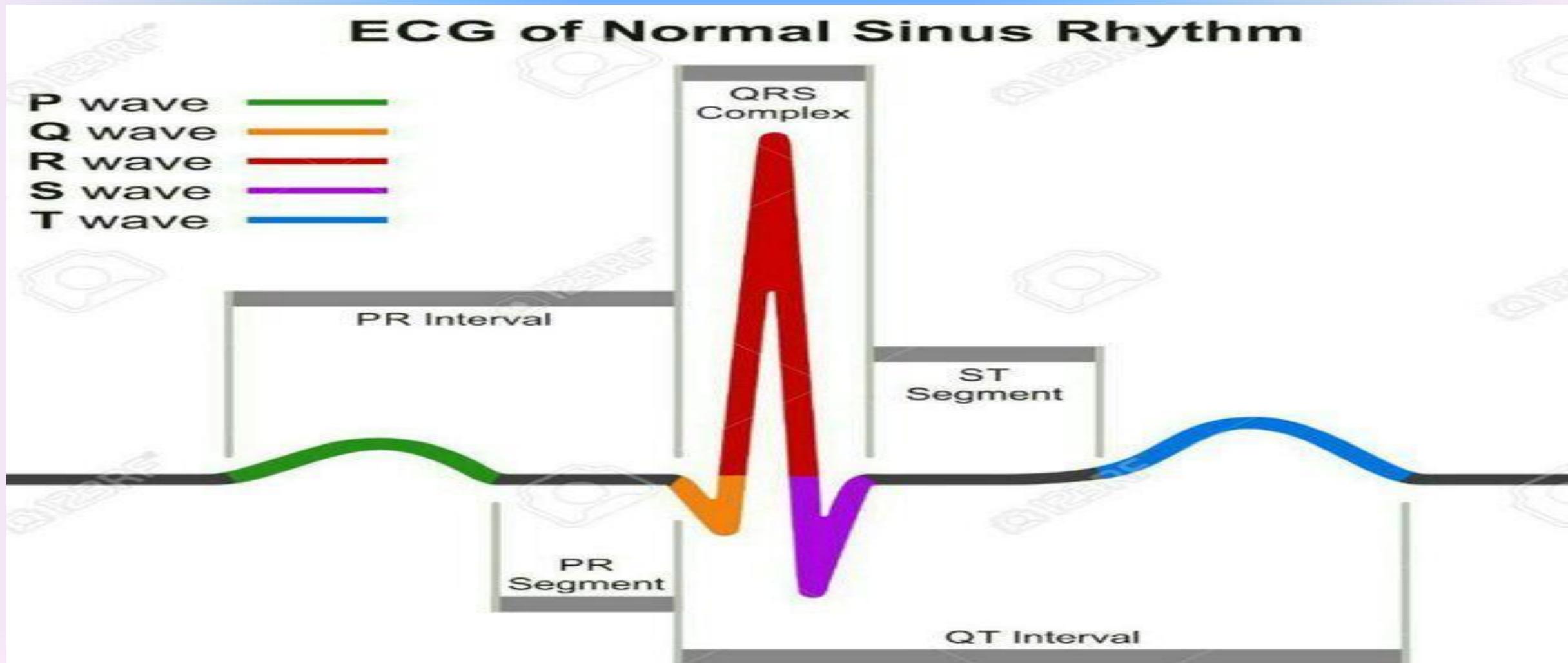


RBBB



LBBB

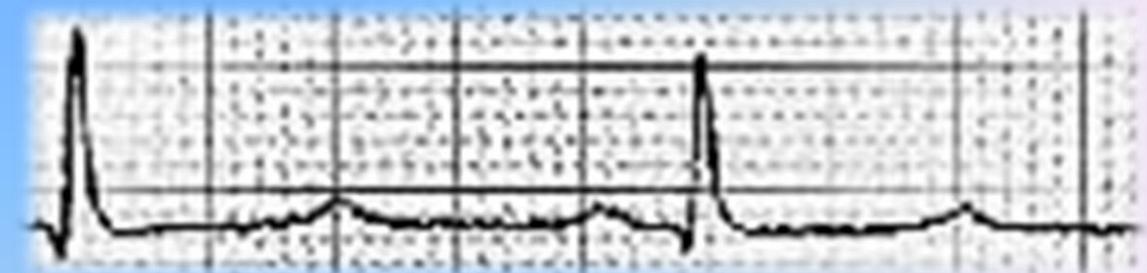
QT Interval



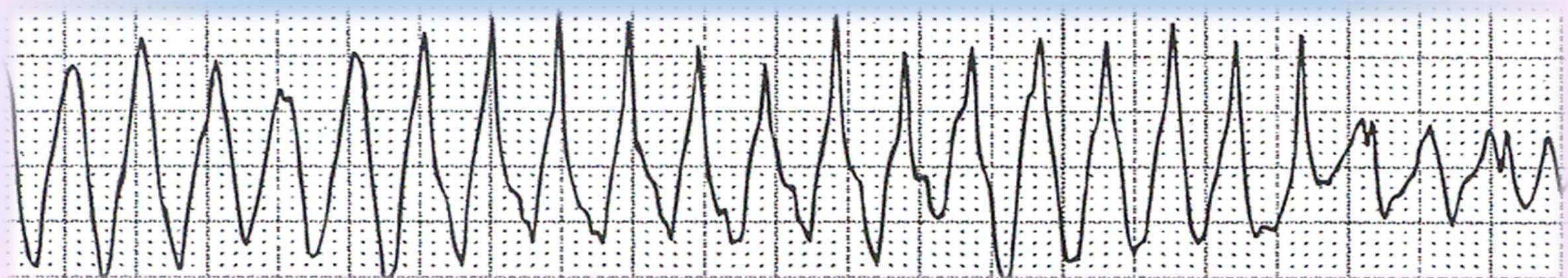
QT Interval

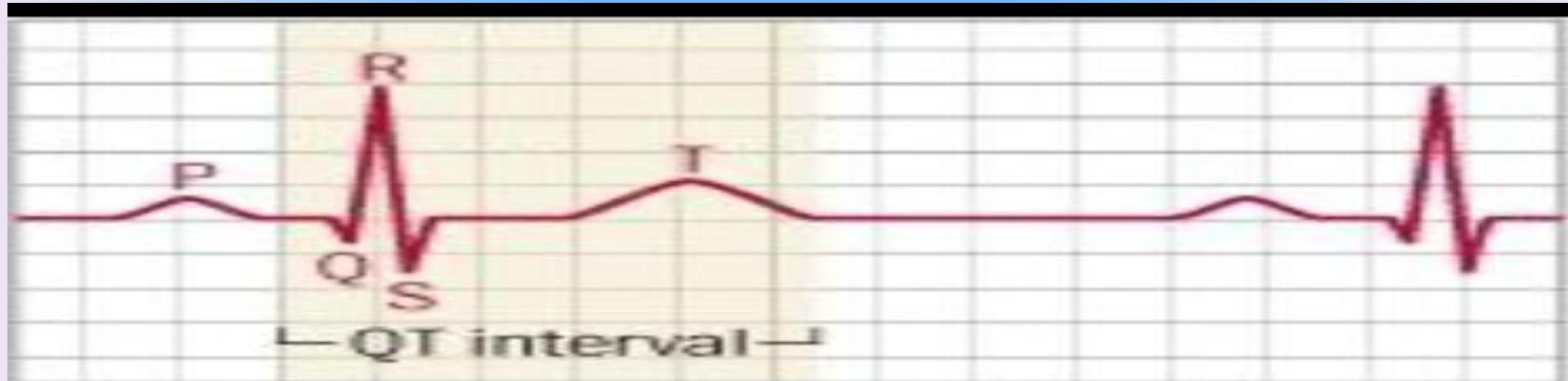
Long QT

