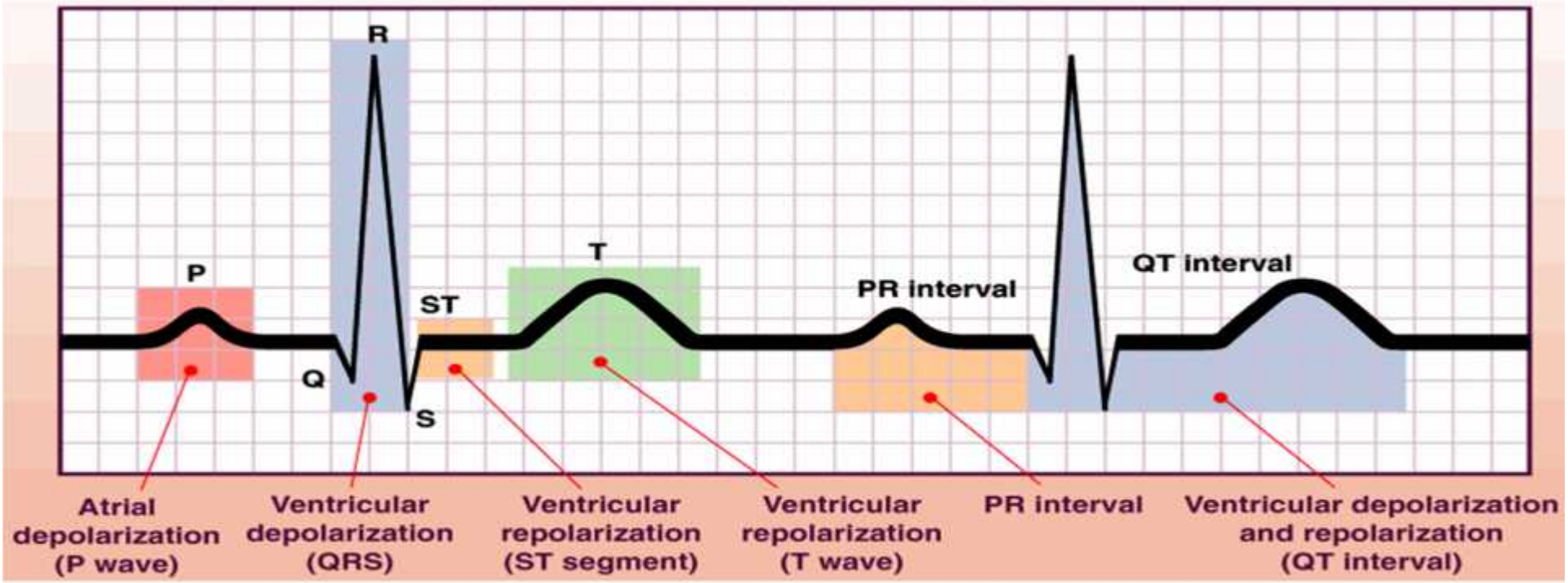
# EKG Dasar

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# ELEKTRO KARDIOGRAFI

PENGERTIAN

Elektrokardiografi adalah ilmu yg mempelajari aktivitas listrik jantung.

Elektrokardigram ( EKG ) adalah suatu grafik yg menggambarkan rekaman listrik jantung.

FUNGSI EKG

EKG mempunyai fungsi diagnostik diantaranya :

Aritmia jantung

Hipertrofi atrium dan ventrikel

Iskemik dan infark miokard

Efek obat-obatan seperti ( digitalis, anti aritmia dll )

Gangguan keseimbangan elektrolit khususnya kalium

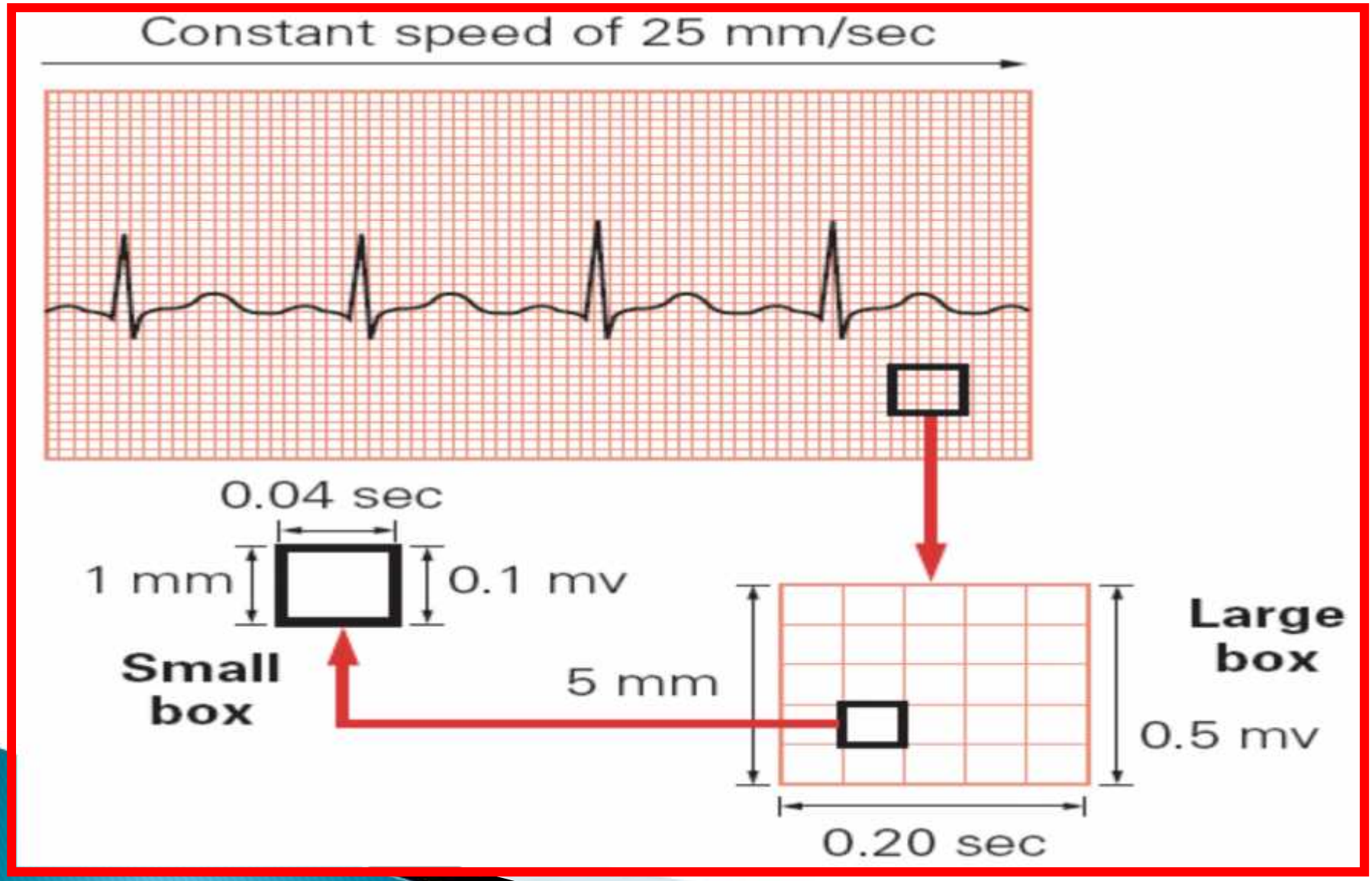
Penilaian fungsi pacu jantung

# KERTAS EKG

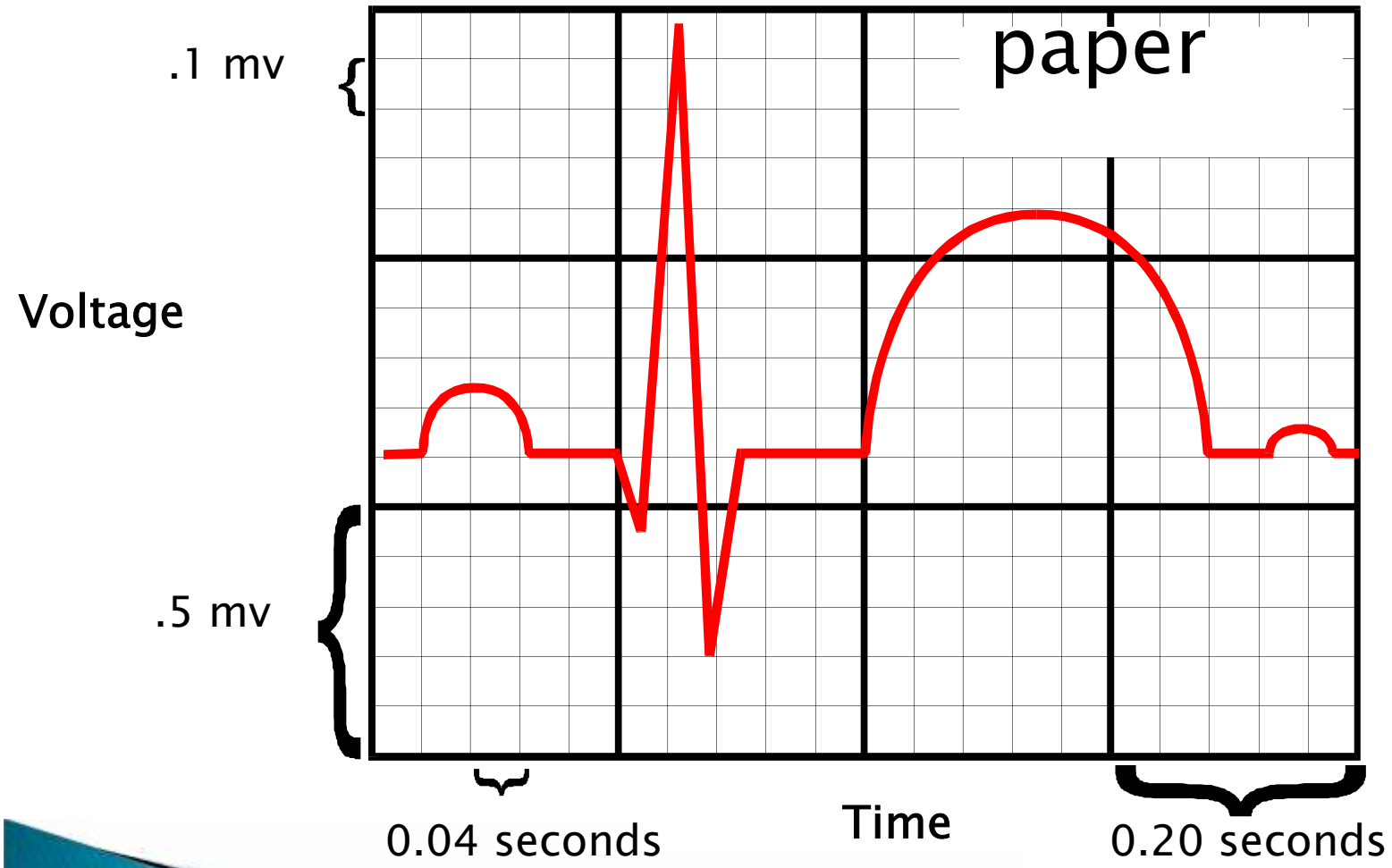
Kertas EKG merupakan kertas grafik yang merupakan garis horizontal dan vertikal dengan jarak 1mm ( kotak kecil ).
Garis yang lebih tebal terdapat pada setiap 5mm
disebut ( kotak besar ).

- Garis horizontal menunjukan waktu, dimana 1mm = 0,04 dtk, sedangkan 5mm = 0,20 dtk.

- Garis vertikal menunjukkan voltage, dimana 1 mm = 0,1 mv, sedangkan 5 mm = 0,5 mv


Constant speed of 25 mm/sec
0.04 sec
1 mm
0.1 mv
Small box
5 mm
Large box
0.5 mv
0.20 sec

# ECG basics – Paper Speed




Paper speed = 25mm / second

# SANDAPAN EKG (*ECG LEADS*)

Pada pemeriksaan EKG rutin dilakukan rekaman pada 12 sandapan yang terdiri dari :

1. Tiga buah sandapan bipolar baku (sandapan I, II dan III)
2. Tiga buah sandapan unipolar ekstremitas (sandapan aVR, aVL dan aVF)
3. Enam buah sandapan unipolar prekordial (sandapan $V_1$ sampai dengan $V_6$)

# SANDAPAN EKG

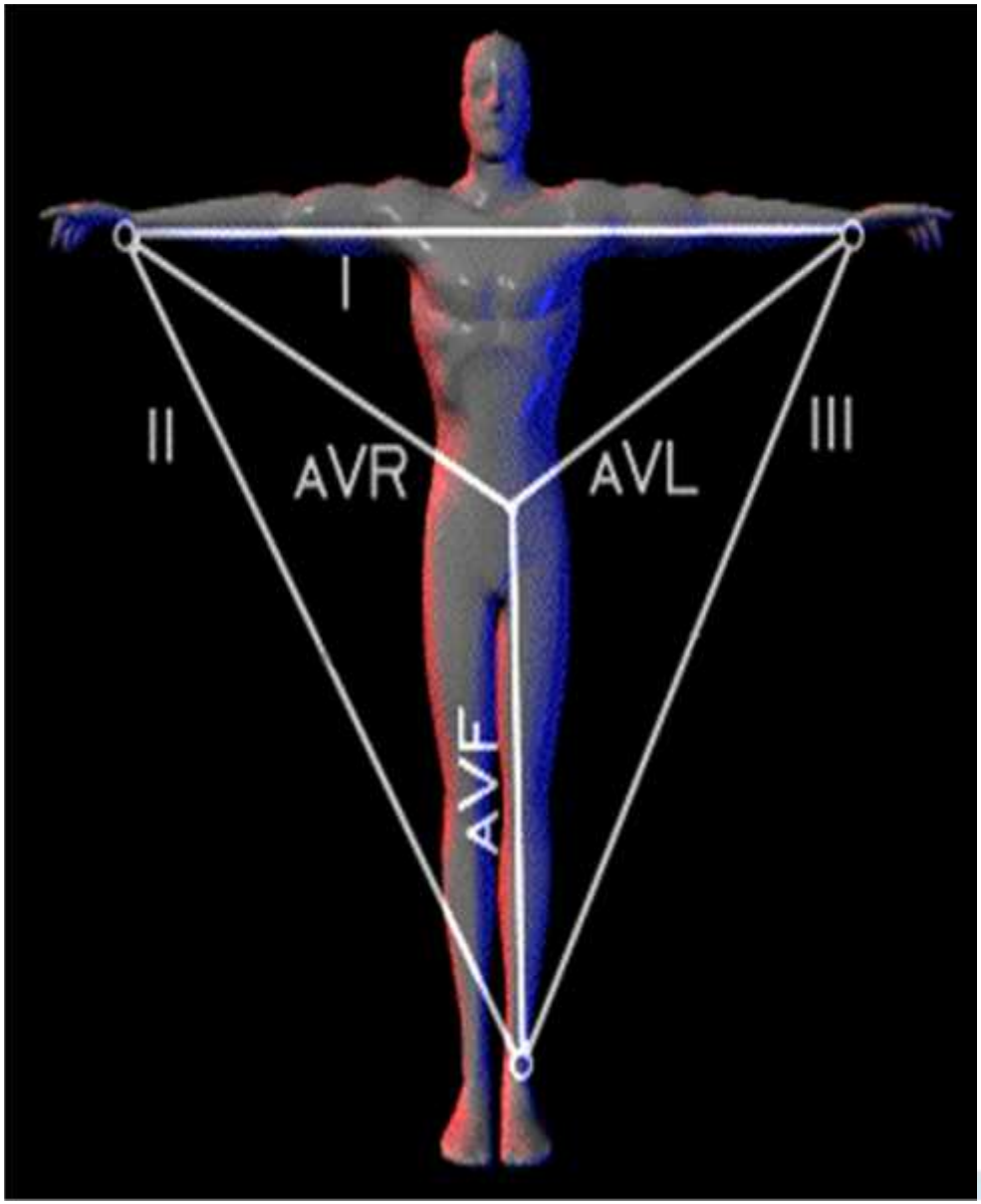
1. Sandapan Bipolar
   Yaitu merekam perbedaan potensial dari dua elektroda

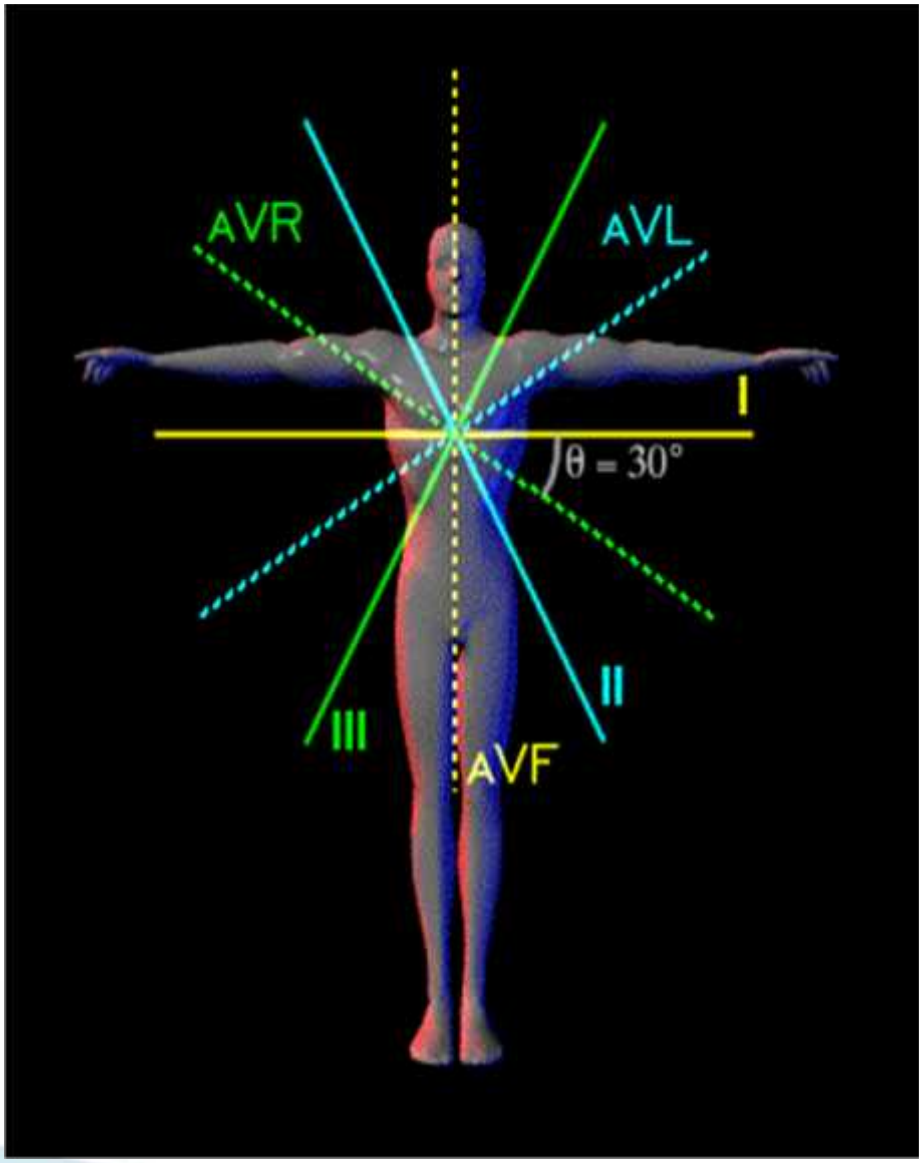
   Sandapan ini ditandai dengan angka romawa ( Lead I, II,dan III )

