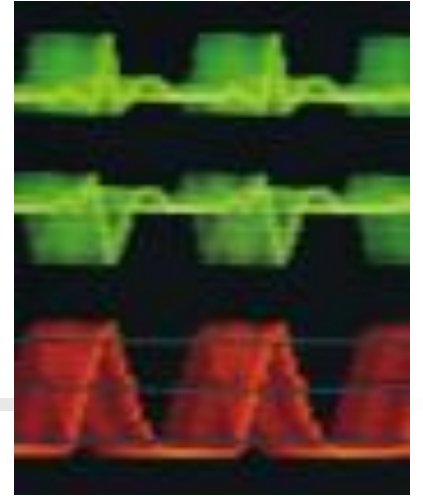
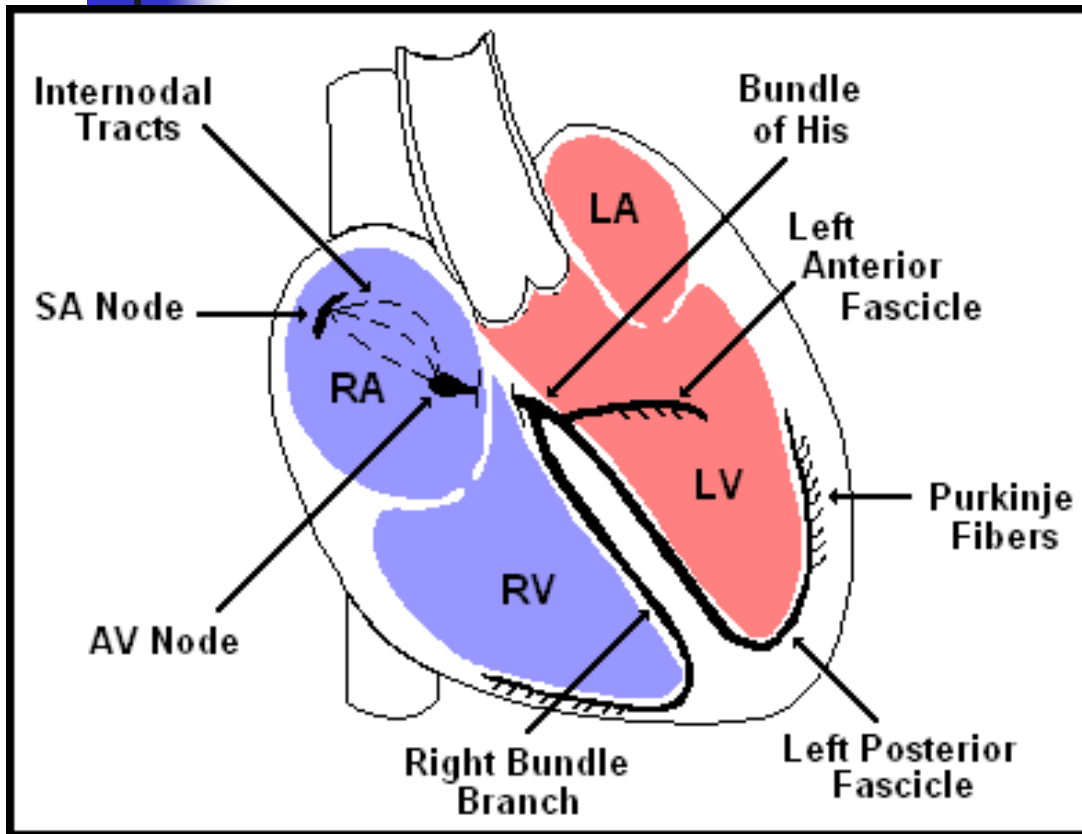