$< 0.36 \text{ s}$	$> 0.44 \text{ s}$
Normal	Long QT

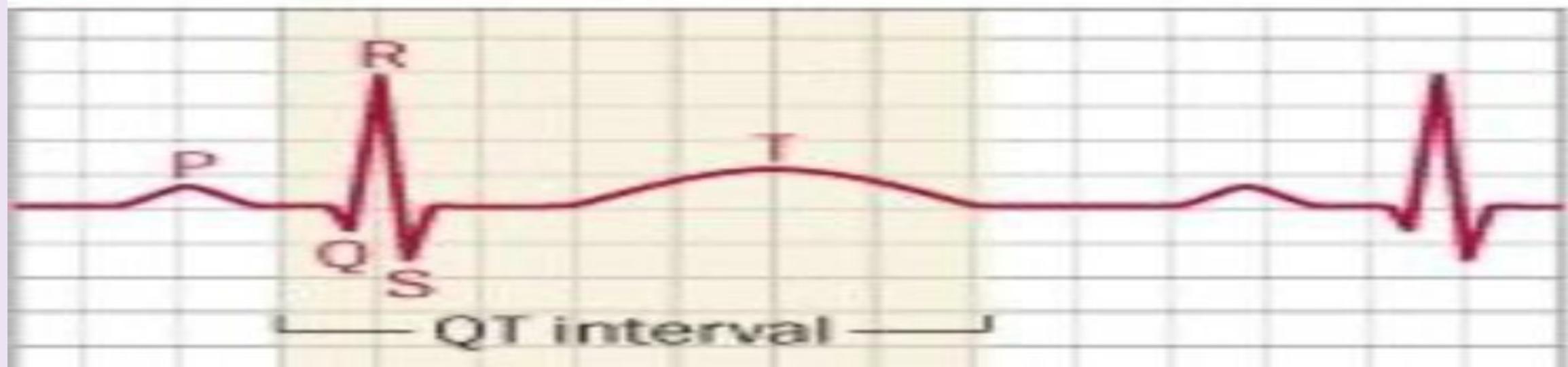


Torsade de Pointes



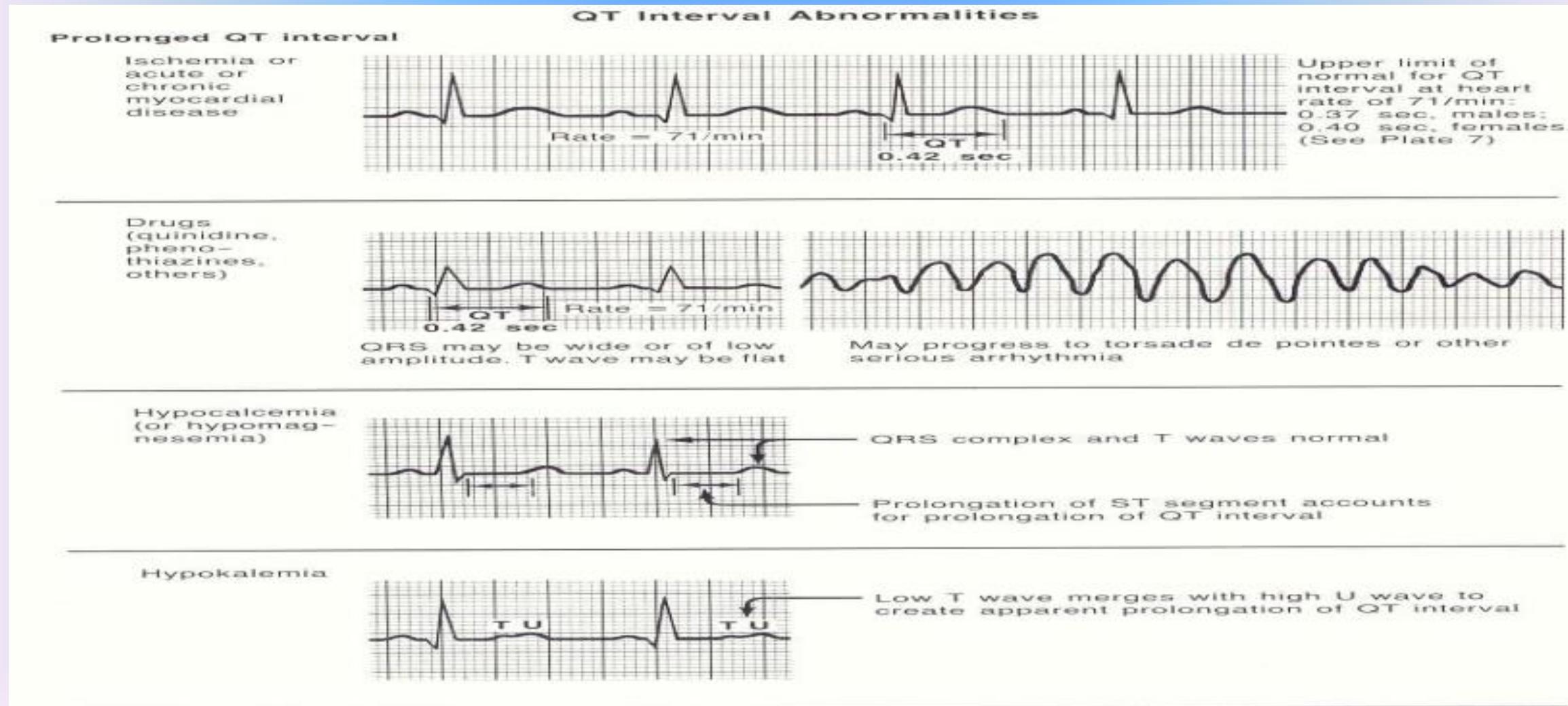


Normal



Long QT syndrome