# SANDAPAN BIPOLAR BAKU

- Sandapan I : selisih potensial antara lengan kanan (RA) dengan lengan kiri (LA), LA bermuatan lebih positif dari RA
- Sandapan II : selisih potensial antara lengan kanan (RA) dengan tungkai kiri (LL), LL bermuatan lebih positif dari RA
- Sandapan III : selisih potensial antara lengan kiri (LA) dengan tungkai kiri (LL), LL bermuatan lebih positif dari LA

# SANDAPAN ECG



# SANDAPAN EKG

Sandapan Unipolar

- Sandapan Unipolar Ektremitas

Merekam besar potensial listrik pada satu ektremitas, elektroda ekplorasi diletakan pada ektremitas yg akan diukur. Gabungan elektroda-elektroda pada ektremitas yg lain membentuk elektroda indiferen ( potensial 0 ) ( aVR, aVL, aVF )

- SandapanUnipolar Prekordial

Merekam besar potensial listrik jantung dengan bantuan elektroda eksplorasi yg ditempatkan di beberapa dingding dada. Elektroda indiferen diperoleh dengan menggabungkan ketiga elektroda ektremitas.
( V1 s/d V9 dan V3R, V4R )

# SANDAPAN UNIPOLAR PREKORDIAL

Sandapan unipolar prekordial ini ditandai dengan huruf V (*Voltage*) dan disertai angka di belakangnya yang menunjukkan lokasi di atas prekordium

Enam tempat di prekordial yang umum dipakai adalah :

$V_1$ : sela iga ke-4 di garis sternalis kanan

$V_2$ : sela iga ke-4 di garis sternalis kiri

$V_3$ : terletak antara $V_2$ dan $V_4$

$V_4$ : sela iga ke-5 di garis midklavikula kiri

$V_5$ : garis aksilaris anterior kiri setinggi $V_4$

$V_6$ : garis mid-aksila kiri setinggi $V_4$

# SANDAPAN PREKORDIAL EKG

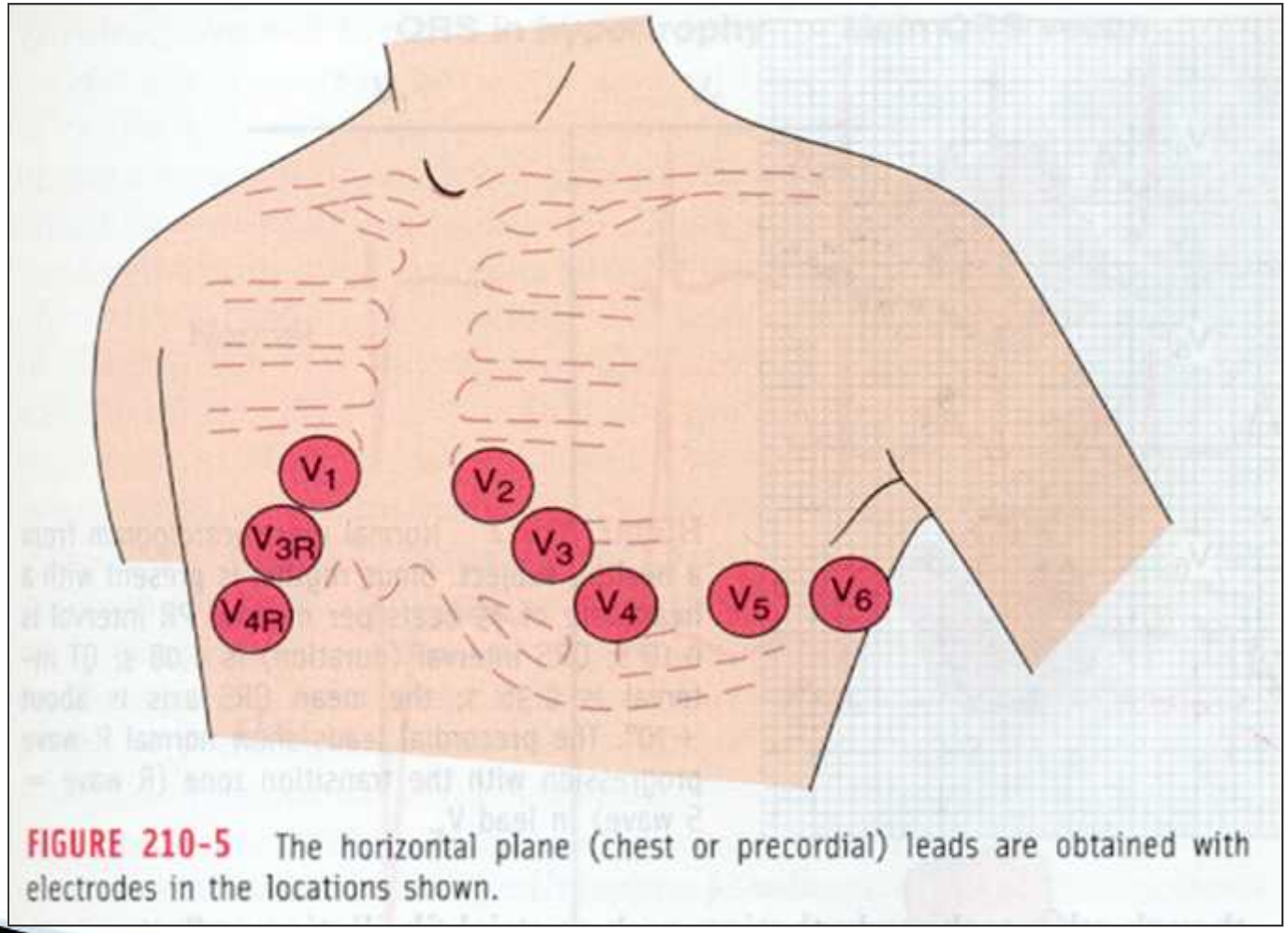
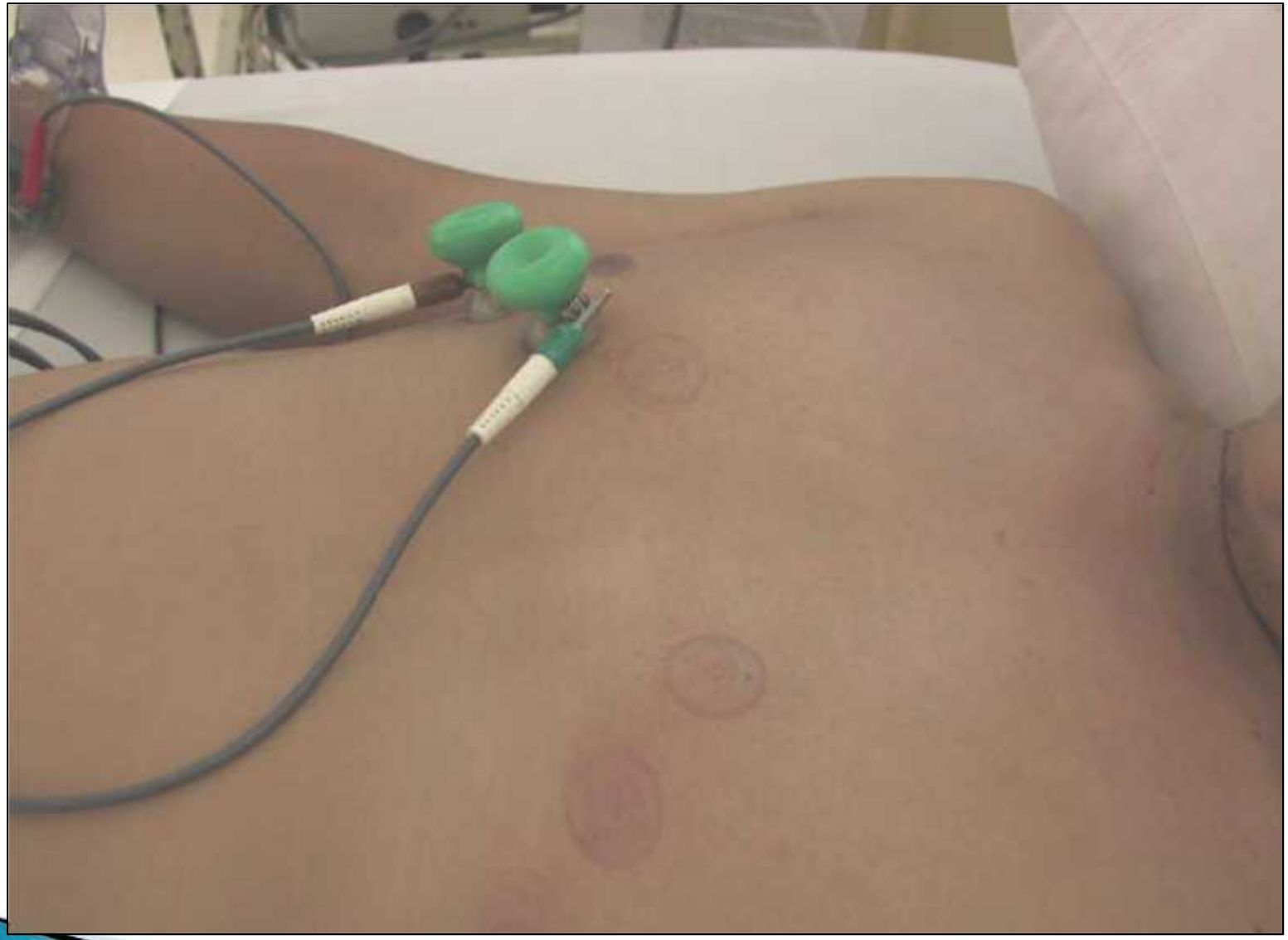
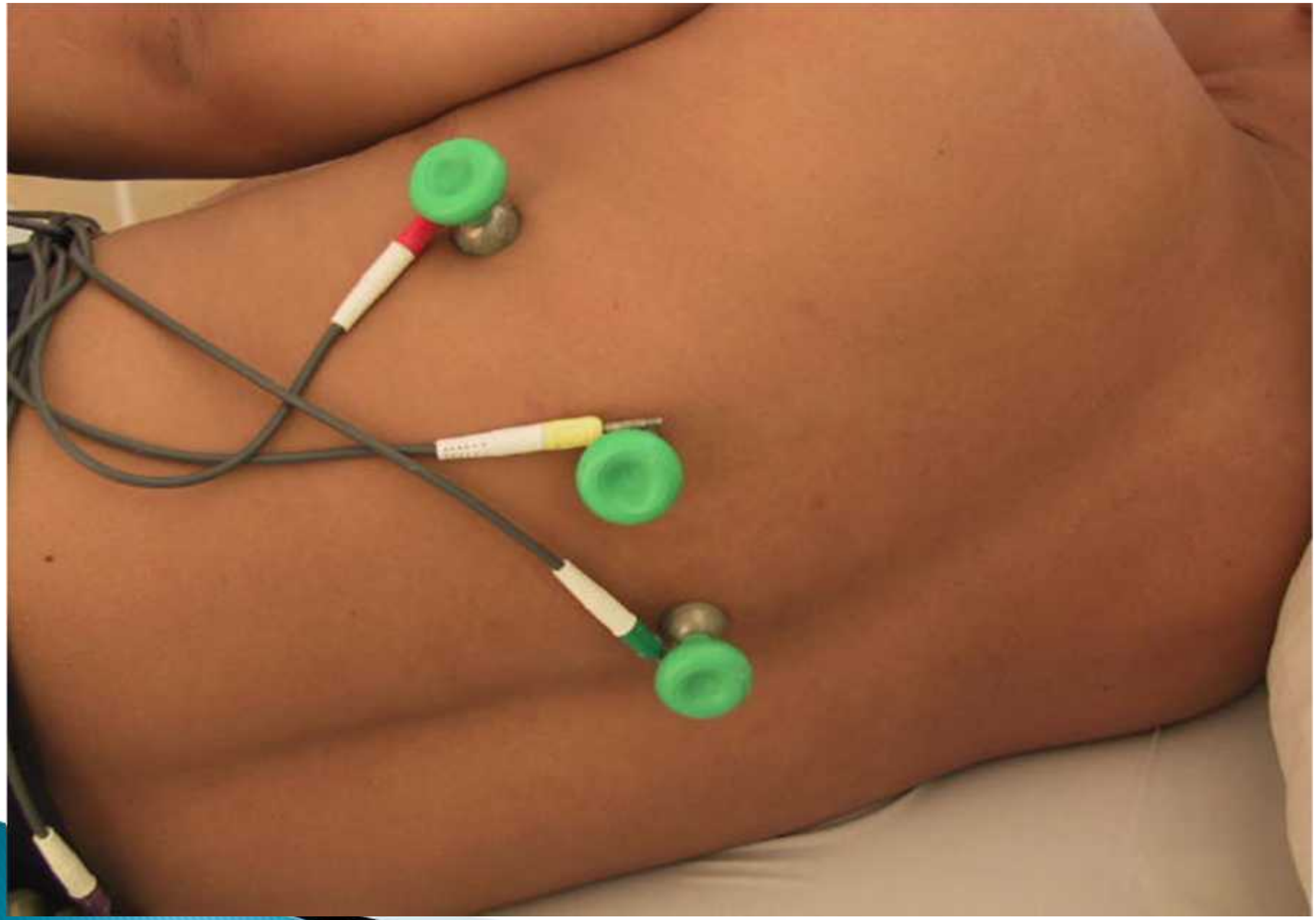



**FIGURE 210-5** The horizontal plane (chest or precordial) leads are obtained with electrodes in the locations shown.

# TAMBAHAN SANDAPAN EKG

- SANDAPAN PREKORDIAL KANAN
  - Tambahan sandapan di V3R – V6R
  - Pada infark inferior yang dicurigai disertai infark ventrikel kanan
  - Pada infark dengan penurunan tekanan darah yang belum jelas etiologinya
- SANDAPAN PREKORDIAL KIRI POSTERIOR
  - Tambahan sandapan di prekordial kiri posterior : V7 – V9
  - Bila dicurigai terdapat infark posterior, misalnya terdapat depresi segmen ST di sandapan prekordial kiri (V1– V3)



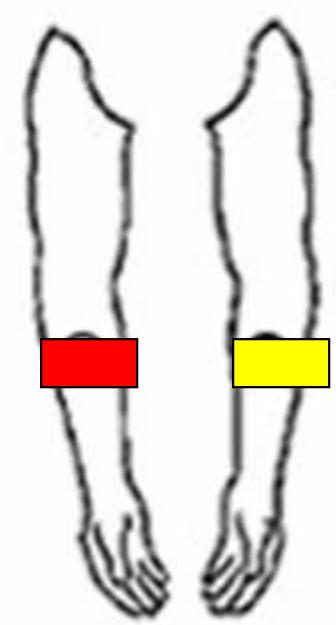


# ECG Electrode Placement

**Standard Configuration**

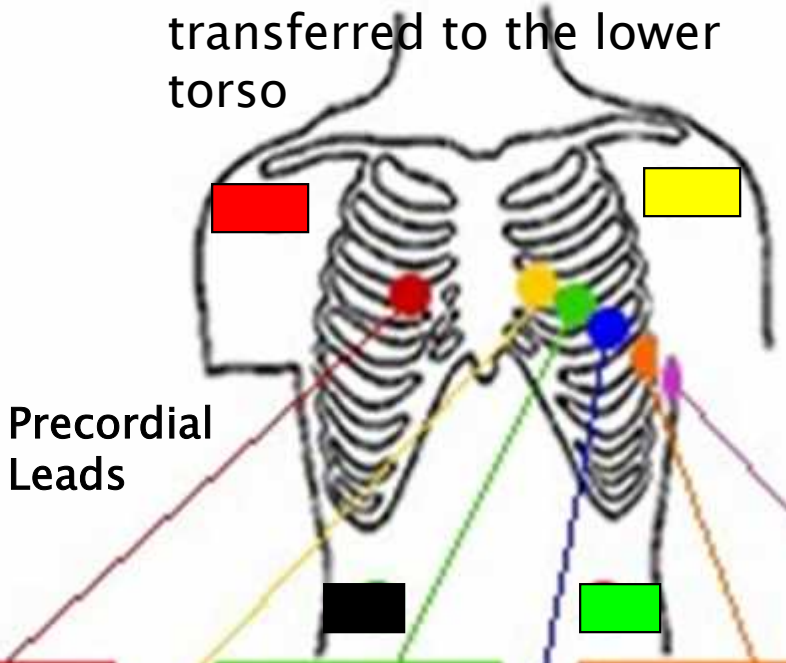
Right Arm (red)

Left Arm (yellow)



**Exercise Configuration**

The right & left arm electrodes are transferred to the upper torso while the leg electrodes are transferred to the lower torso



Precordial Leads

V1 red

V2 yellow

V3 green

V4 blue

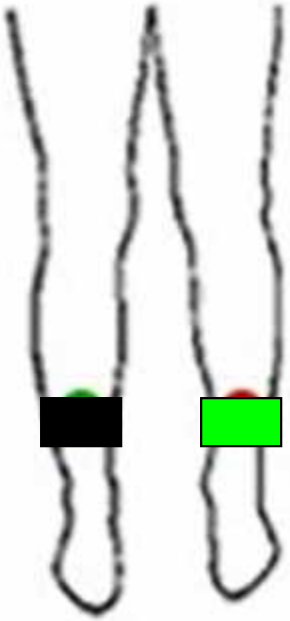
V5 orange

V6 violet

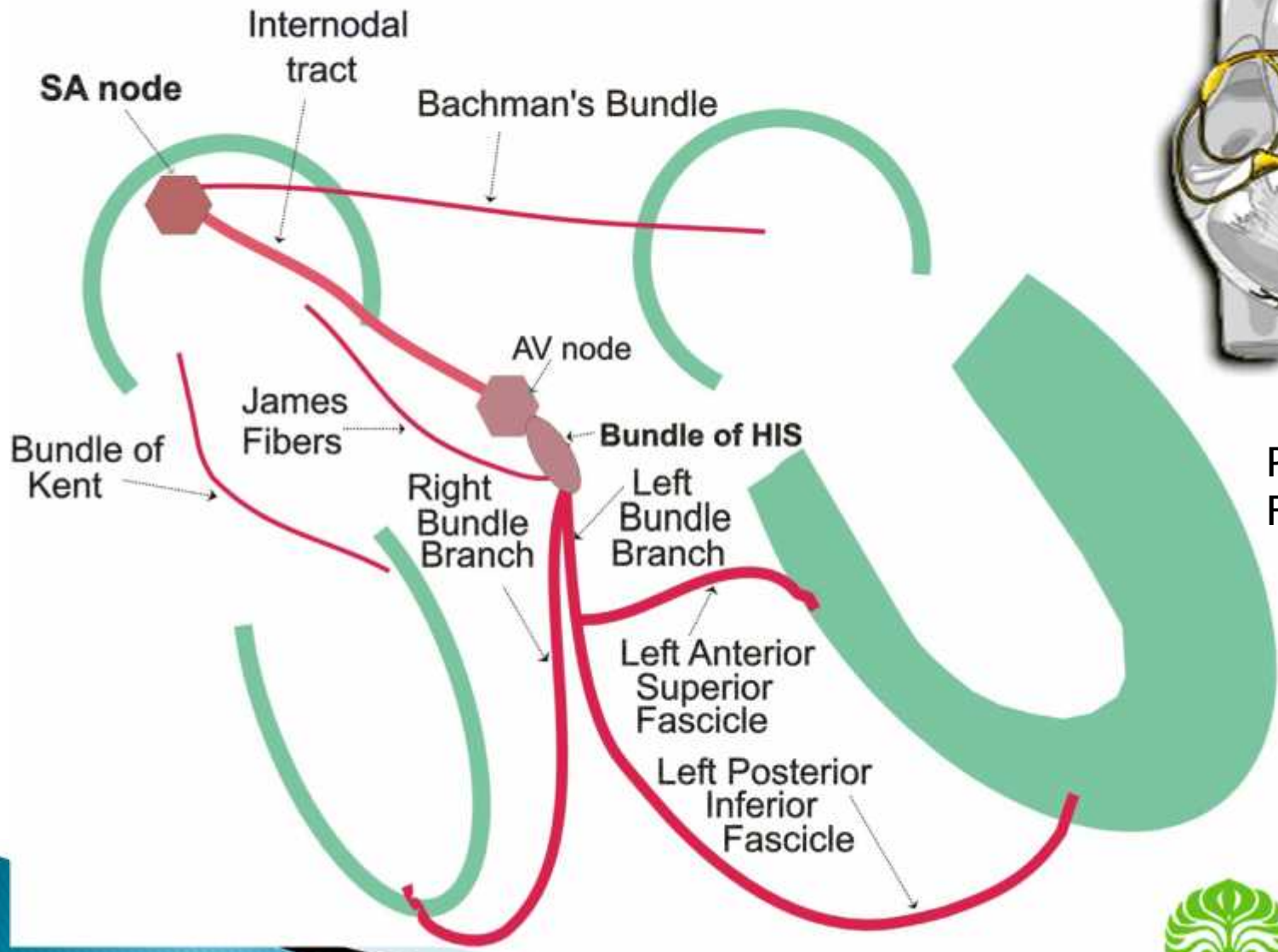
**Standard Configuration**

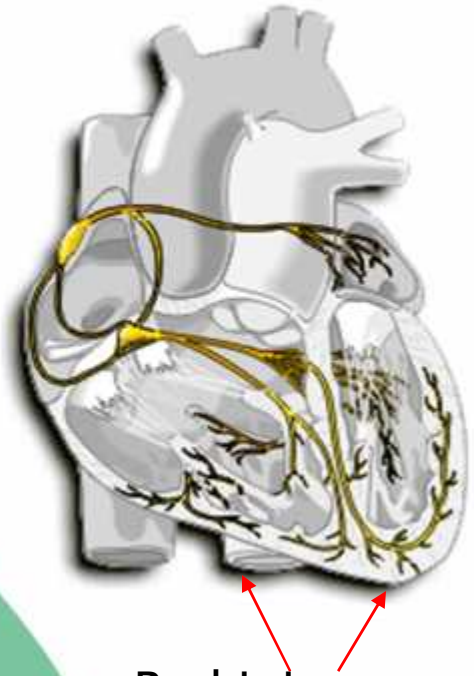
Right Leg (black – ground)

Left Leg (green)