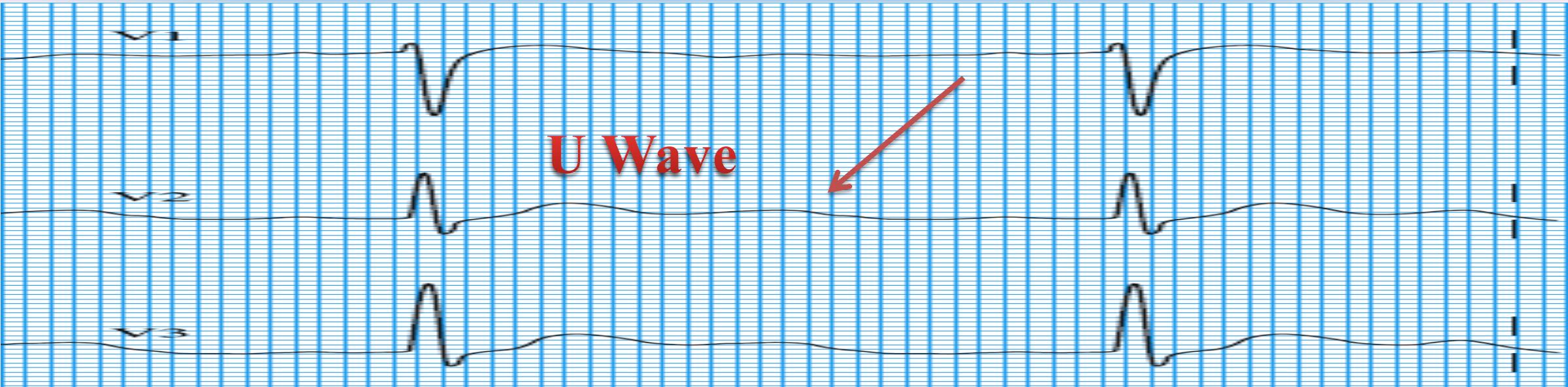
QT interval Abnormalities

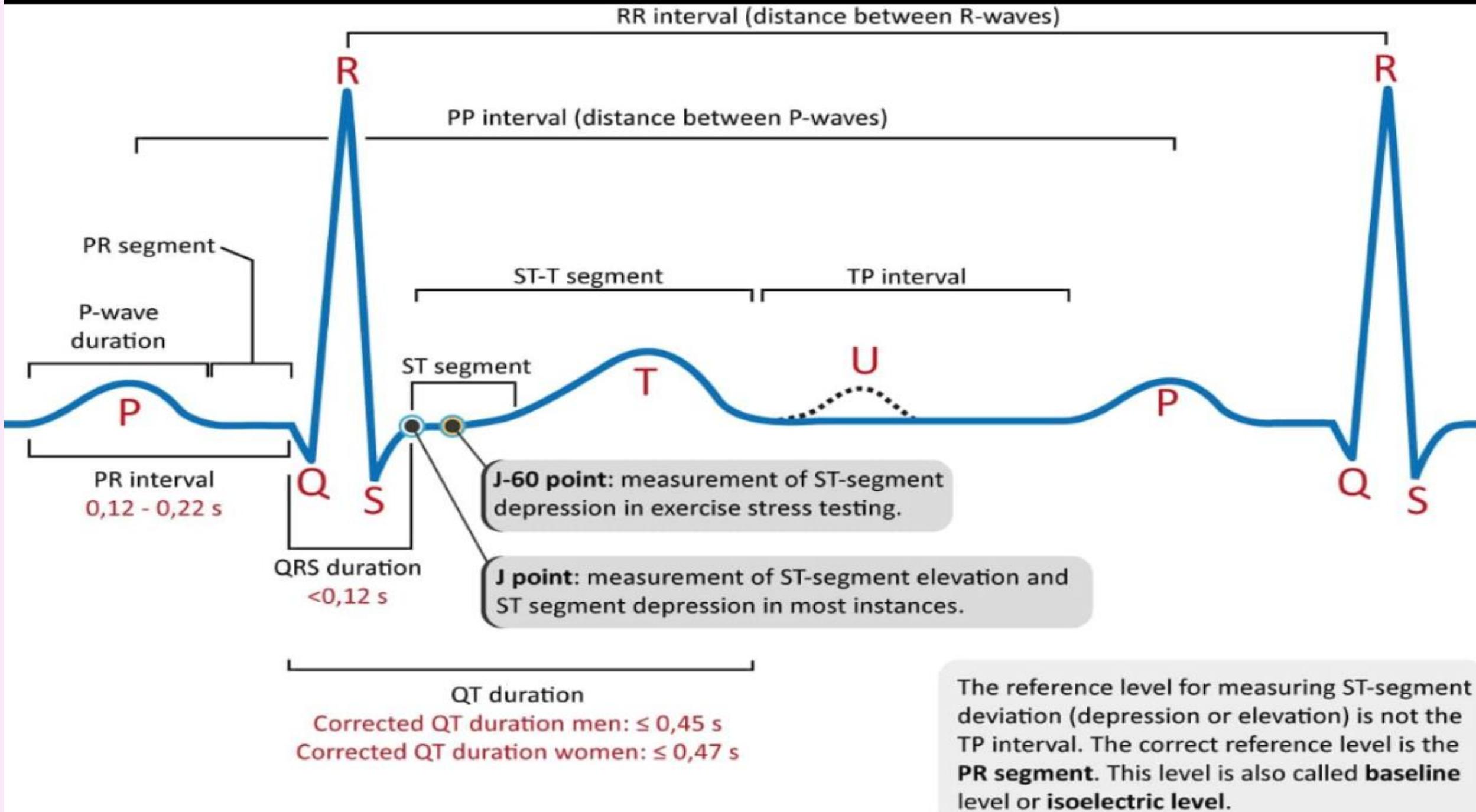


U Wave

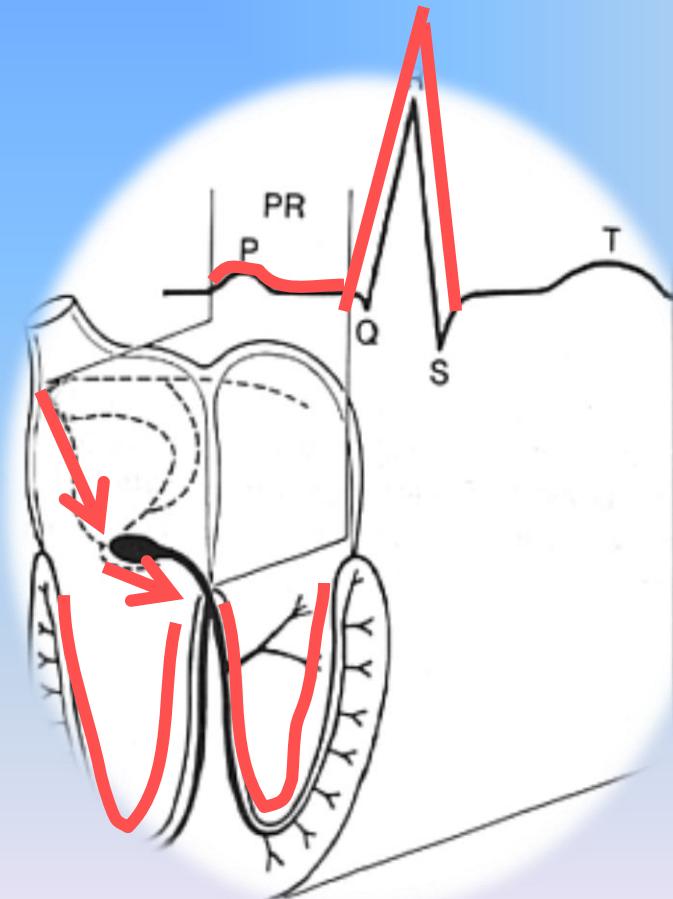
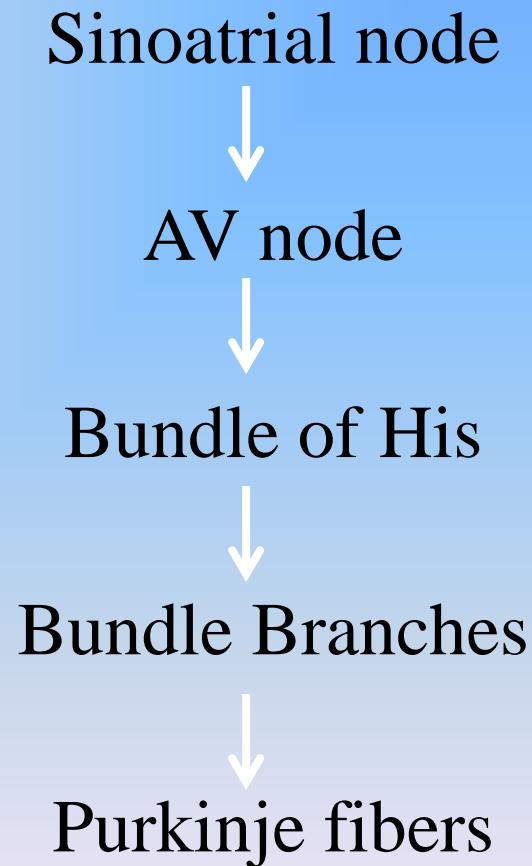
U wave measures 90 to 110 ms.