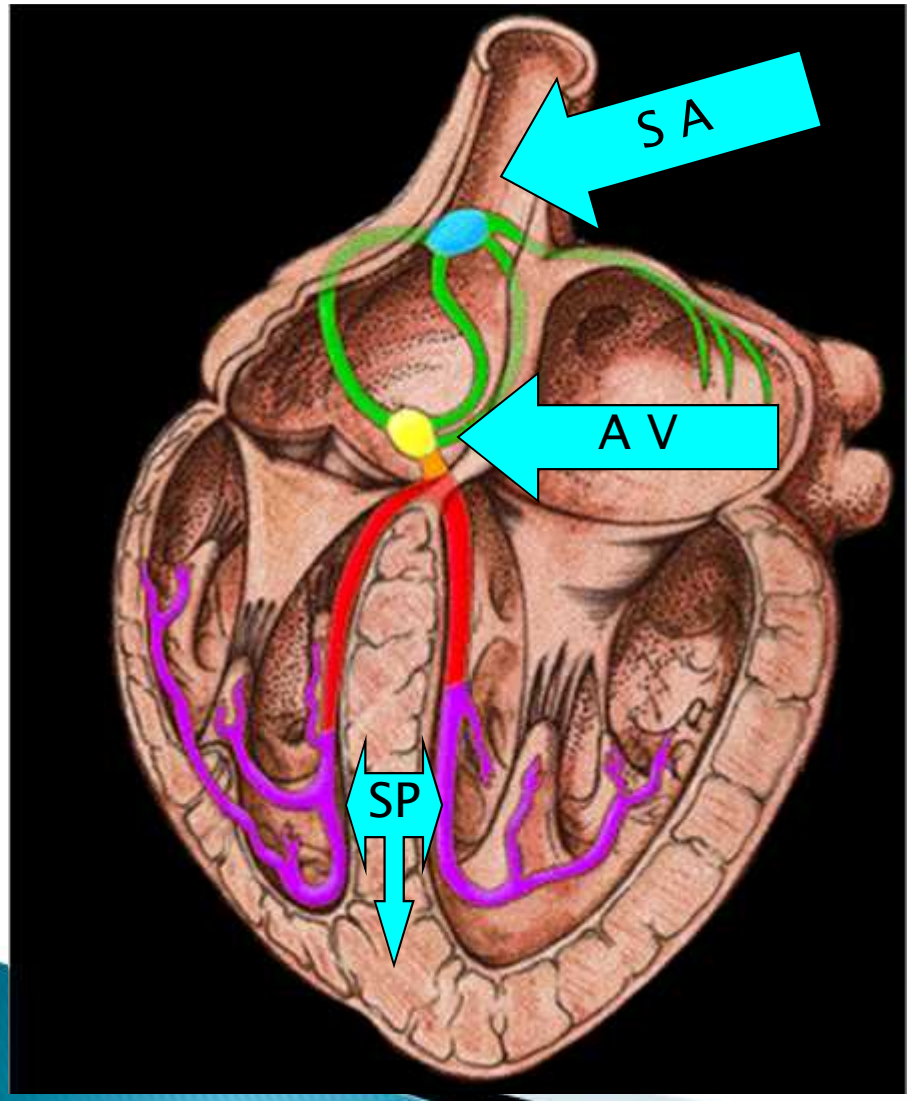
# The Conduction System of the Heart

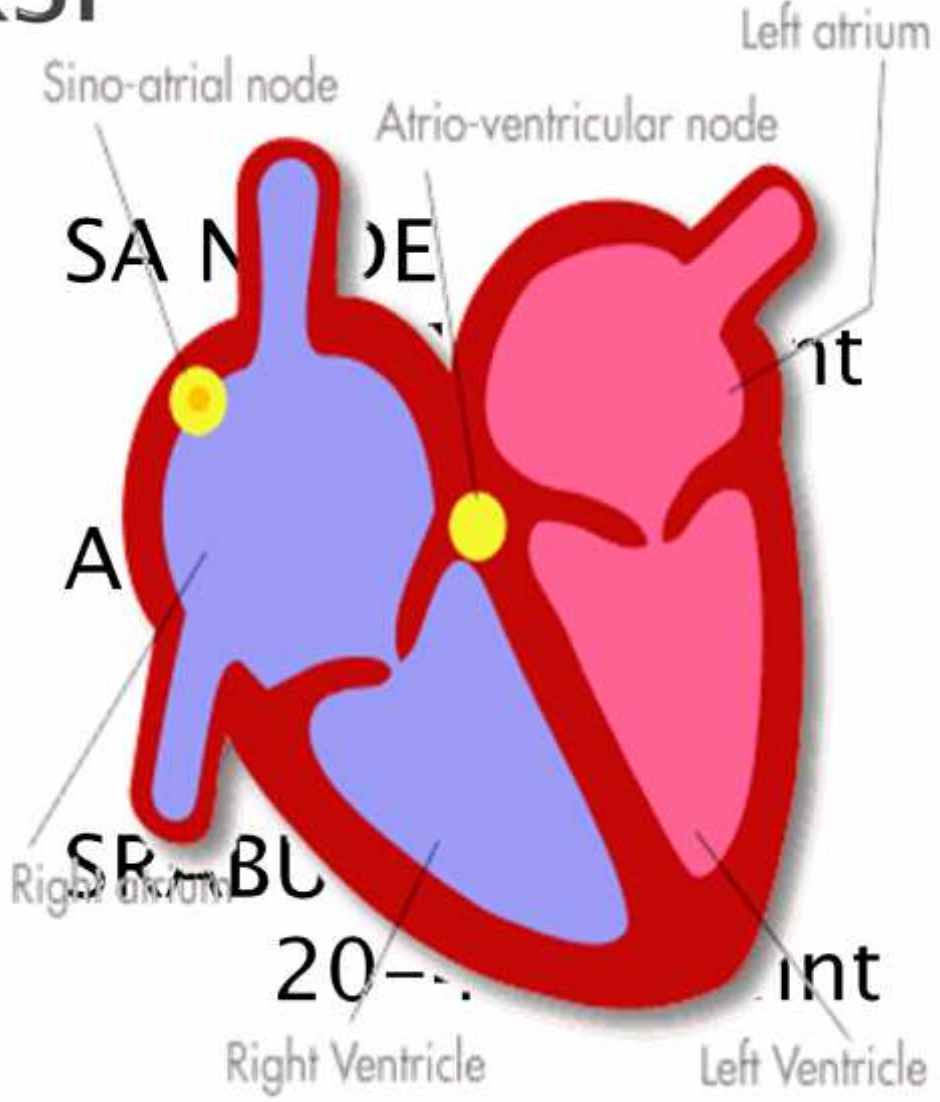


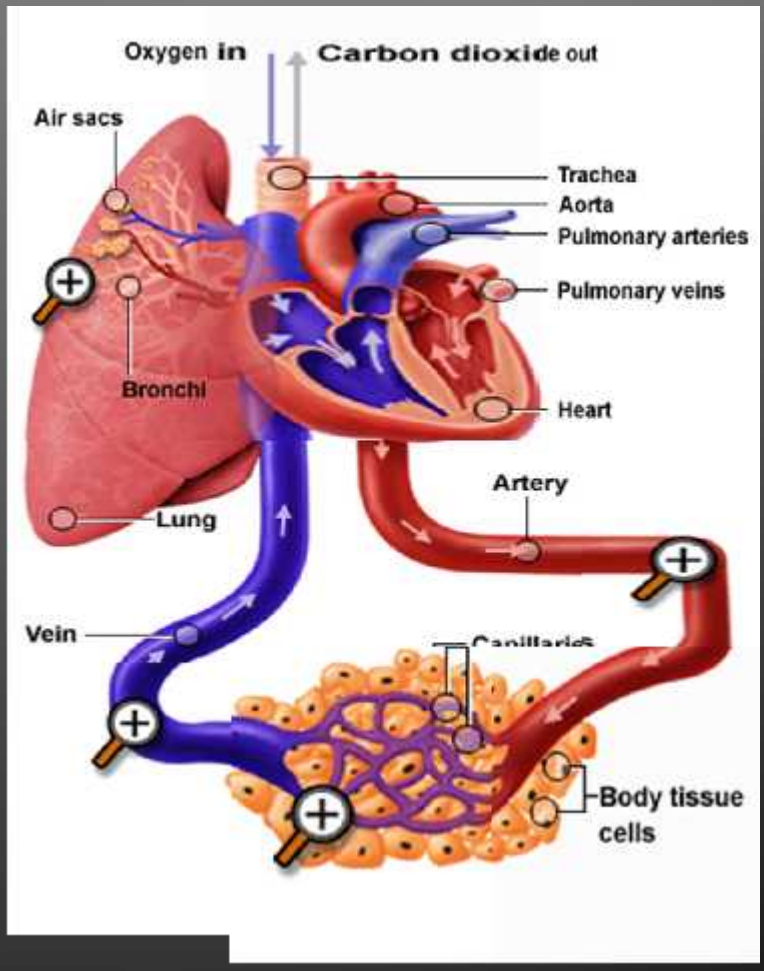
Purkinje Fibers

# SISTEM KONDUKSI

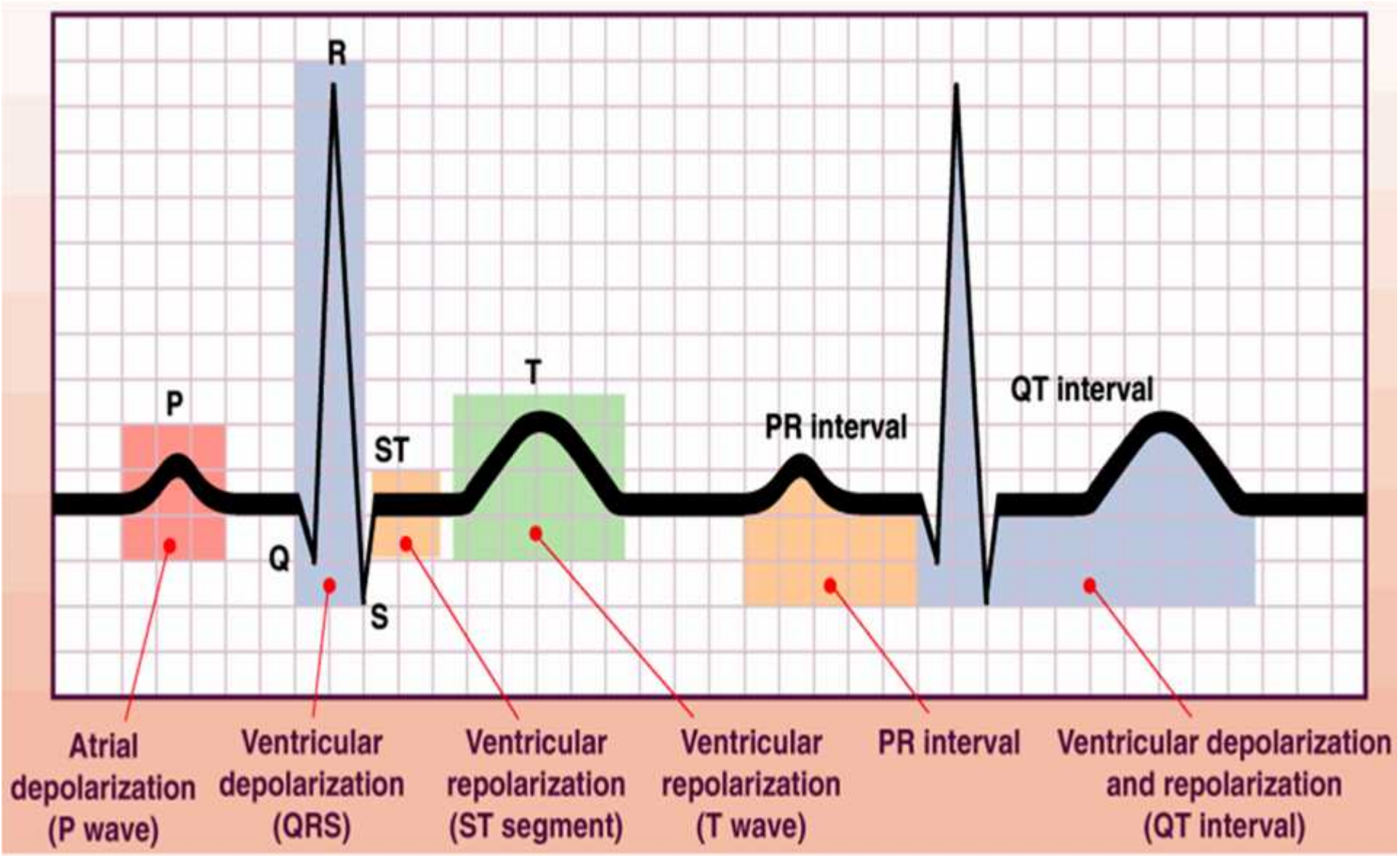


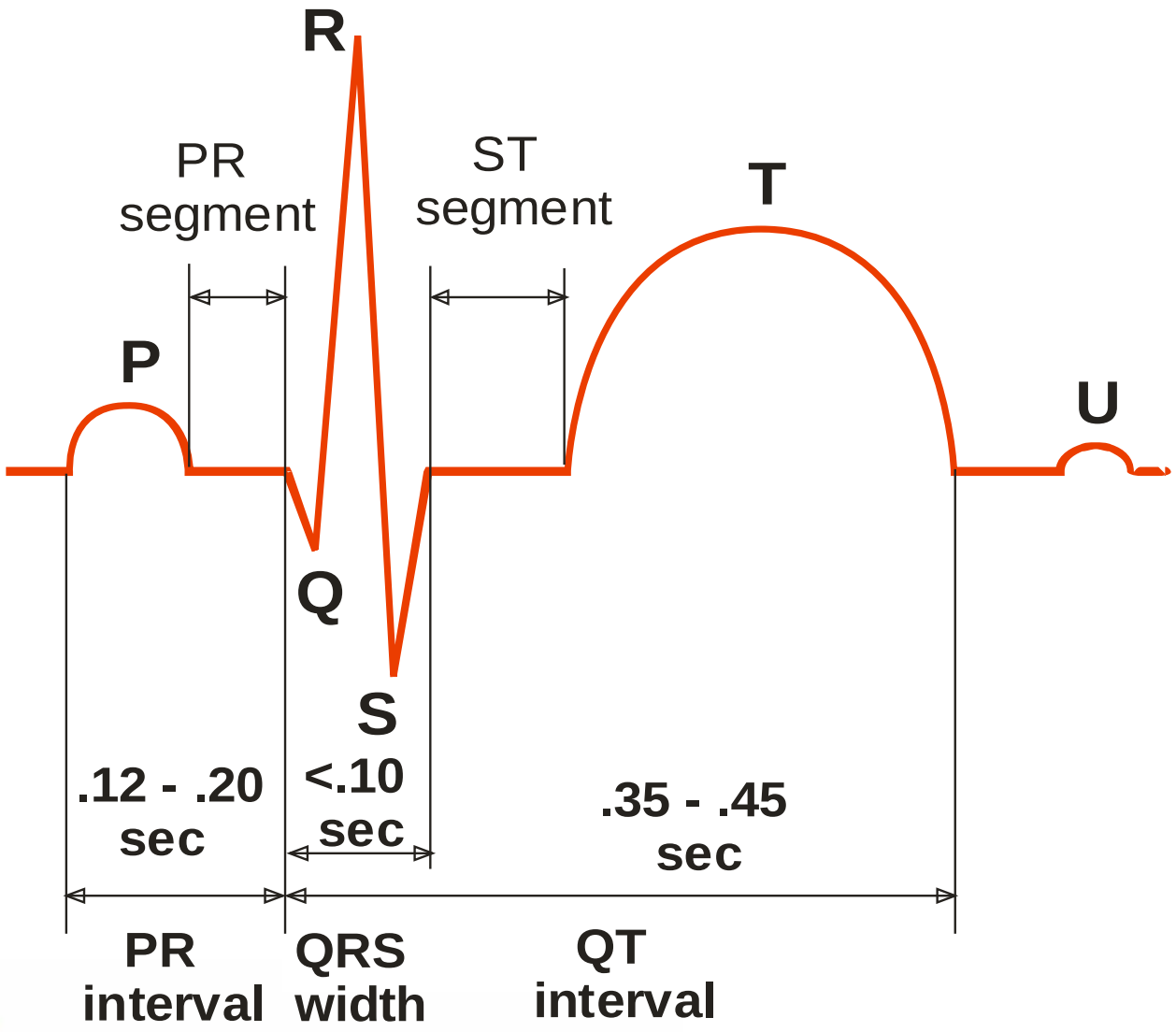
# Siklus Jantung



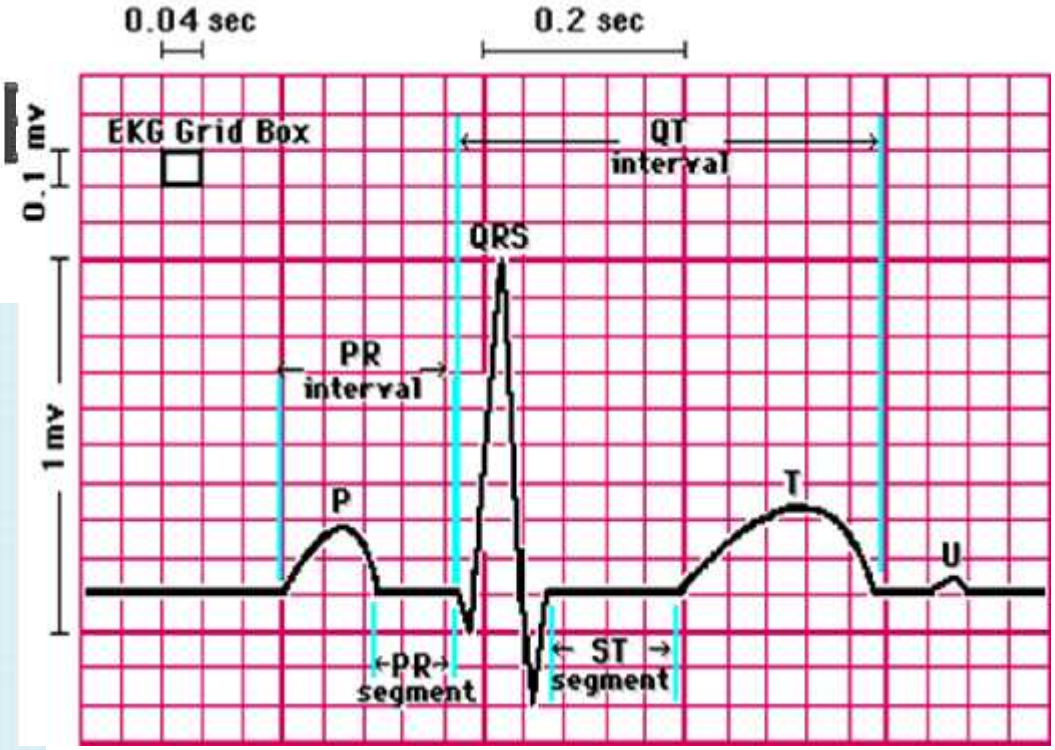
# GAMBAR EKG


R
T
P
ST
PR interval
QT interval
Q
S
Atrial depolarization (P wave)
Ventricular depolarization (QRS)
Ventricular repolarization (ST segment)
Ventricular repolarization (T wave)
PR interval
Ventricular depolarization and repolarization (QT interval)

# ECG Basics – the ECG Complex



# How to read I




- Rhythm
- QRS Rate
- QRS Axis
- P Wave Morphology
- PR Interval
- QRS Duration
- QRS Morphology
- ST Segment Deviation
- T Wave Morphology
- U Wave Morphology
- Others (LVH, LV Strain, BBB, QT interval)
- Conclusion

**Normal Value:**

| | |
|---|---|
| **PR Interval** | **0,12” until 0,20”** |
| **QRS Duration** | **0,04” until 0,12”** |
| **Normal Axis** | **- $30^0$ until + $110^0$** |

# 1. RHYTHM

**Normal cardiac rhythm : SINUS rhythm**

**Sinus rhythm characteristics :**

- **Negative P wave in aVR and positive di II**
- **P wave is always followed by QRS complex**
- **Regular: Constant R – R interval**
- **Rate 60-100 bpm**

RAHI

# Normal Sinus Rhythm

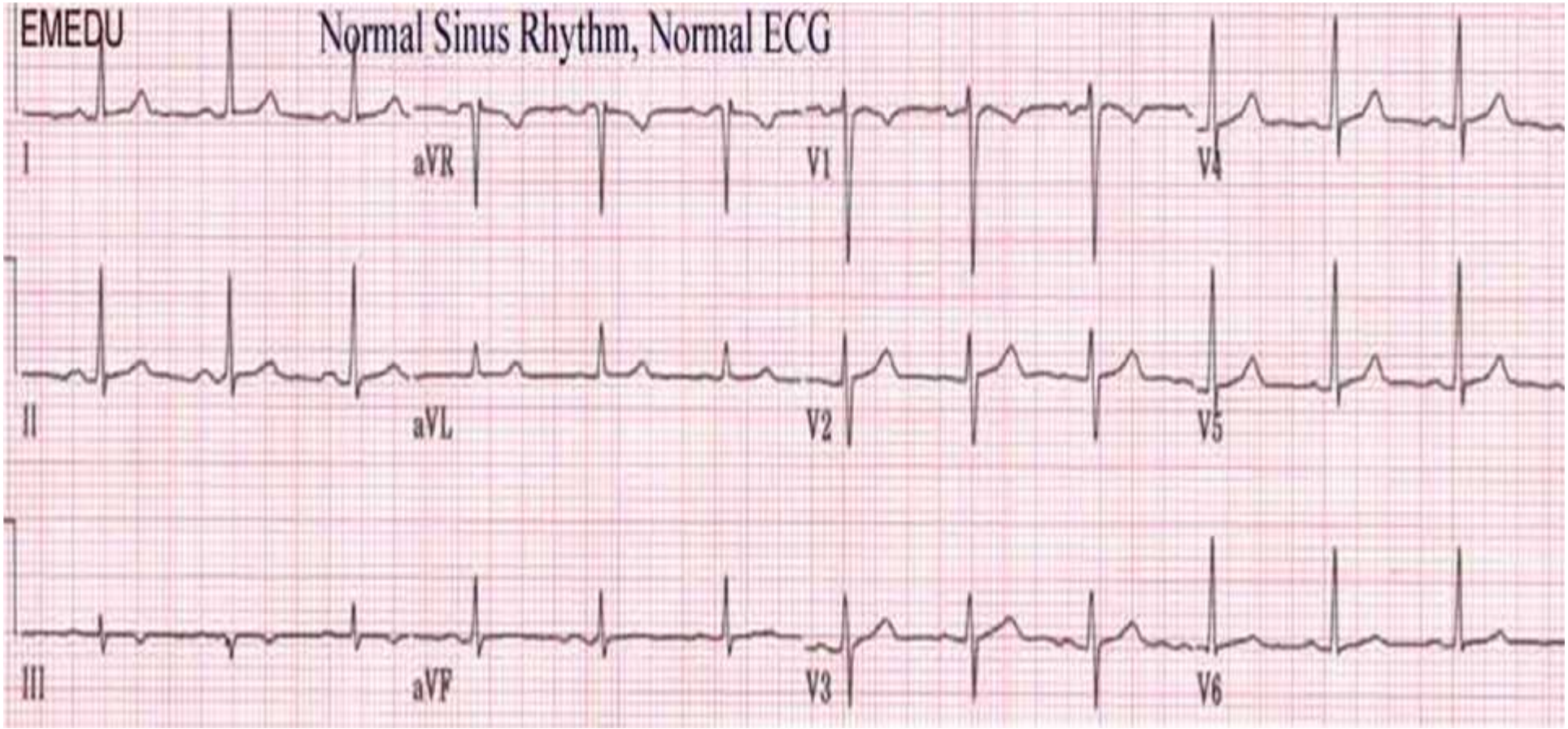
Rhythm : Regular
Rate : 60 – 100
P wave : Normal in configuration; precede each QRS
PR : Normal ( 0. 12 – 0.20 seconds )
QRS : Normal ( less than 0.12 seconds )

**Others:**

**Block : LBBB, RBBB, AV Block**

**Arrhythmia : Tachyarrhythmia**

**Bradyarrhythmia**


EMEDU
Normal Sinus Rhythm, Normal ECG
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

# NORMAL ECG

# HOW TO COUNT RATE?

**Normal heart rate : 60 – 100 x/minutes**
- **> 100 x/minutes : Sinus Tachycardia**
- **< 60 x/minutes : Sinus Bradicardia**

**Determination heart rate (normal paper speed 25 mm/s):**

- $\frac{300}{\text{Count number of large square (bold boxes in one R – R' interval)}}$

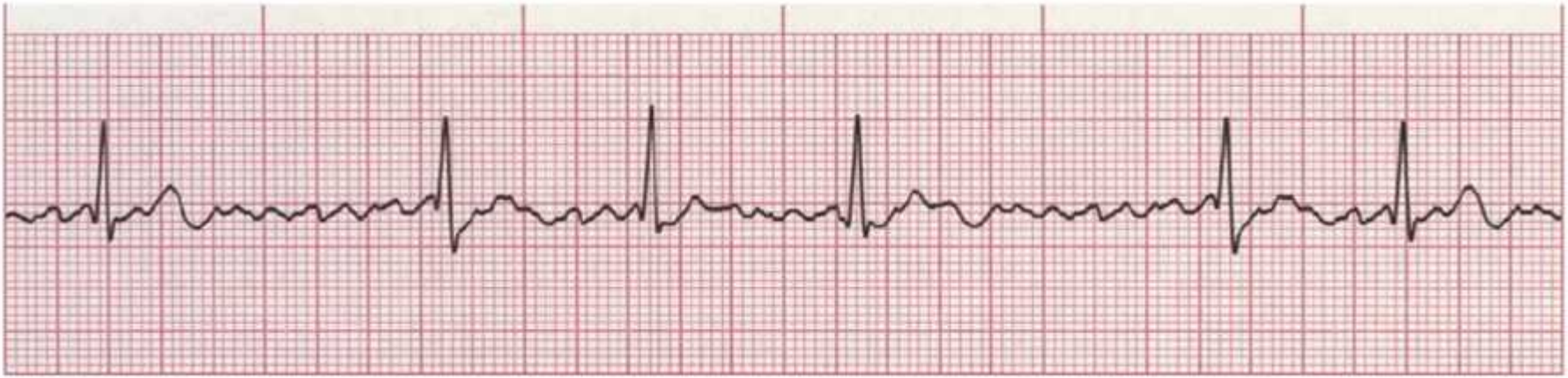
- $\frac{1500}{\text{Count number of small square in one R – R' intervals}}$

- **Number of QRS complex in 6 seconds, multiply by 10**

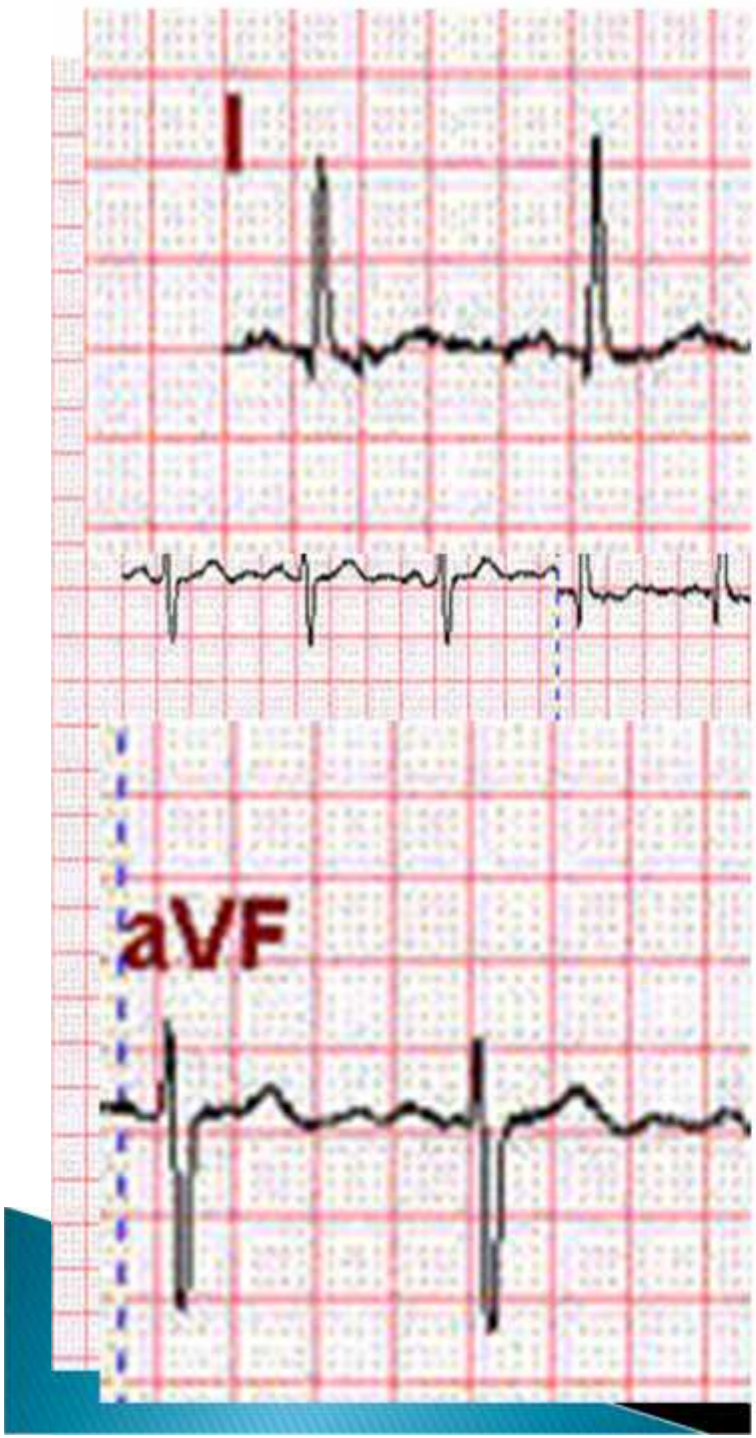
# Lead II

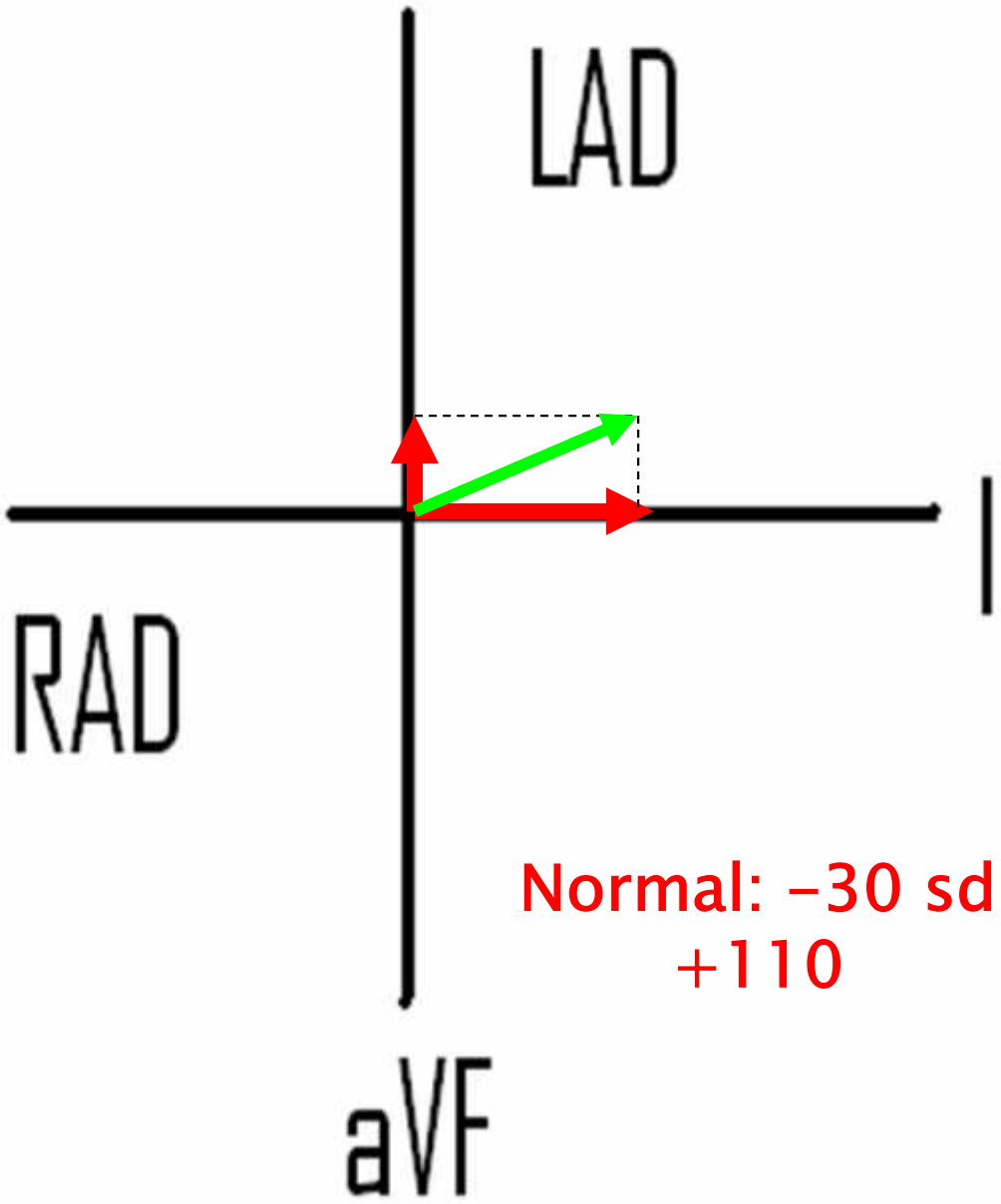
Berapa Heart Rate ?