hypokalemia and hypercalcemia

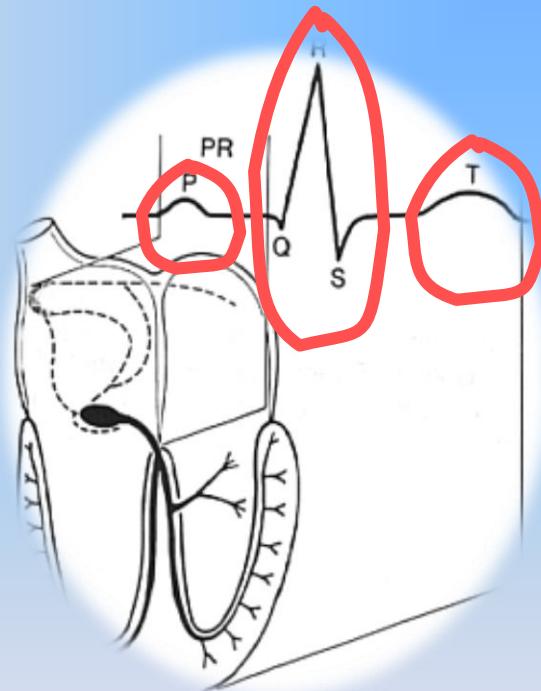




Impulse Conduction & the ECG



PQRST

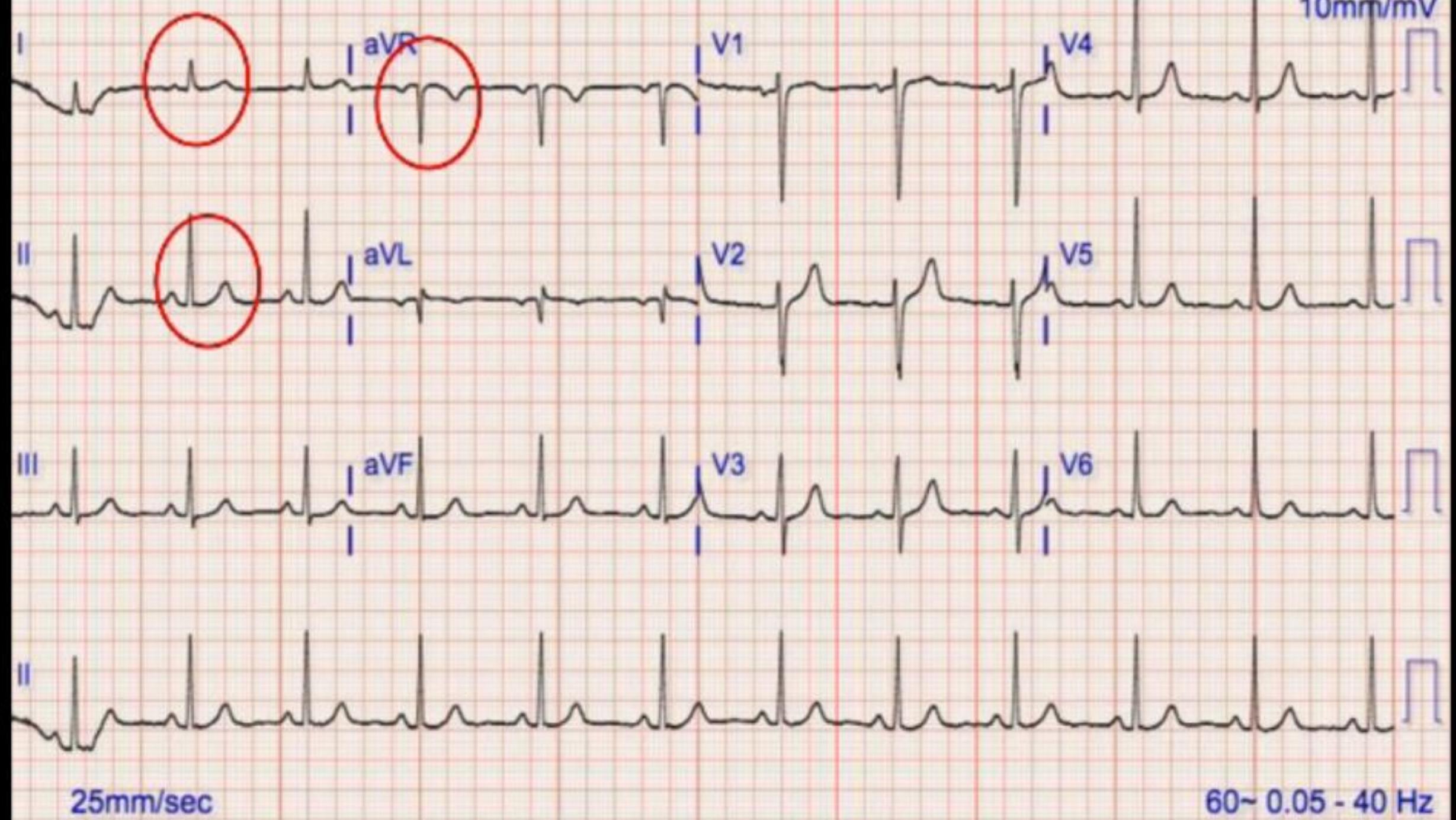


P wave : Atrial depolarization

QRS : ventricular depolarization

T wave : ventricular Repolarization

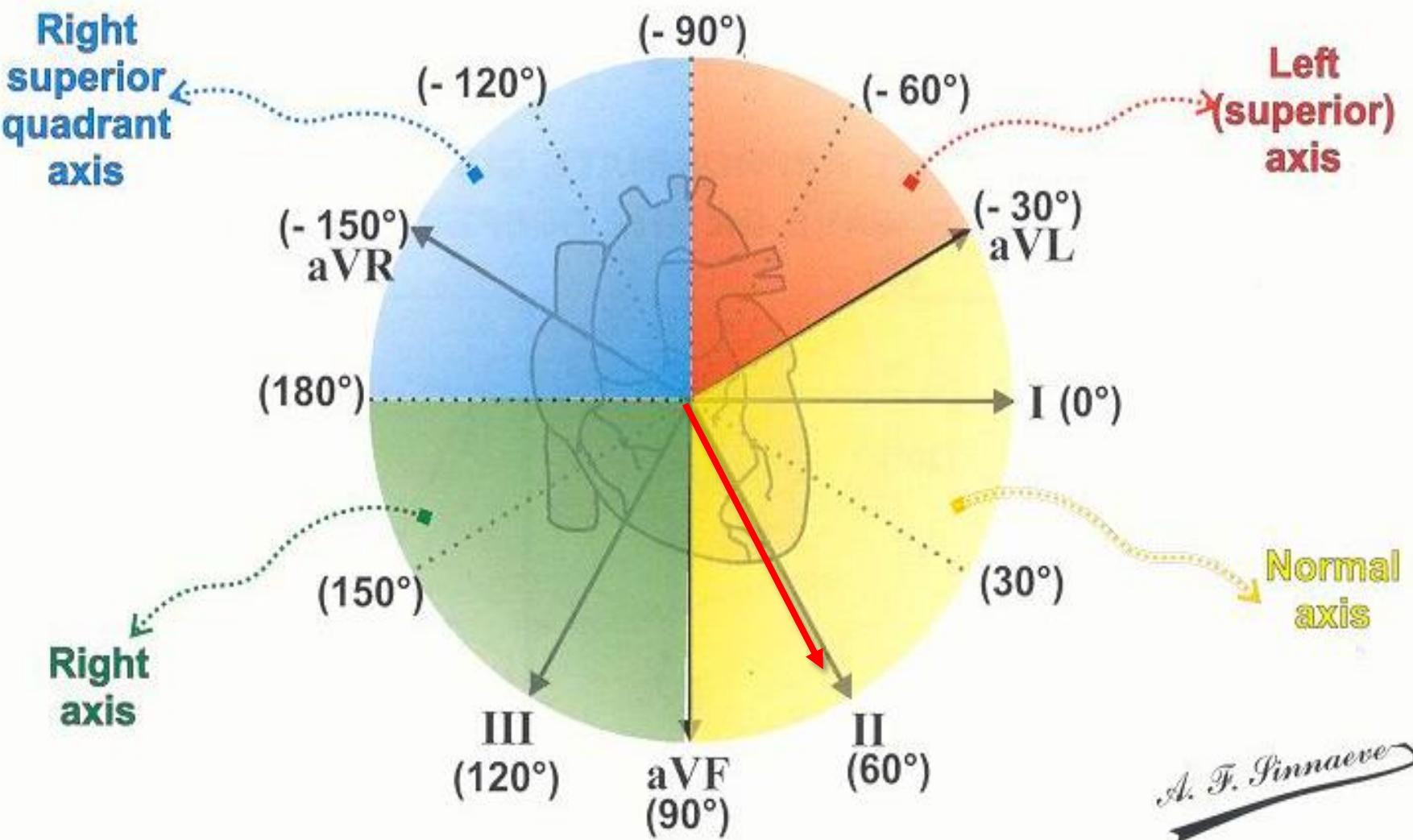
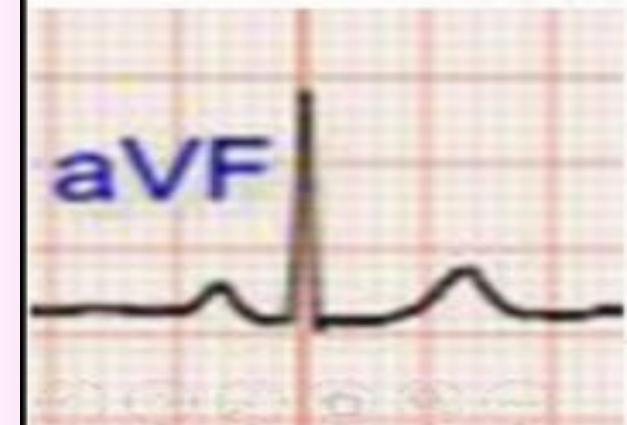
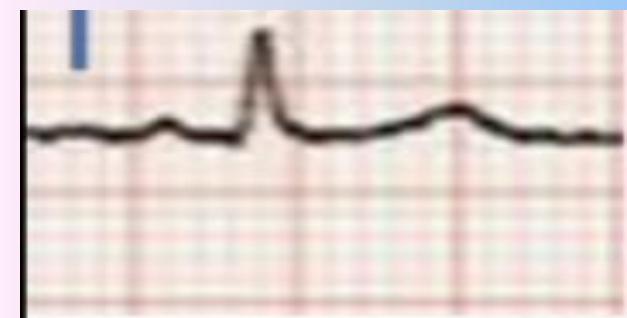
10mm/mV



25mm/sec

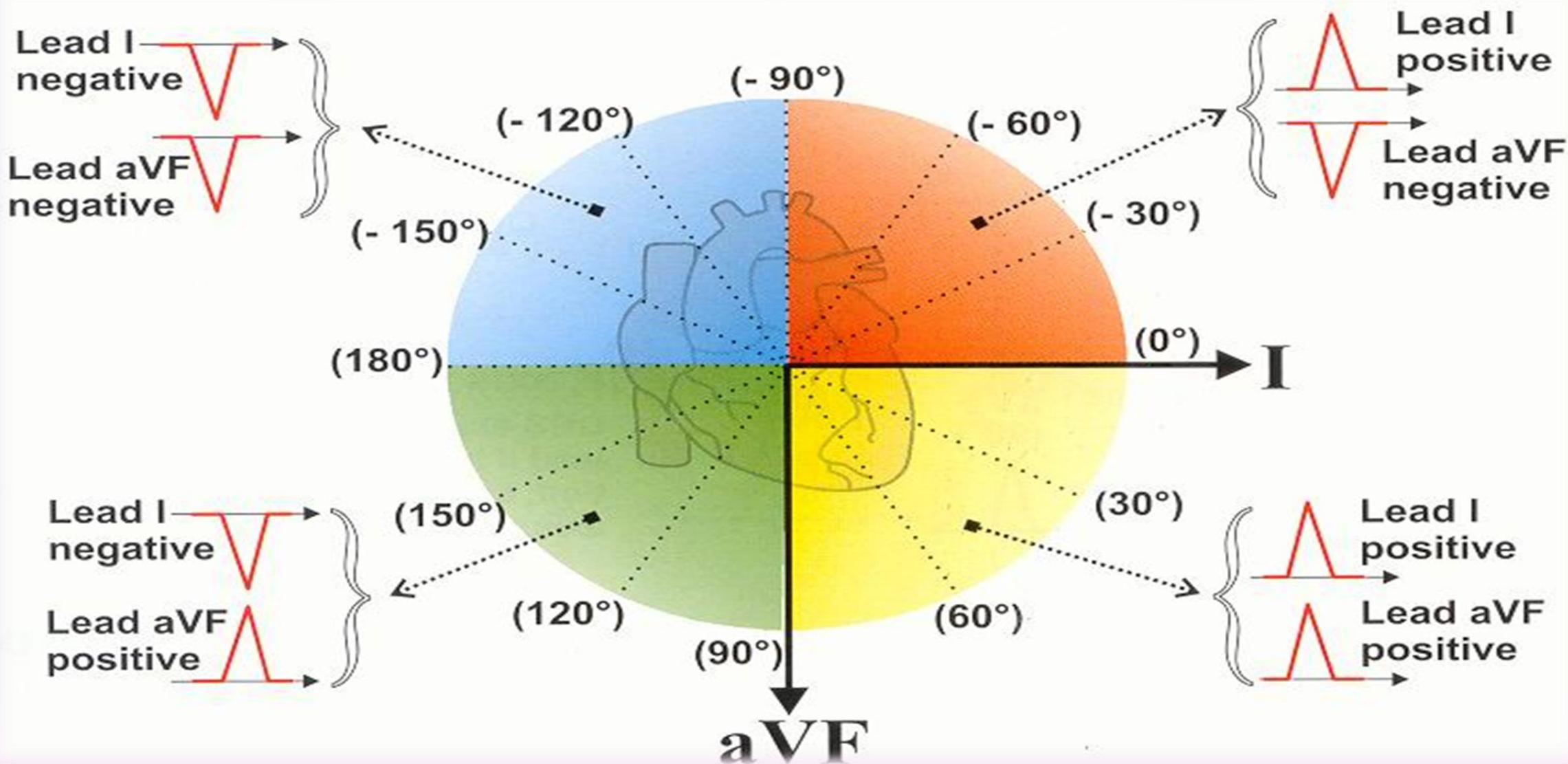
60~ 0.05 - 40 Hz

Vector Concept

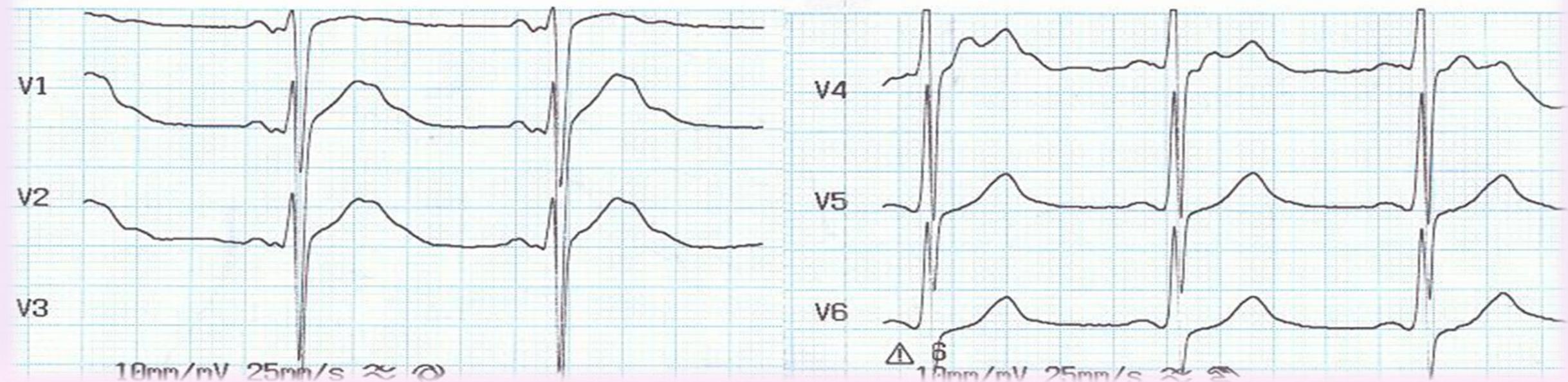
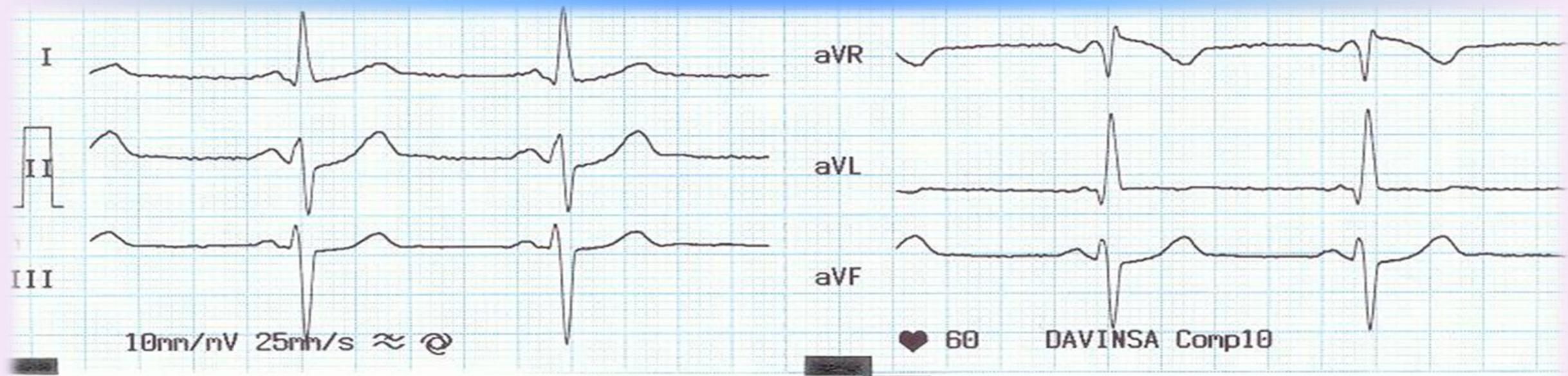