# Lead II



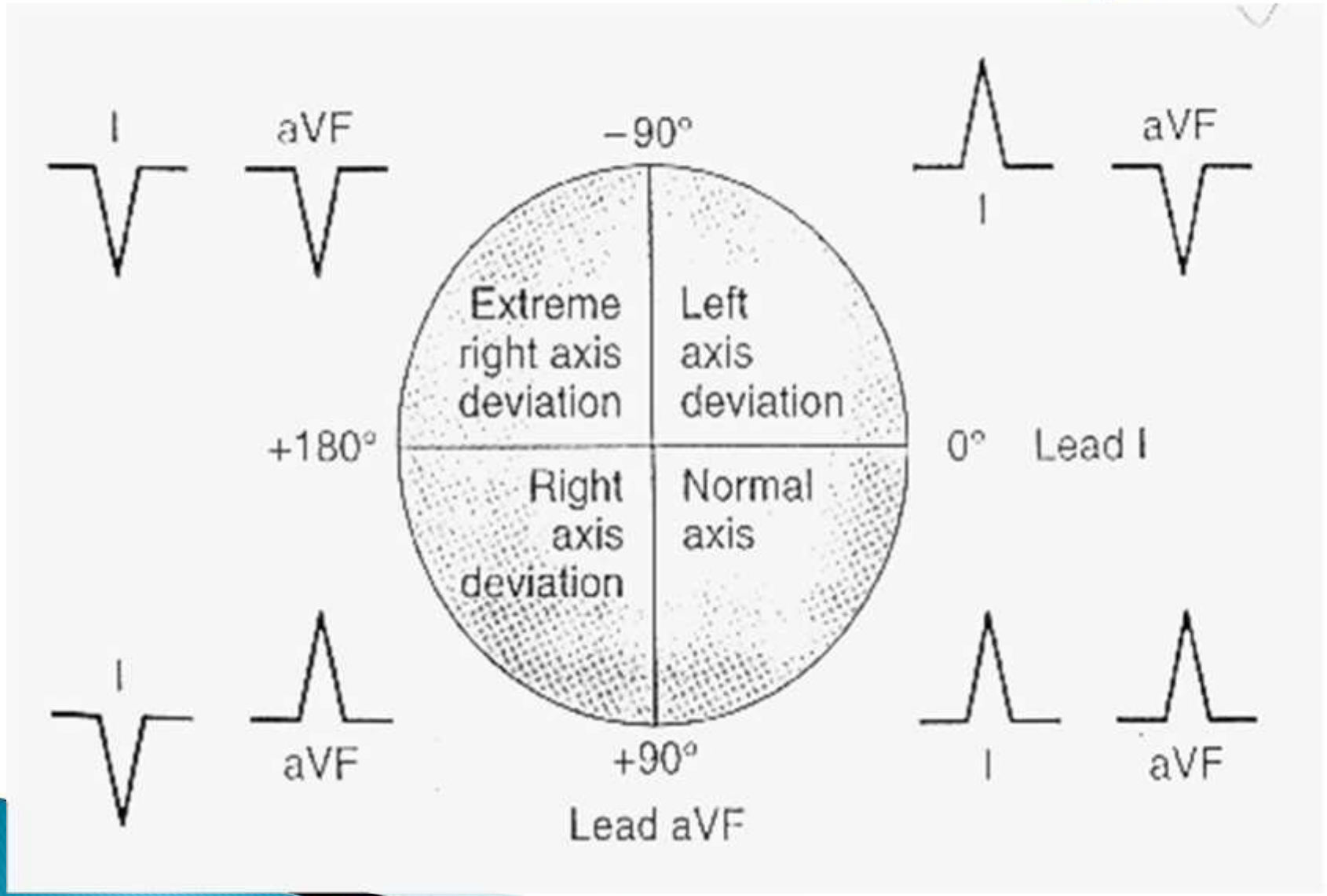
Berapa Heart Rate ?



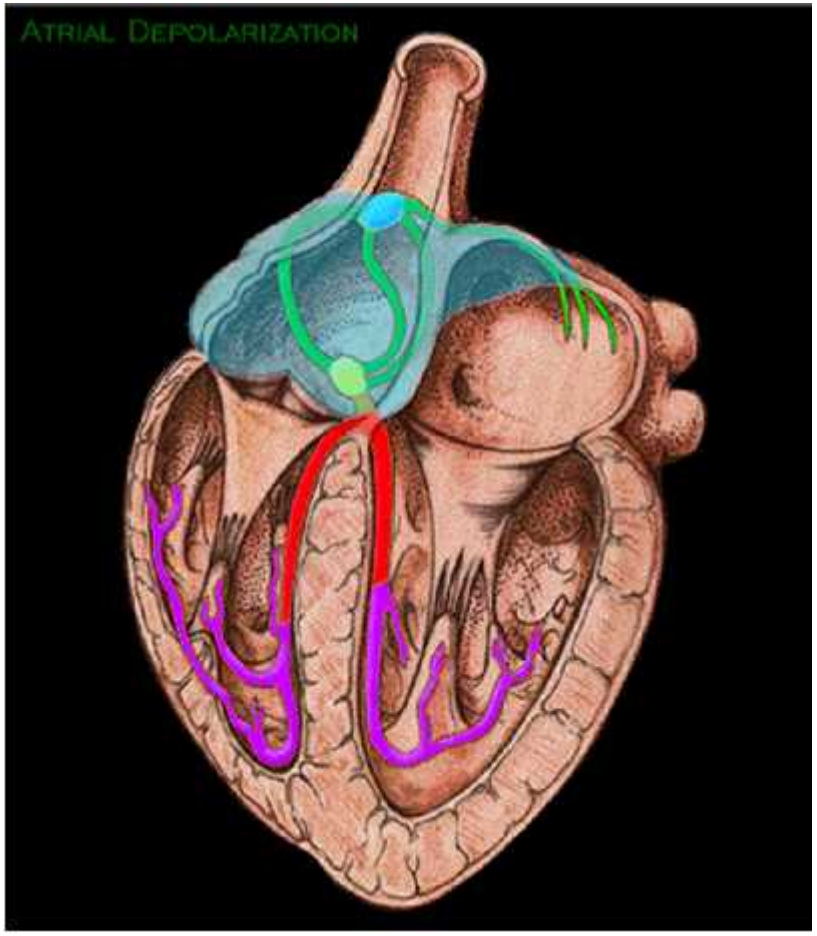




Normal: -30 sd
+110

# QRS Axis


I
aVF
−90°
I
aVF
Extreme right axis deviation
Left axis deviation
+180°
0°
Lead I
Right axis deviation
Normal axis
I
aVF
+90°
I
aVF
Lead aVF

# Atrial Depolarization

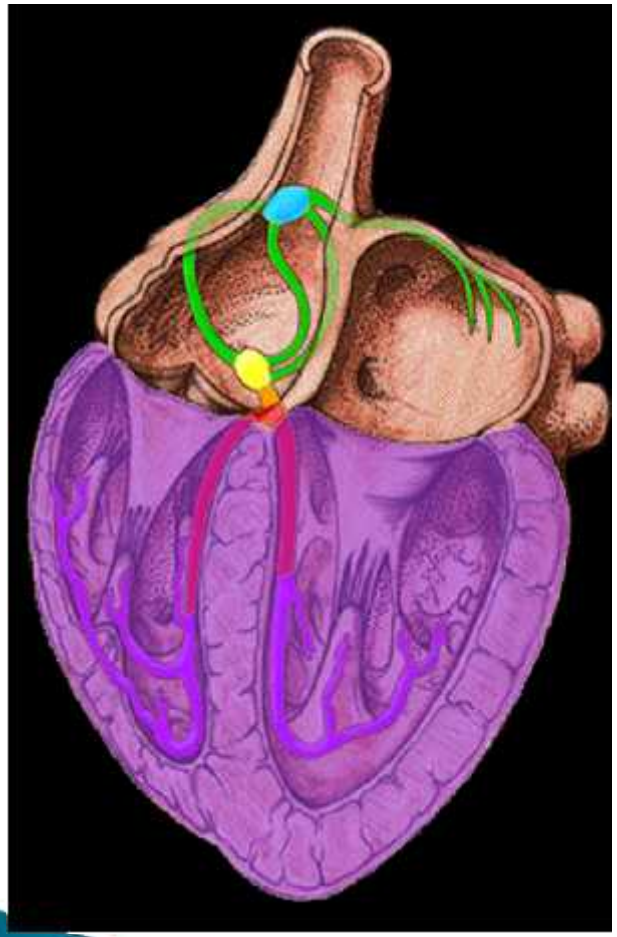


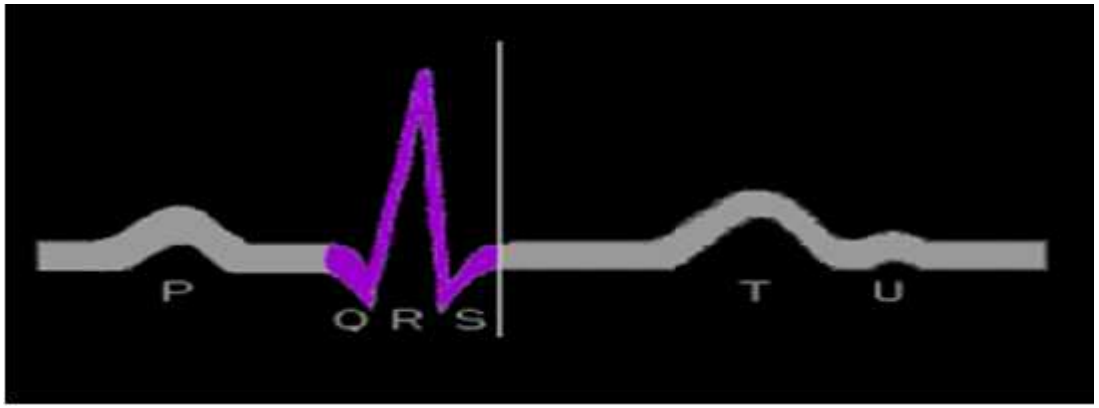


GELOMBANG P

a. Lebar kurang dari 0,12 detik
b.Tinggi kurang dari 0,3 mv
c. Selalu Positif di lead II
d. Selalu negative di lead AVR

# Ventricle Depolarization





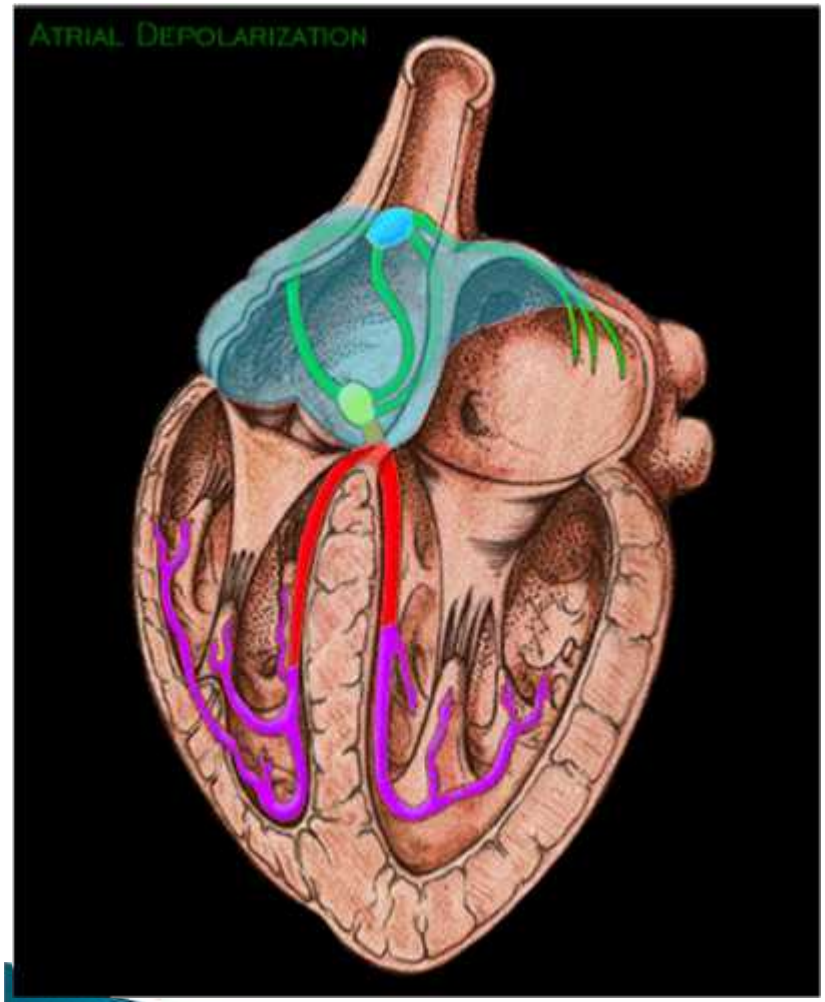

Gelombang QRS :

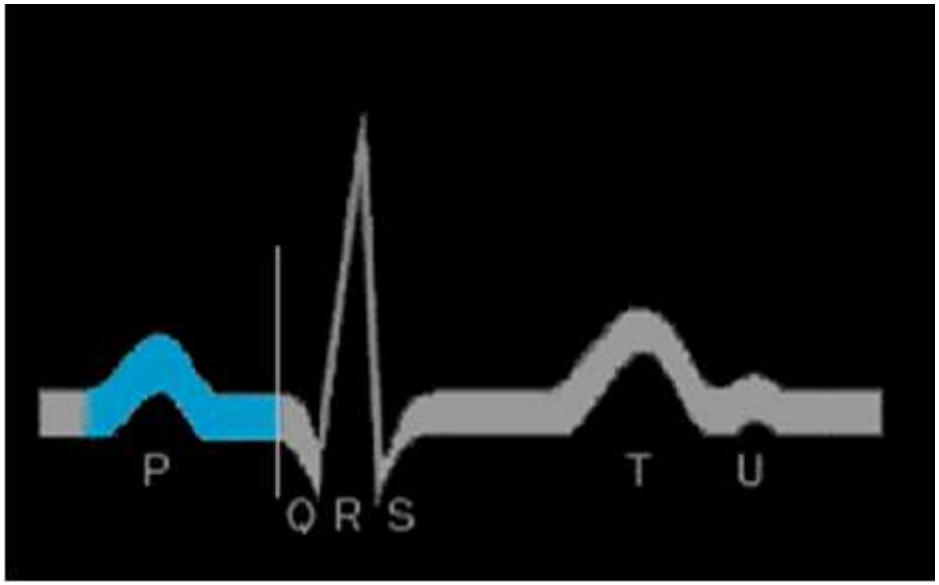
Normal : lebar tidak melebihi 0,12 “

Tinggi tergantung lead

Gelombang QRS terdiri dari gel Q,
Gel R dan gelombang S

# PR Interval




P – R Interval :
Diukur dari permulaan gelombang P sampai permulaan gelombang QRS

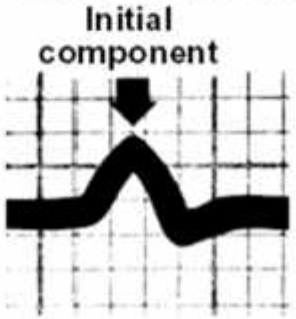
Normal : 0,12 – 0,20 detik

# Hypertrophy

## Atrial Hypertrophy (pages 245-249)

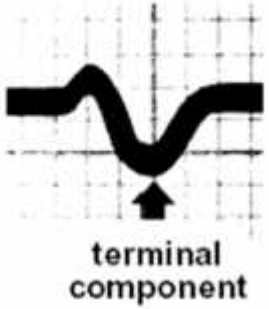
***Right Atrial Hypertrophy*** (page 248)

- large, diphasic P wave with tall initial component.




***Left Atrial Hypertrophy*** (page 249)

- large, diphasic P wave with wide terminal component.



# Ventricular Hypertrophy (pages 250-258)

## ***Right Ventricular Hypertrophy*** (pages 250-252)

- R wave greater than S in $V_1$, but R wave gets progressively smaller from $V_1$ - $V_6$.
- S wave persists in $V_5$ and $V_6$.
- R.A.D. with slightly widened QRS.
- Rightward rotation in the horizontal plane.

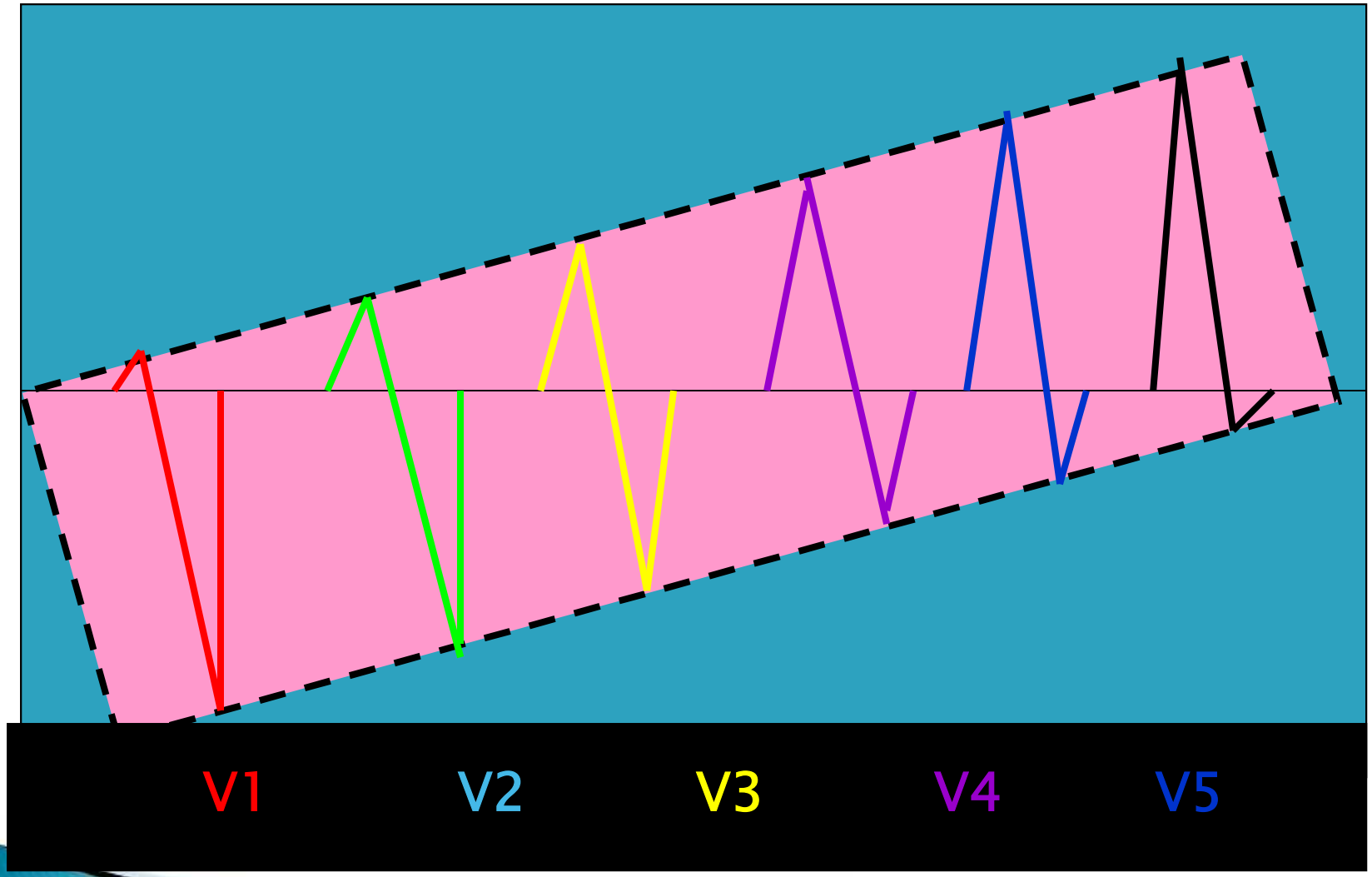
## ***Left Ventricular Hypertrophy*** (pages 253-257)

S wave in $V_1$ (in mm.)
\+ R wave in $V_5$ (in mm.)
Sum in mm. is more than 35 mm. with L.V.H.

- L.A.D. with slightly widened QRS.
- Leftward rotation in the horizontal plane.

# 4. HYPERTROPHIC SIGNS

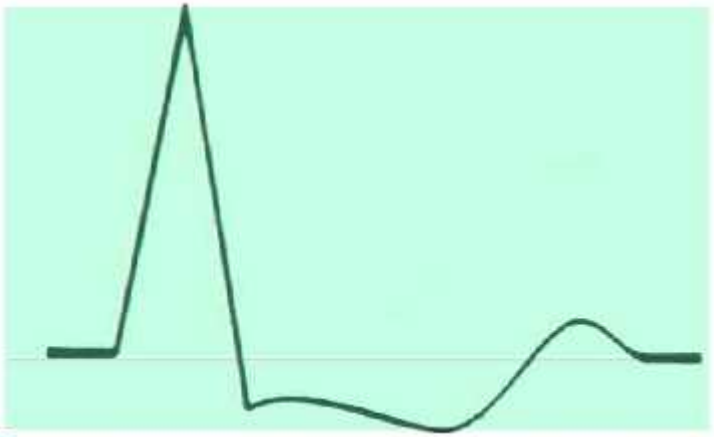
RAHI



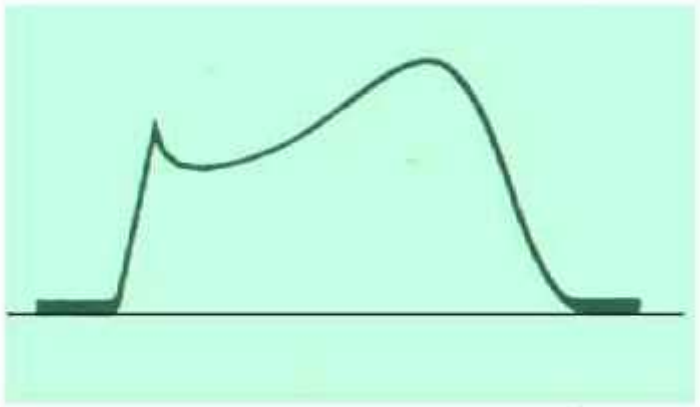

GELOMBANG R DAN S DI LEAD PERIKORDIAL

# Segmen ST, diukur dari akhir QRS s/d awal gel T

- Normal : Isoelektris
- Kepentingan : Elevasi : Pada injuri/infark akut
  Depresi : Pada iskemia



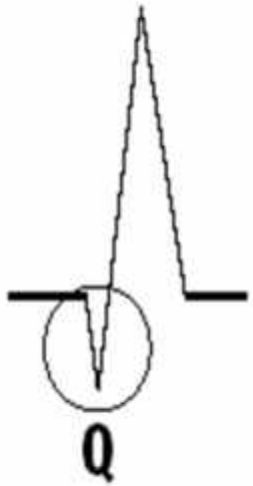
NON STEMI



STEMI

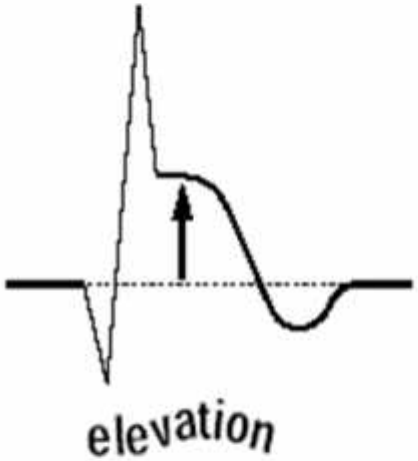
# Infarction and Ischemia

**Q wave = Necrosis (significant Q's only)** (pages 272-284)



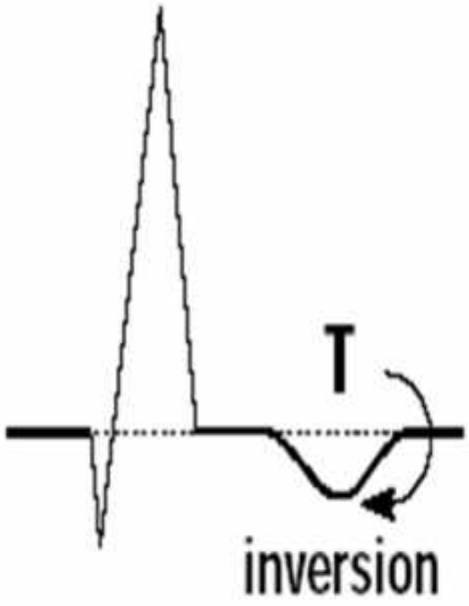

- Significant Q wave is one millimeter (one small square) wide, which is .04 sec. in duration…
  … or is a Q wave 1/3 the amplitude (or more) of the QRS complex.
- Note those leads (omit AVR) where significant Q's are present … see next page to determine infarct location, and to identify the coronary vessel involved.
- Old infarcts: significant Q waves (like infarct damage) remain for a lifetime. To determine if an infarct is acute, see below.

## ST (segment) elevation = (acute) **Injury** (pages 266-271) (also Depression)

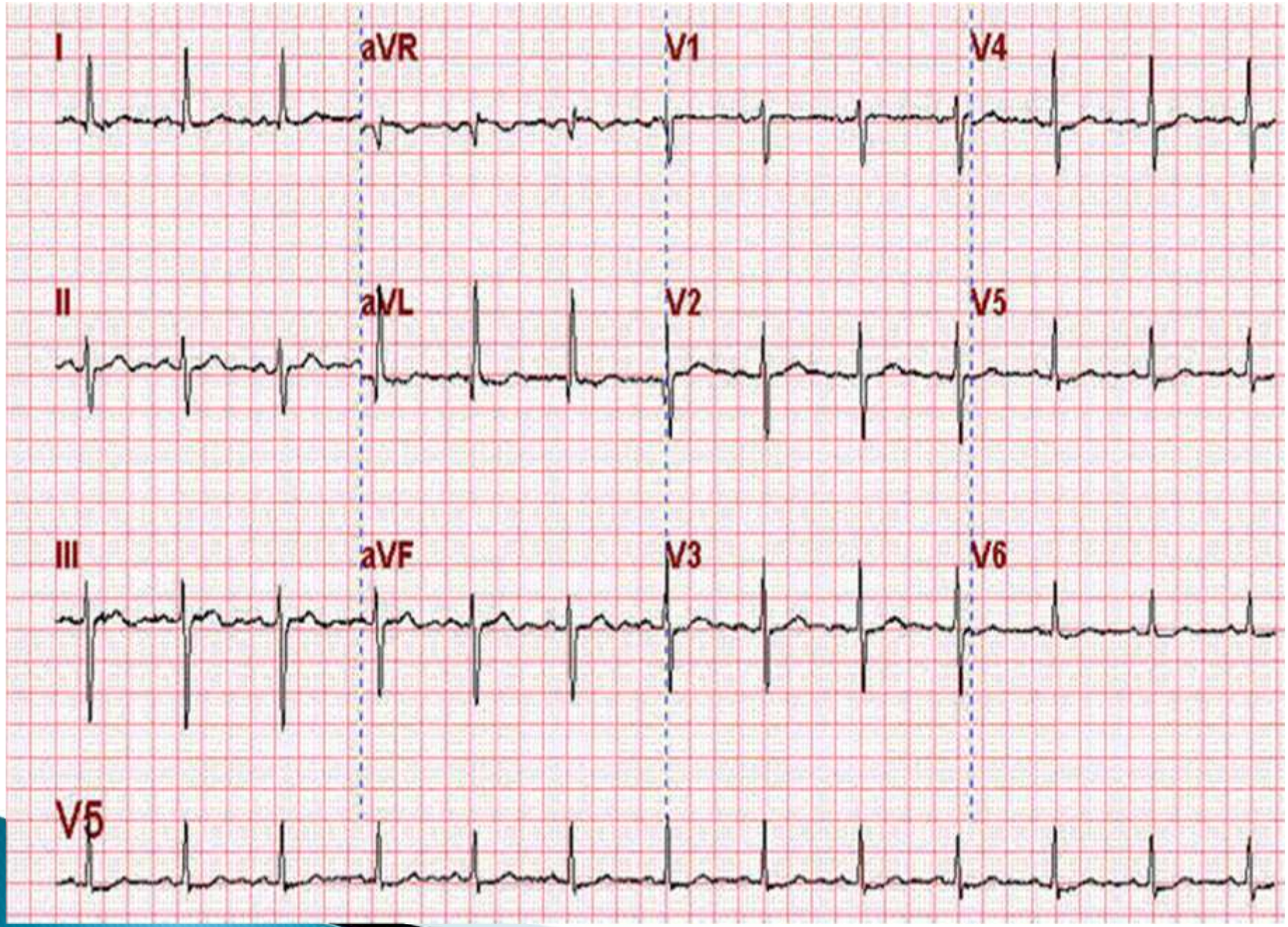


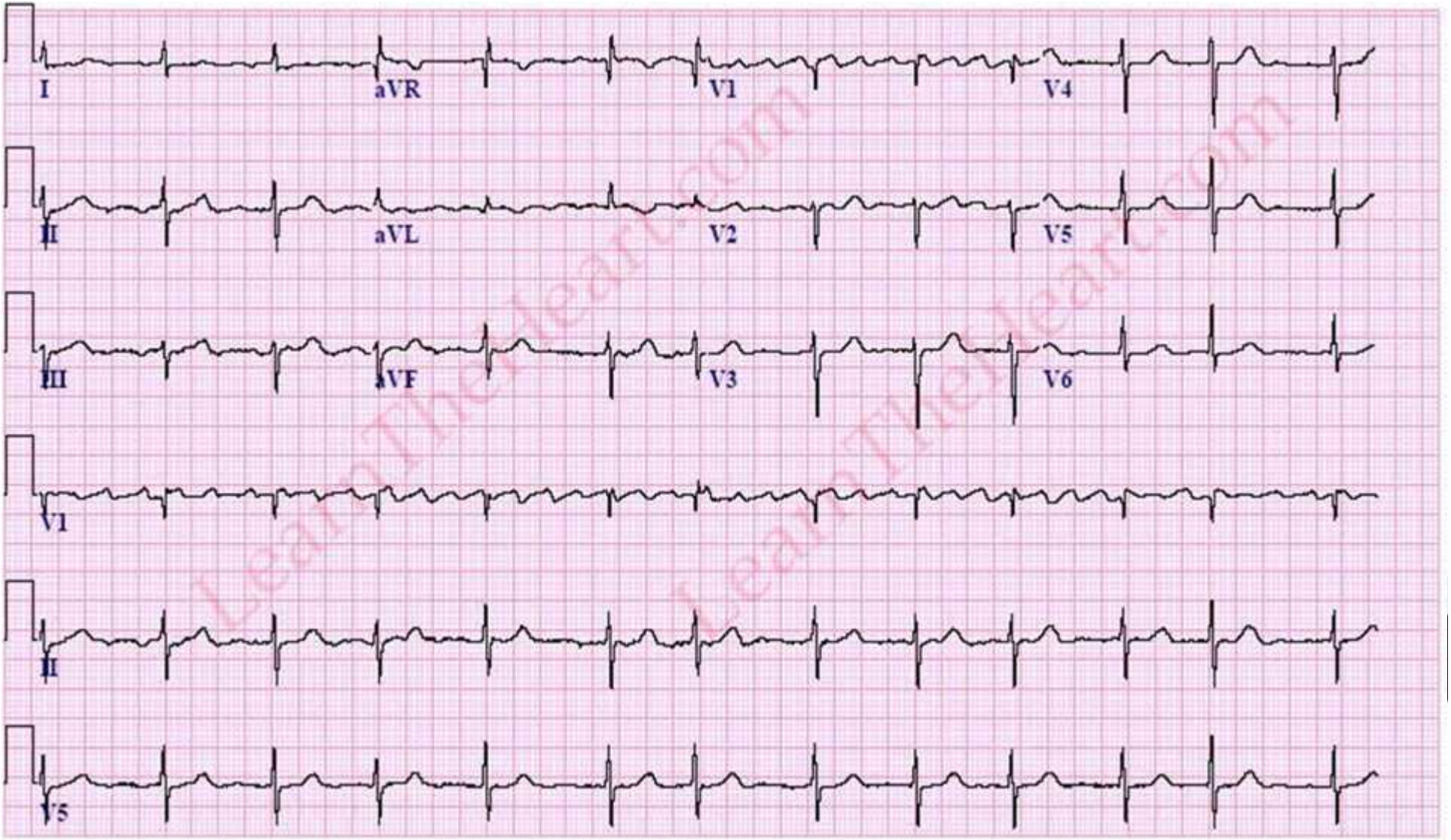

- Signifies an acute process, ST segment returns to baseline with time.
- ST elevation associated with significant Q waves indicates an acute (or recent) infarct.
- A tiny "non-Q wave infarction" appears as significant ST segment elevation without associated Q's. Locate by identifying leads in which ST elevation occurs (next page).
- ST depression (persistent) may represent "subendocardial infarction," which involves a small, shallow area just beneath the endocardium lining the left ventricle. This is also a variety of "non-Q wave infarction." Locate in the same manner as for infarction location (next page).