A. F. Sinnaeve

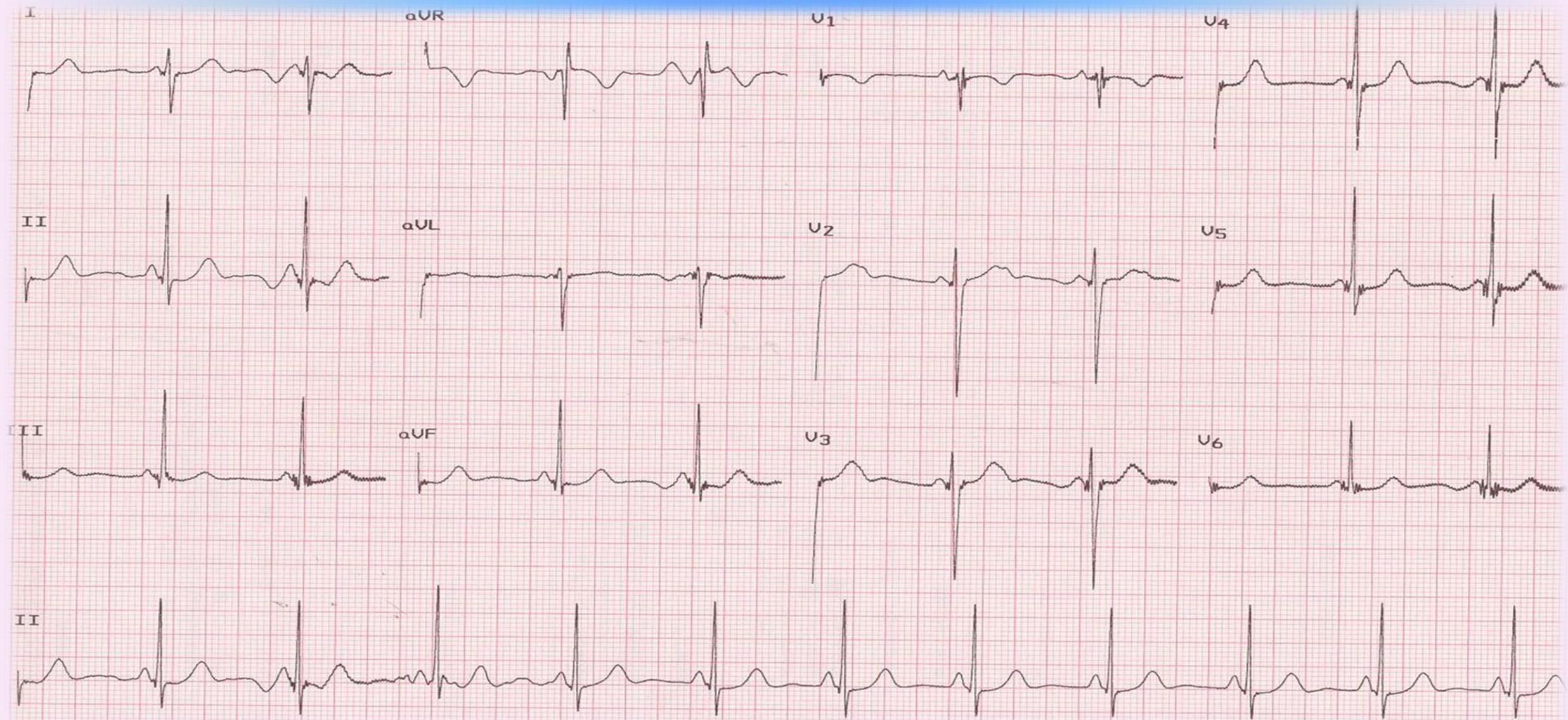
QRS Axis



Left Axis Deviation



Right Axis Deviation



Summary

Axis	I	AVF
Normal	+	+
LAD	+	-
RAD	-	+
Undeterminate	-	-

Rhythm Analysis

Step 1: Determine regularity

Step 2: Calculate rate

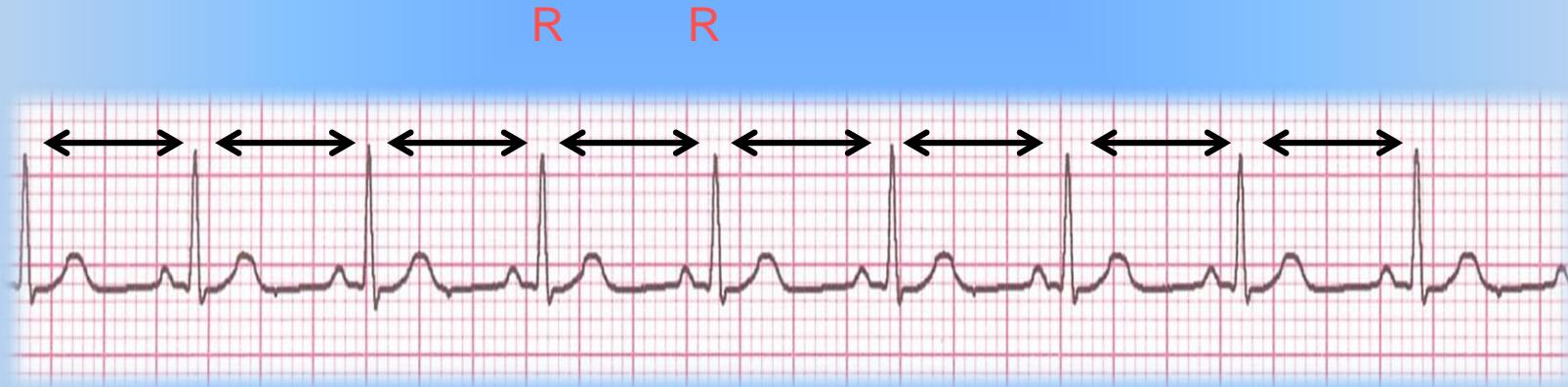
Step 3: Assess the P waves

Step 4: Determine PR interval

Step 5: Determine QRS duration

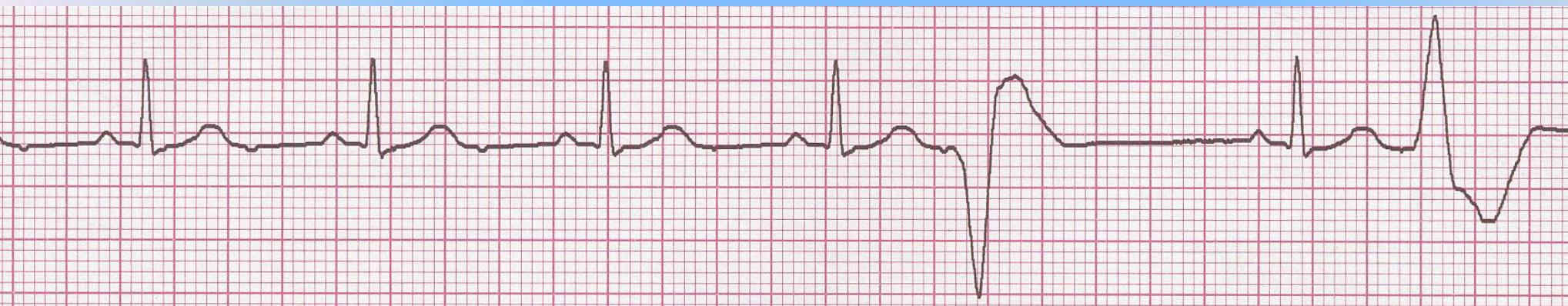


Determine regularity

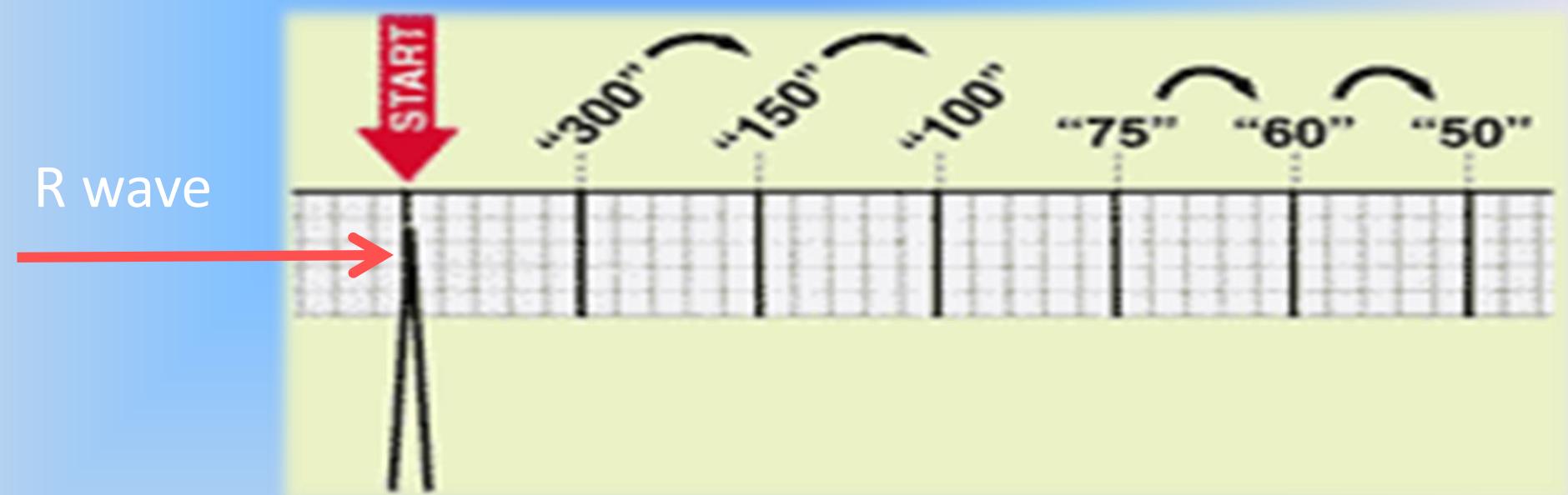


1. Regular
2. Regularly irregular
3. Irregularly irregular?

Interpretation? *Regular*



Step 1: Calculate Rate



If the second R wave is 1 large box away the rate is 300

2 boxes – 150

3 boxes – 100

4 boxes – 75

5- etc. (cont)

Calculate Rate



– Memorize the sequence:

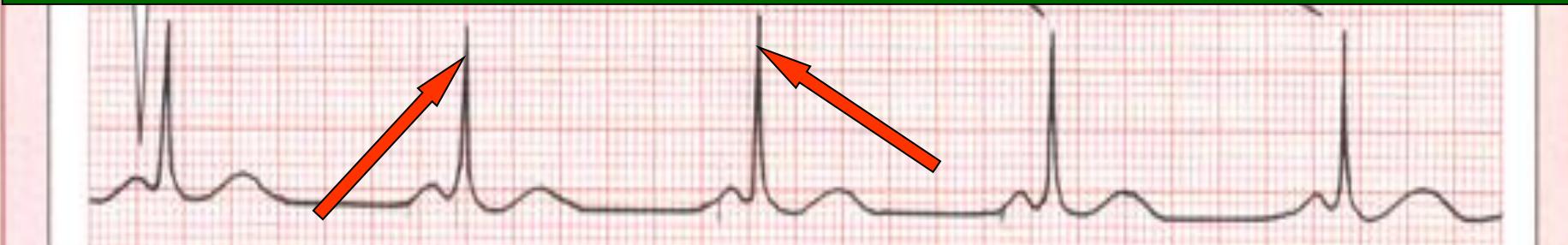
300 - 150 - 100 - 75 - 60 - 50

Interpretation?