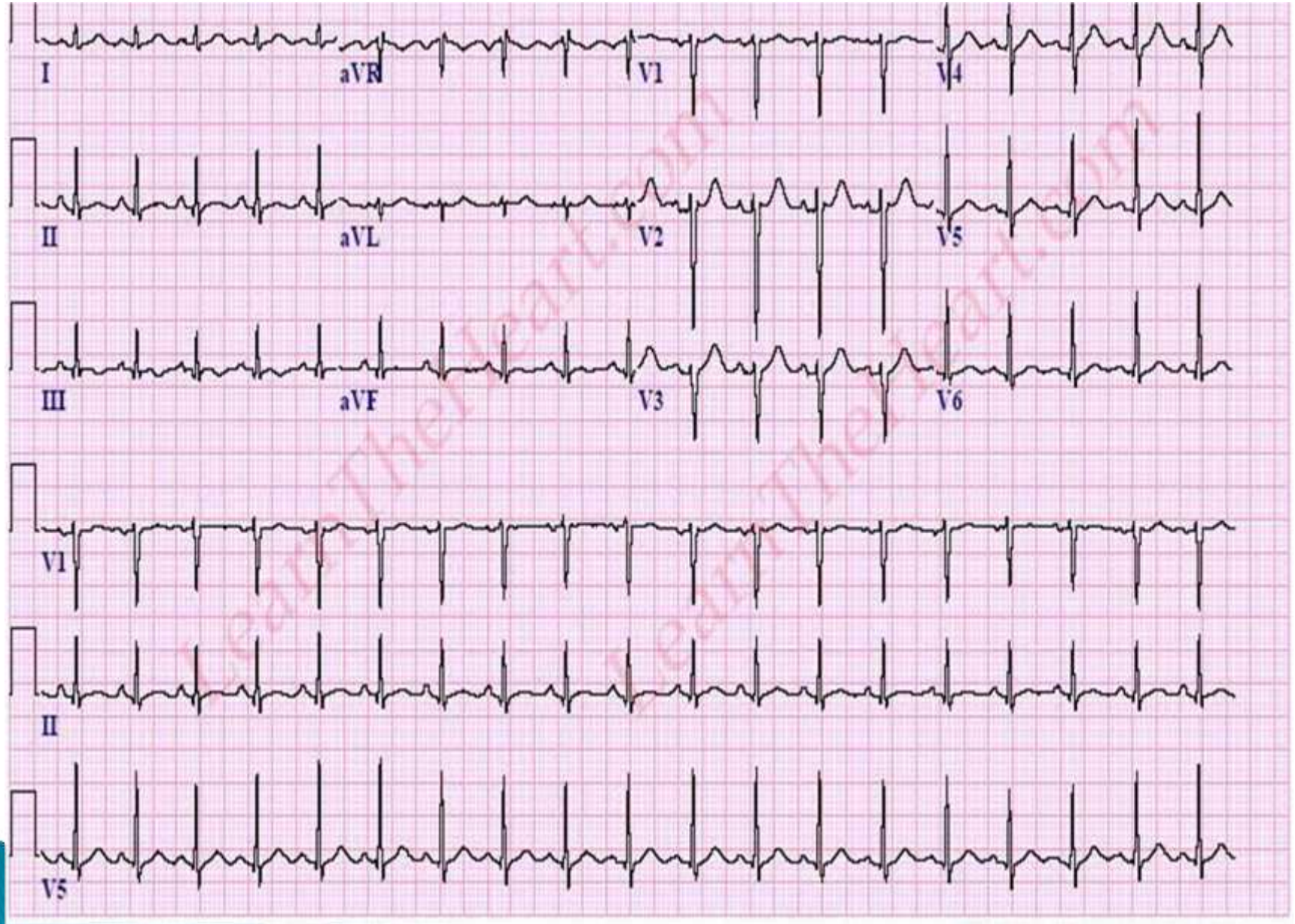
## T wave inversion = Ischemia (pages 264, 265)

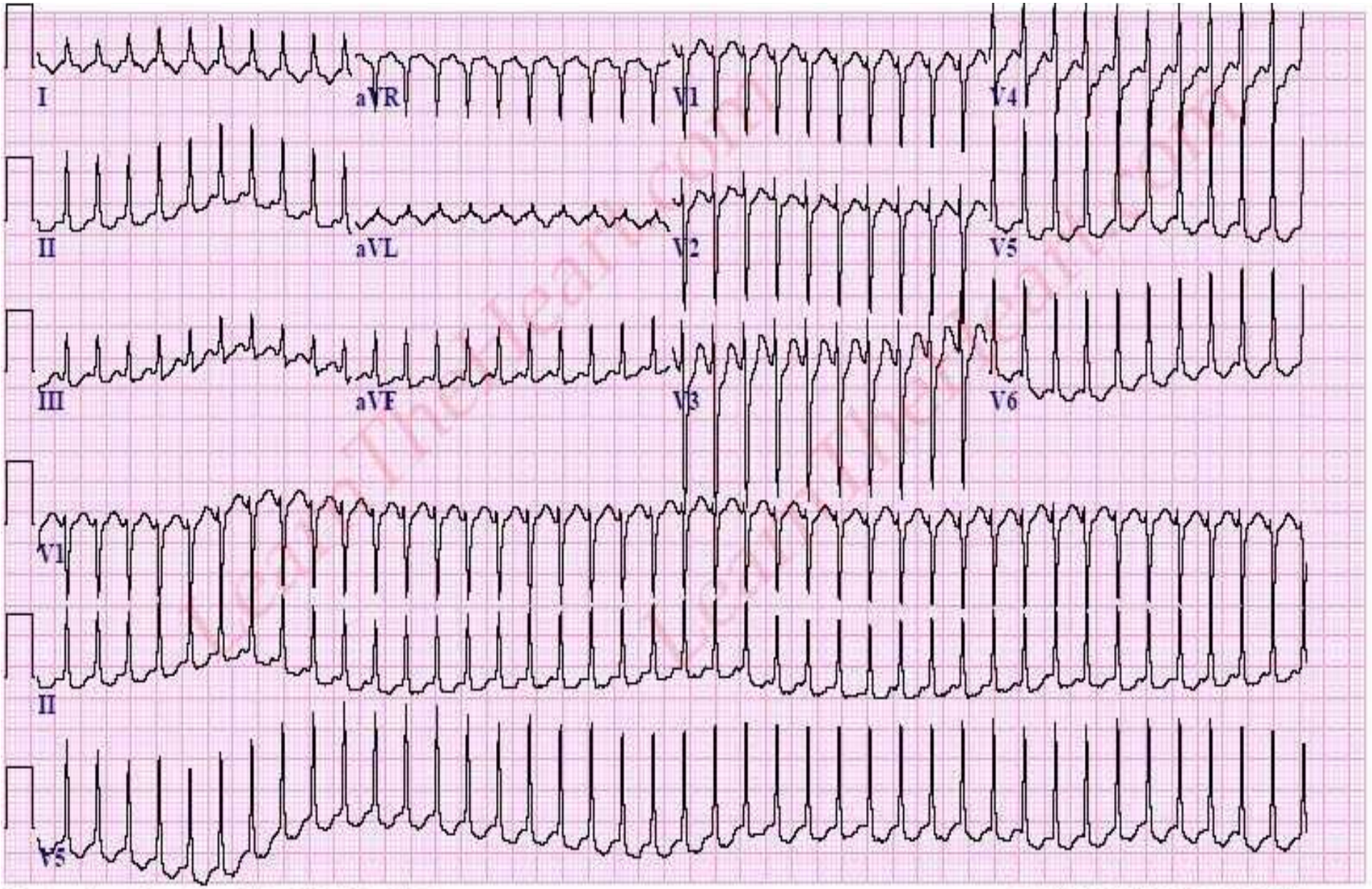



- Inverted T wave (of ischemia) is symmetrical (left half and right half are mirror images). Normally T wave is upright when QRS is upright, and vice versa.
- Usually in the same leads that demonstrate signs of acute infarction (Q waves and ST elevation).
- Isolated (non-infarction) ischemia may also be located; note those leads where T wave inversion occurs, then identify which coronary vessel is narrowed (next page).

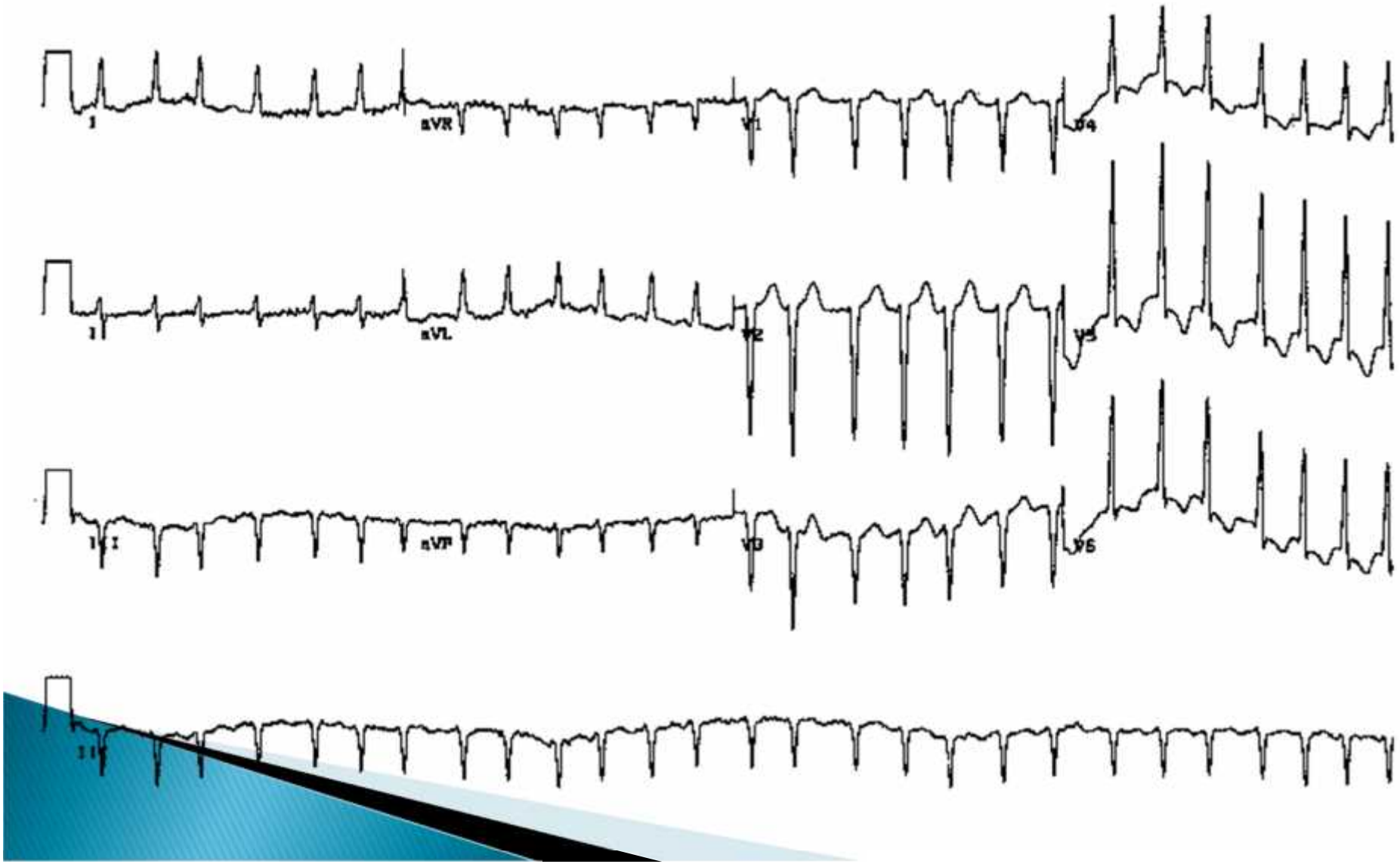

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V5

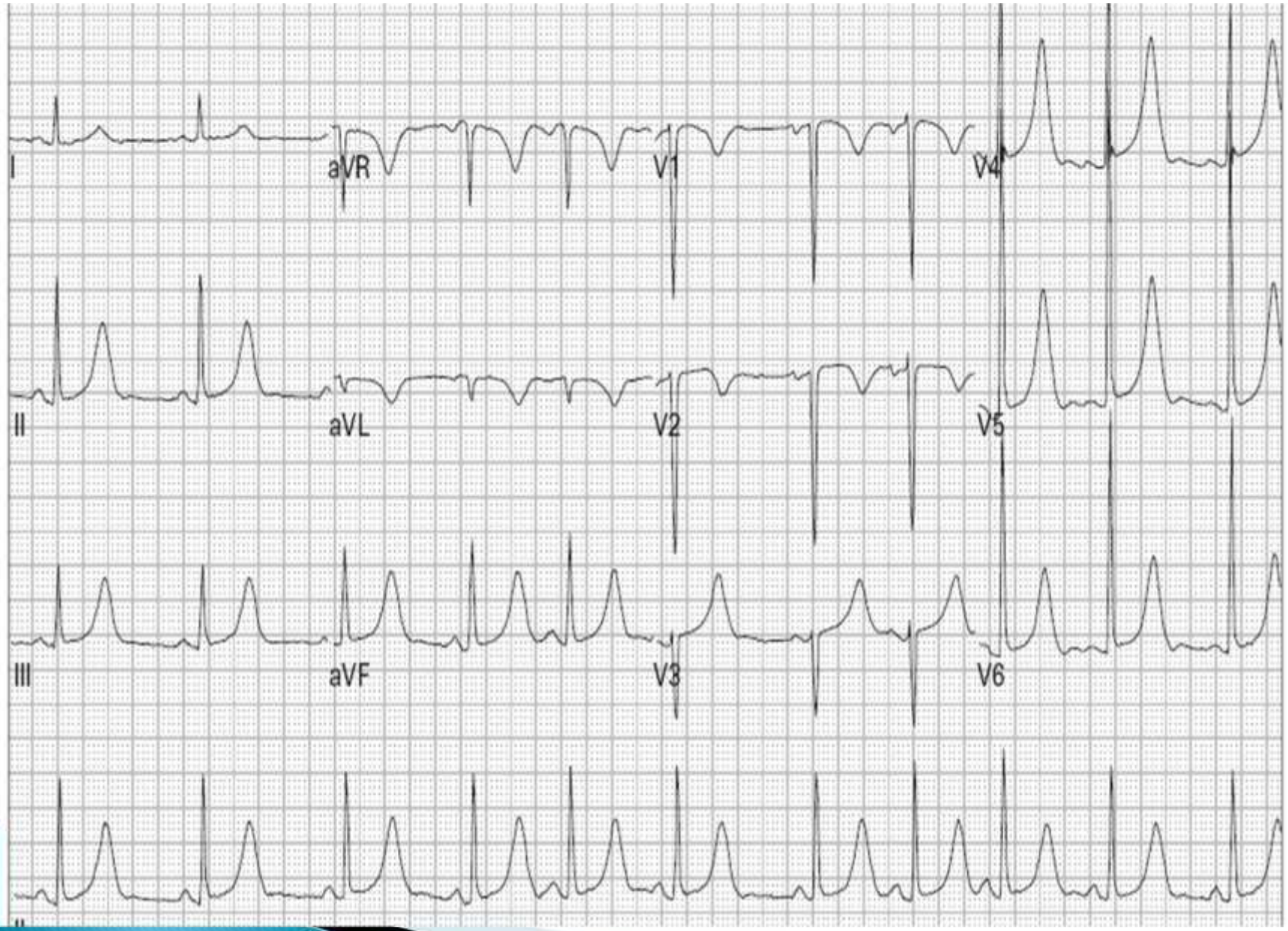

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 150Hz 005C 12SL 250 CID: 1
EID:607 EDT: 14:06 17-NOV-2001 ORDER:


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5

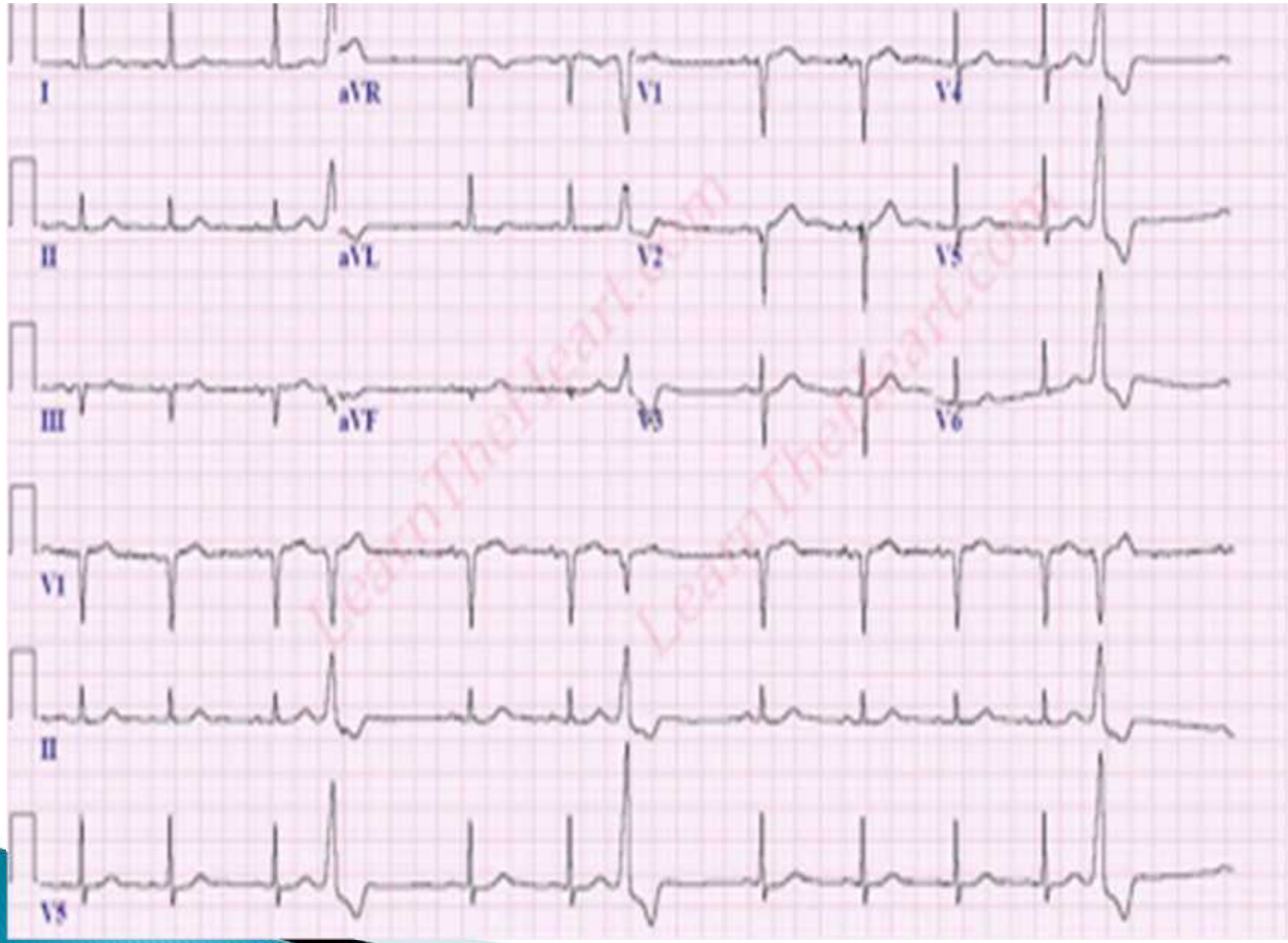

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 40Hz 005C 12SL 254 CID: 30
EID:610 EDT: 16:14 28-APR-2005 ORDER:

# Atrial Fibrillation with Rapid Ventricular Response

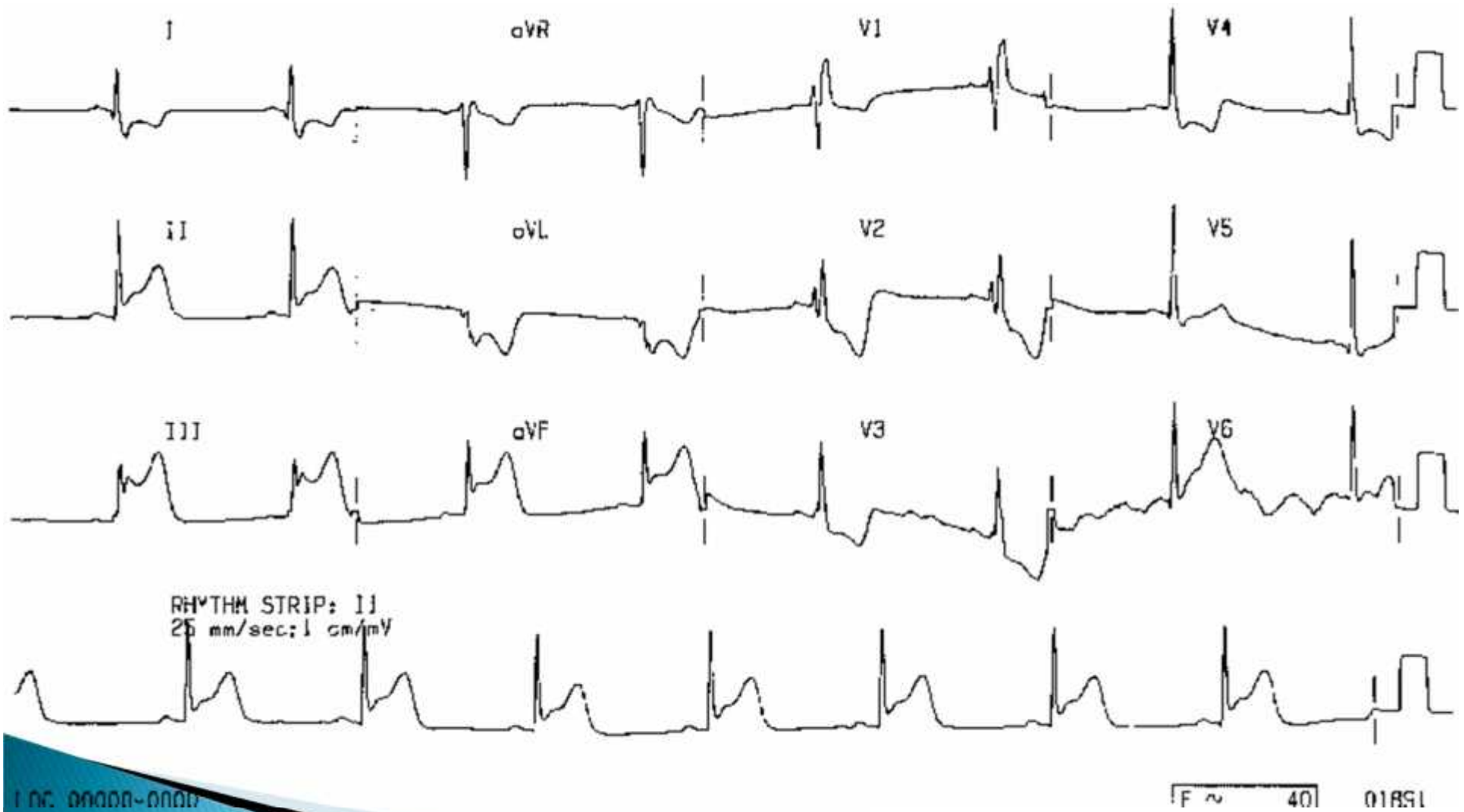



I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

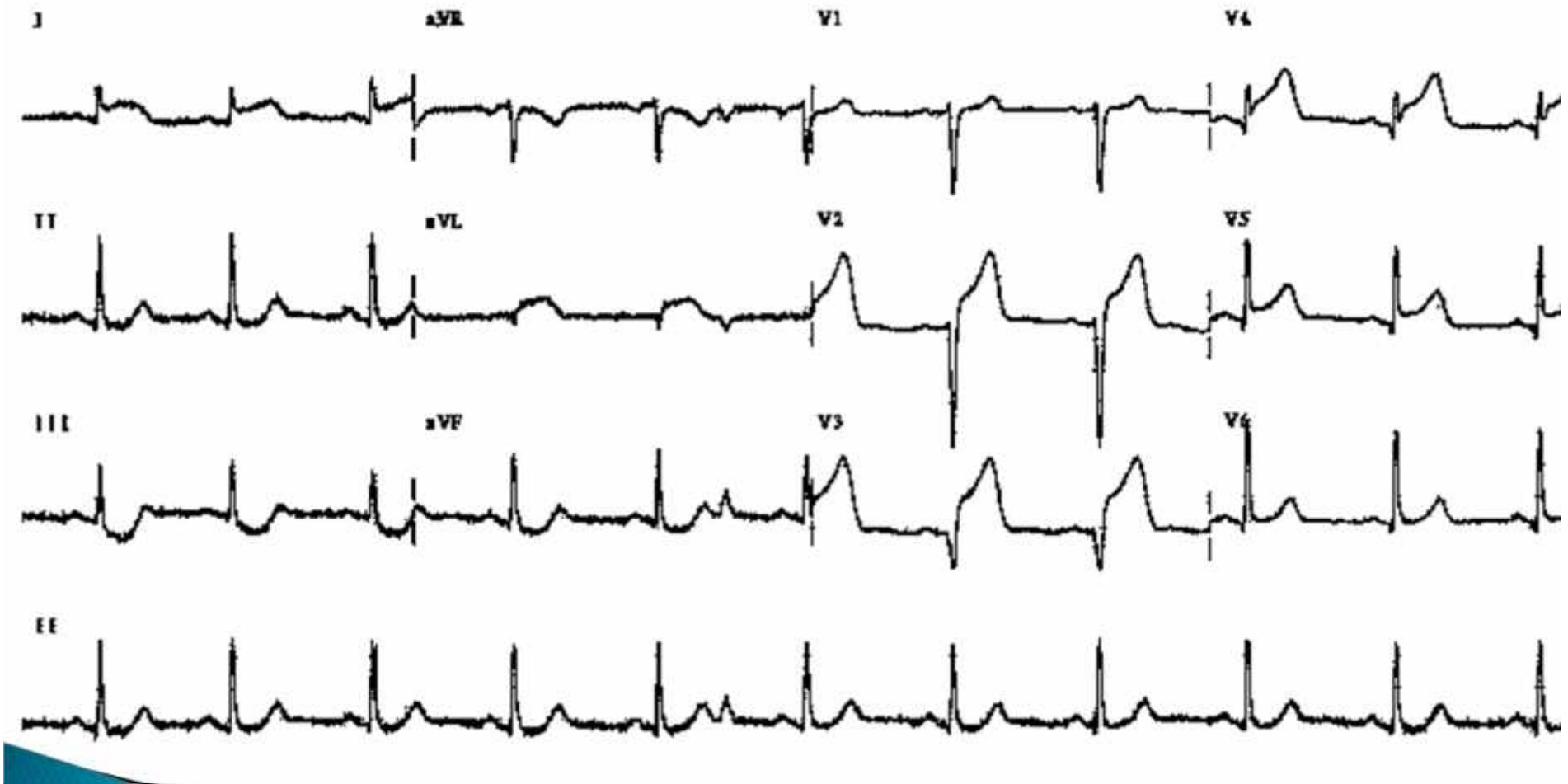

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5

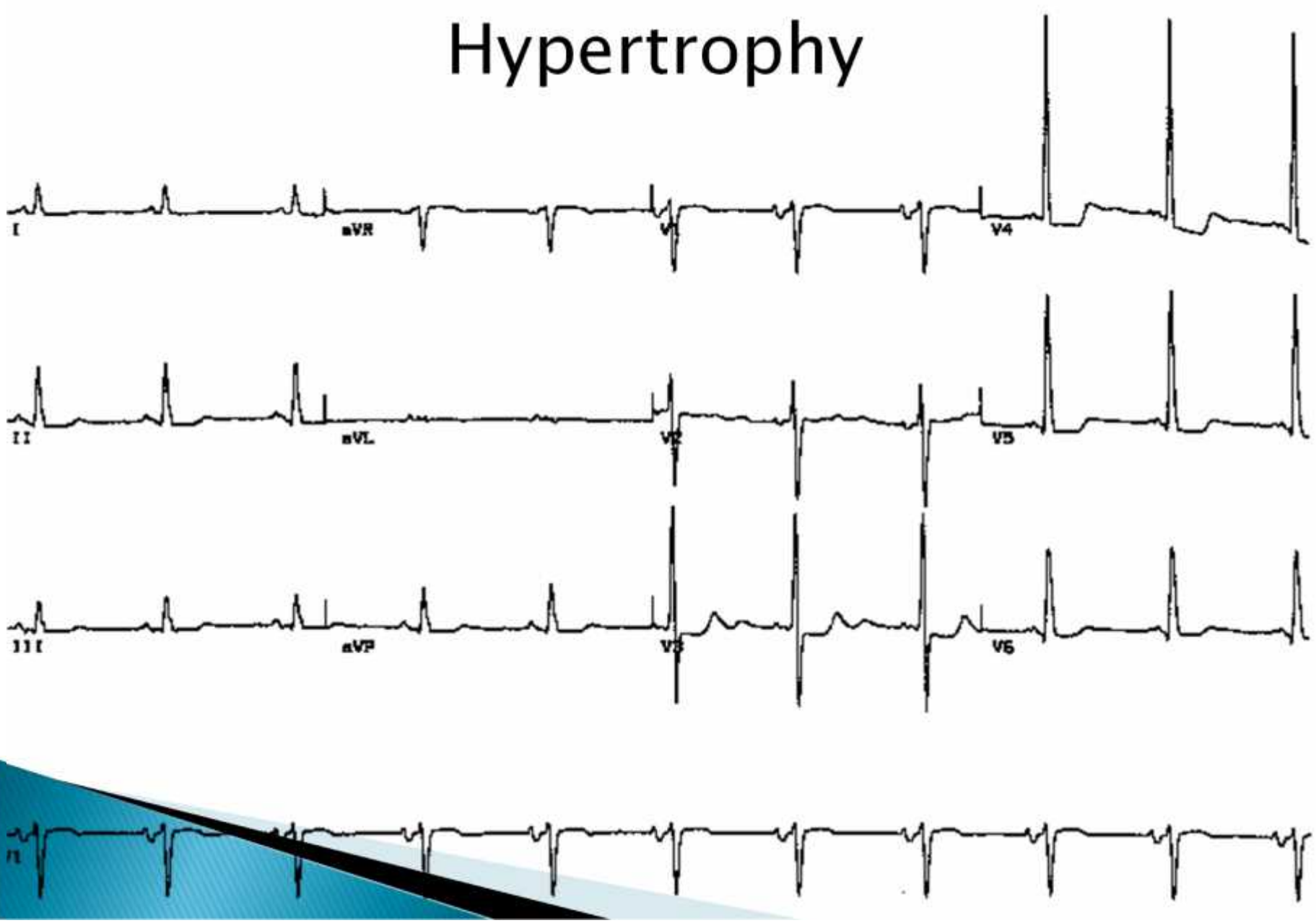
# Inferior Acute MI and RBBB



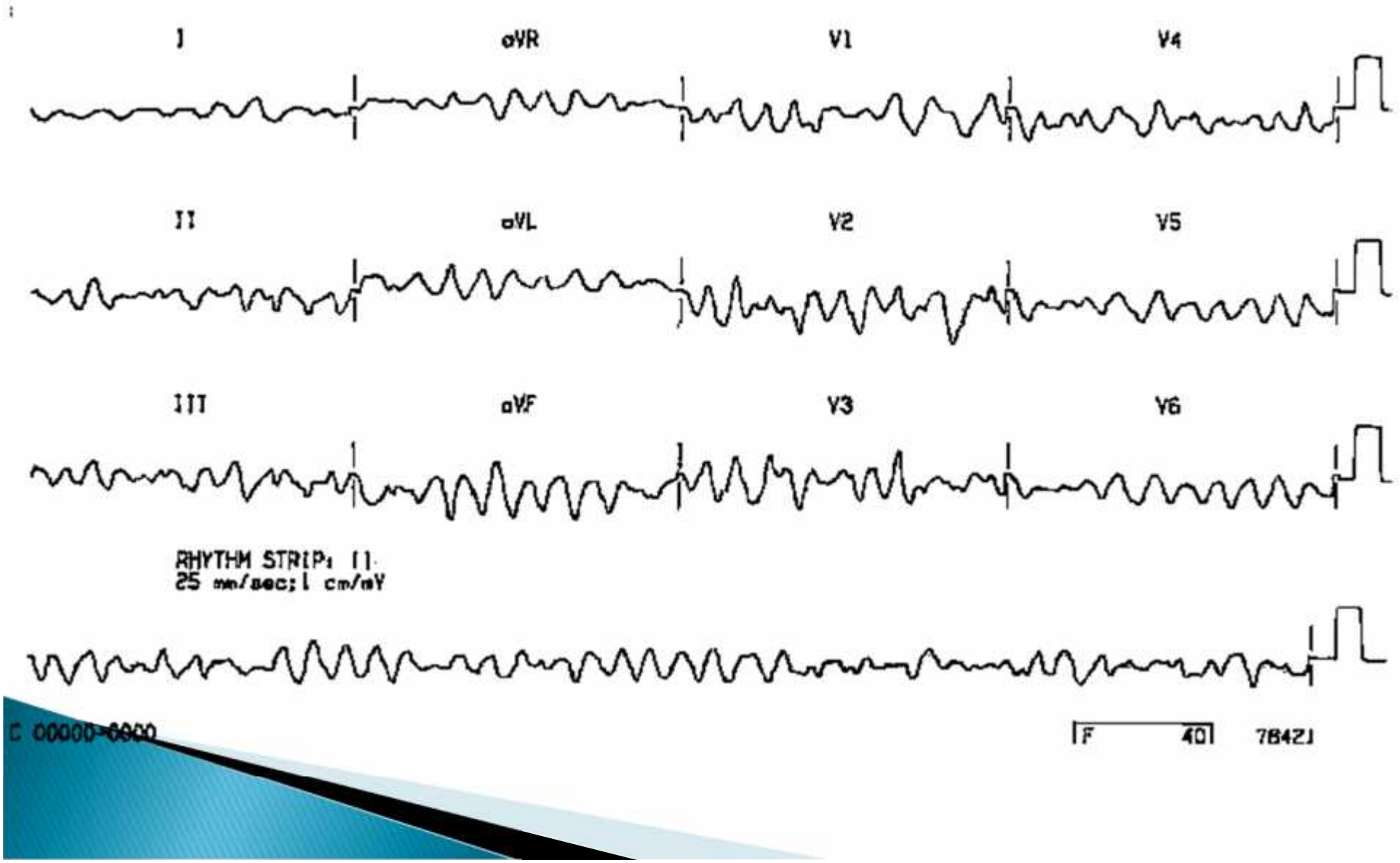
# Anterior Acute MI

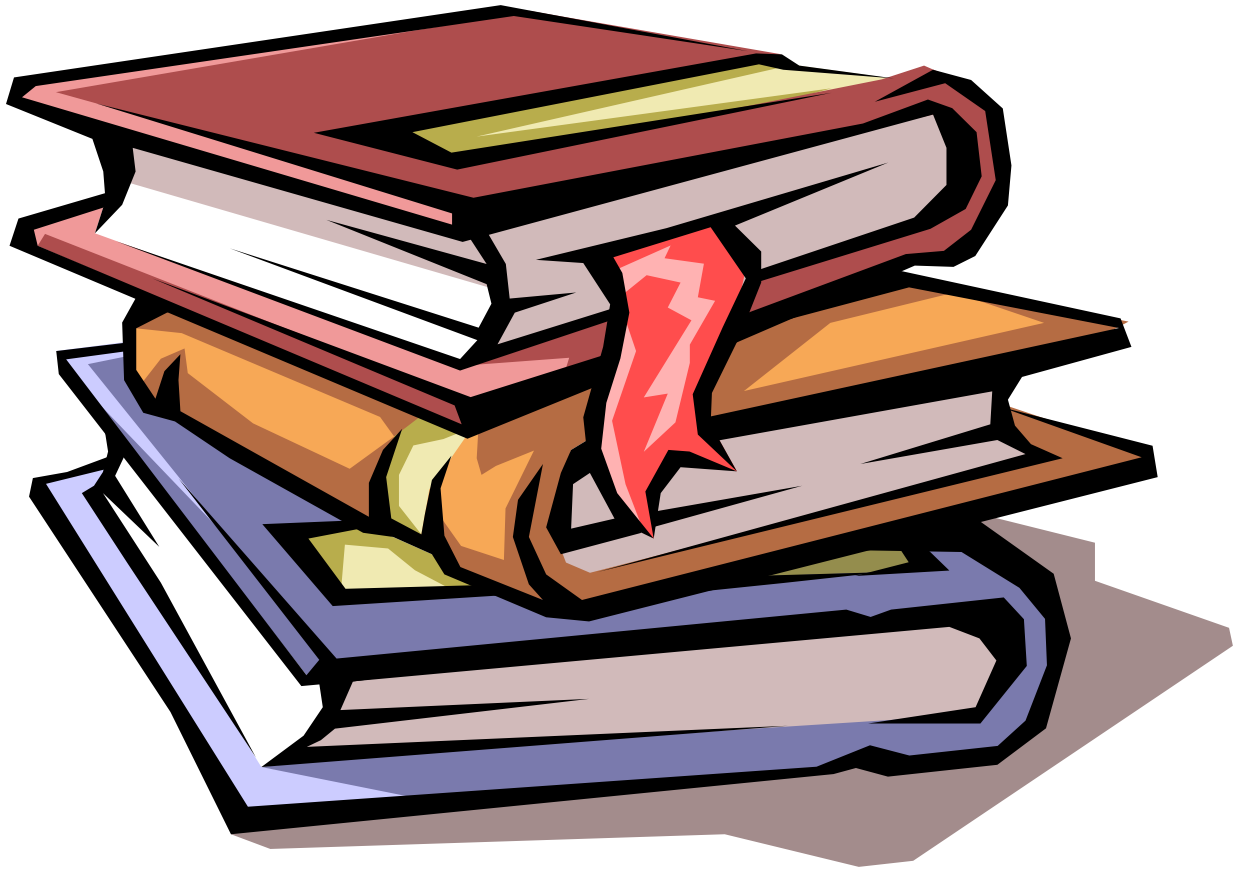


# Left Ventricular Hypertrophy



# Ventricular Fibrillation





# TERIMAKASIH