*Approx. 1 box less than 100
= 95 bpm*

۱۵۰۰

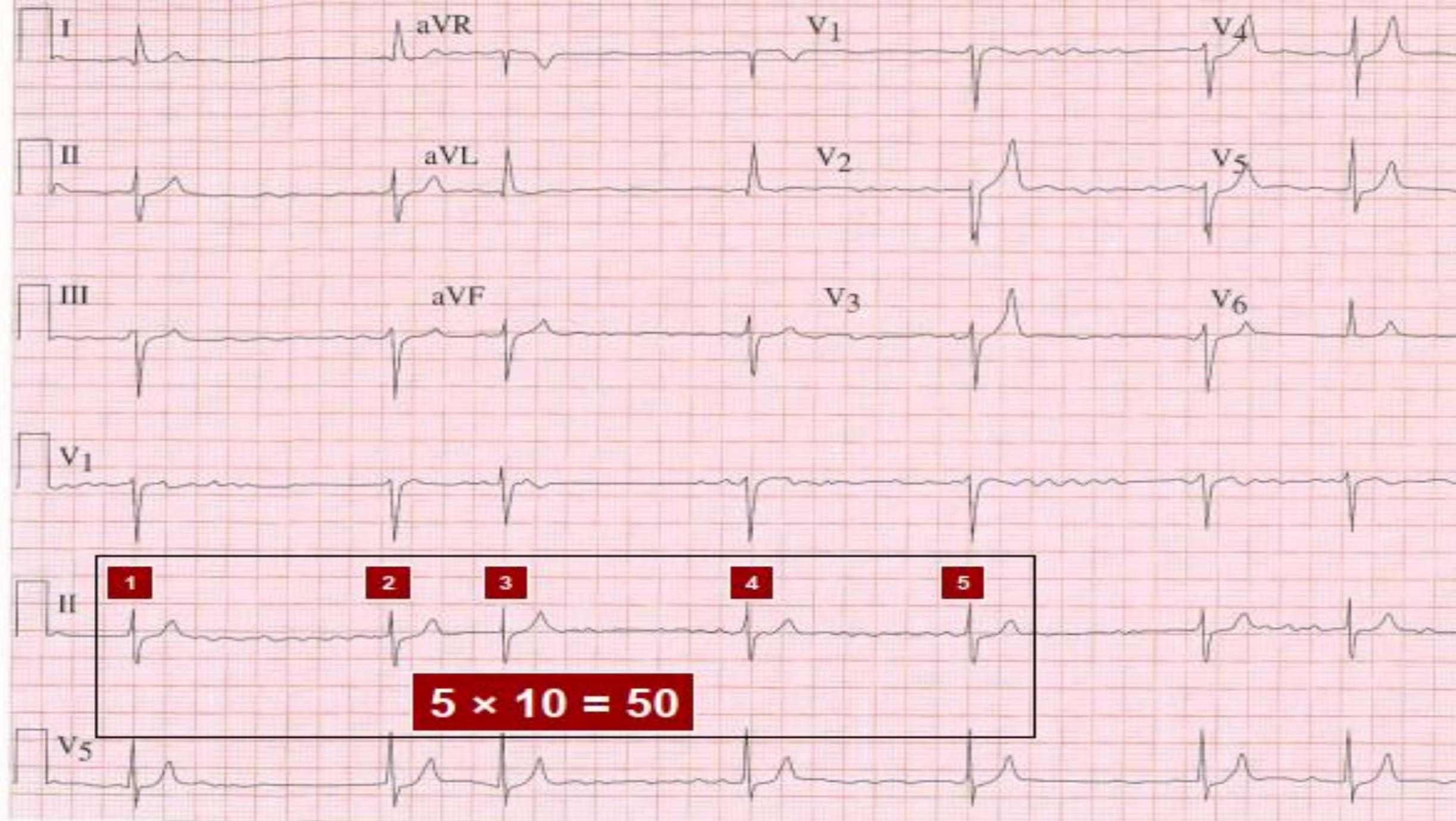
$$= \frac{\text{تعداد ضربات قلبی}}{\text{تعداد خانه های کوچک}}$$



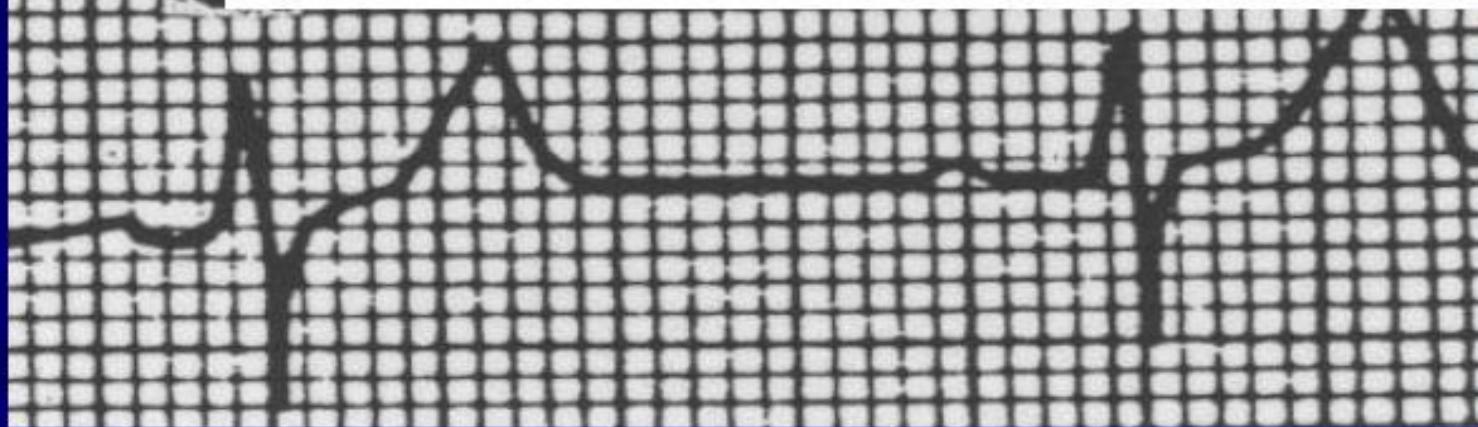
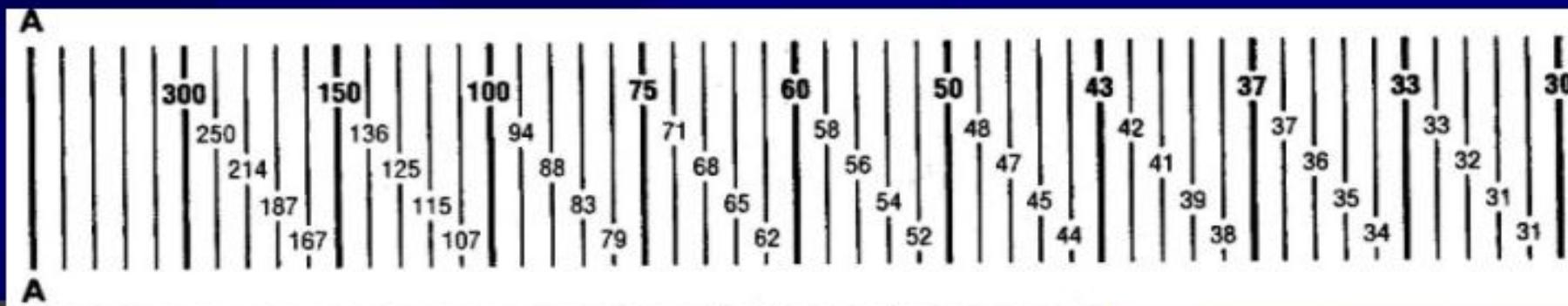
$10 \times \text{تعداد کمپلکس QRS در 6 ثانیه} = \text{تعداد ضربات قلبی}$

این روش فقط برای ریتمهای نا منظم و ایررگولار می باشد

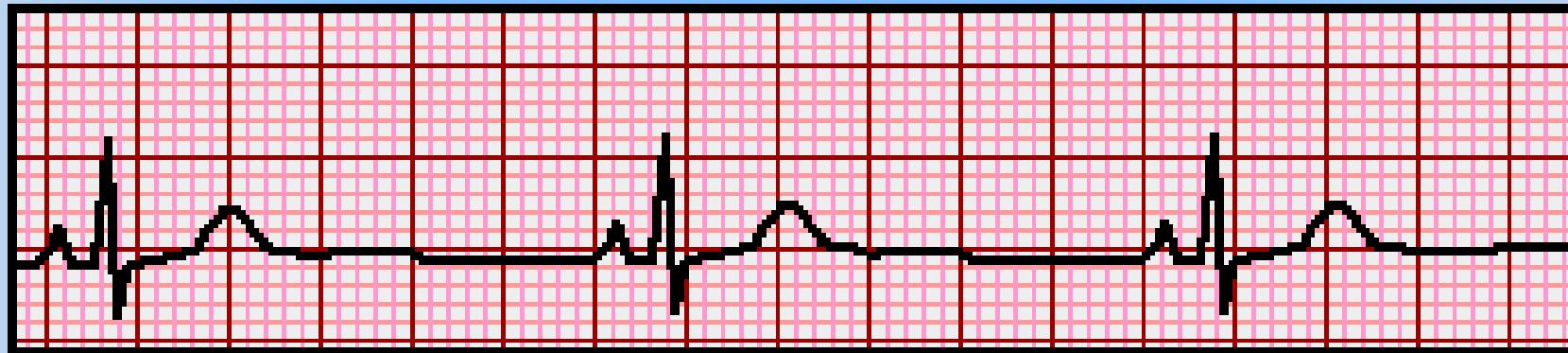




خط کش مدرج

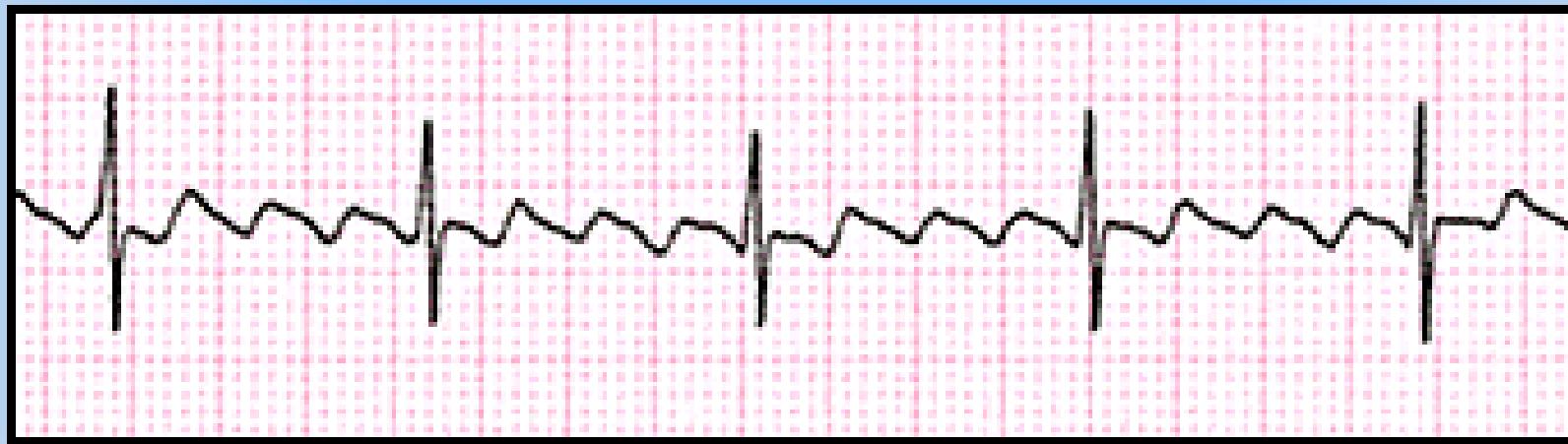


What is the heart rate?



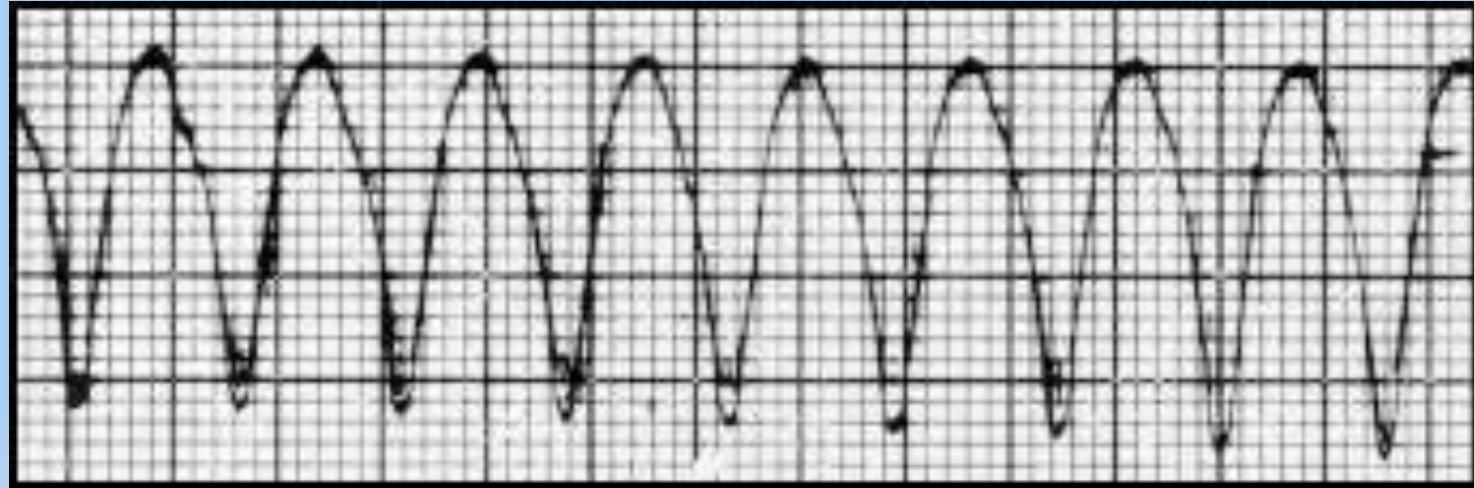
$$(300 / 6) = 50 \text{ bpm}$$

What is the heart rate?



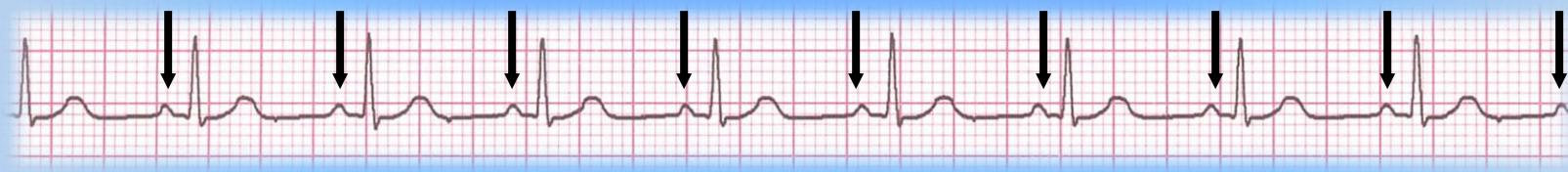
$$(300 / \sim 4) = \sim 75 \text{ bpm}$$

What is the heart rate?



$$(300 / 1.5) = 200 \text{ bpm}$$

Step 3: Assess the P waves



- Are there P waves?
- Do the P waves all look alike?
- Do the P waves occur at a regular rate?
- Is there one P wave before each QRS?

Interpretation?

Normal P waves with 1 P wave for every QRS

Step 4: Determine PR interval



- Normal: 0.12 - 0.20 seconds.
(3 - 5 boxes)

Interpretation?

0.12 seconds

Step 5: QRS duration



- Normal: 0.08 - 0.11 seconds.
(1 - 3 boxes)

Interpretation?

0.08 seconds

Rhythm Summary



- Rate 90-95 bpm
- Regularity Regular
- P waves Normal
- PR interval 0.12 s
- QRS duration 0.08 s

Interpretation?

Normal Sinus Rhythm