# EKG Interpretation



# The Normal Conduction System



## 1) THE SINOATRIAL NODE (KEITH FLACK) :

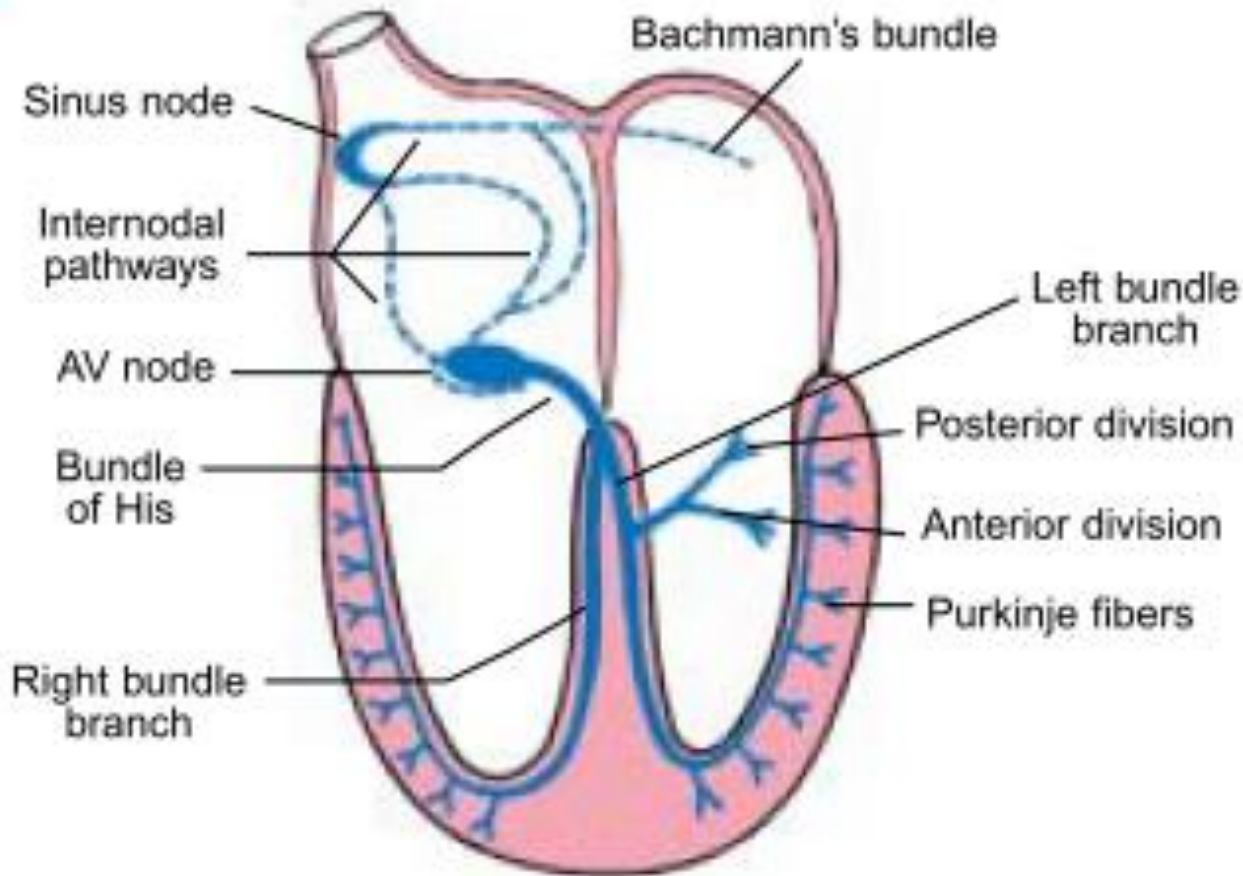
- postero-superior in the RA
- Heart rate 60-90/minute

## 2)THE ATRIOVENTRICULAR NODE (ASCHOFF TAWARA):

- atrio-ventricular level, near the inter-atrial septum;
- SAN is connected to the AVN through specialized **internodal pathways**:

- a)anterior pathway - **Bachman**
- b)midle pathway - **Wenckebach**
- c) posterior pathway- **Thorel**

# The excitoconductory system



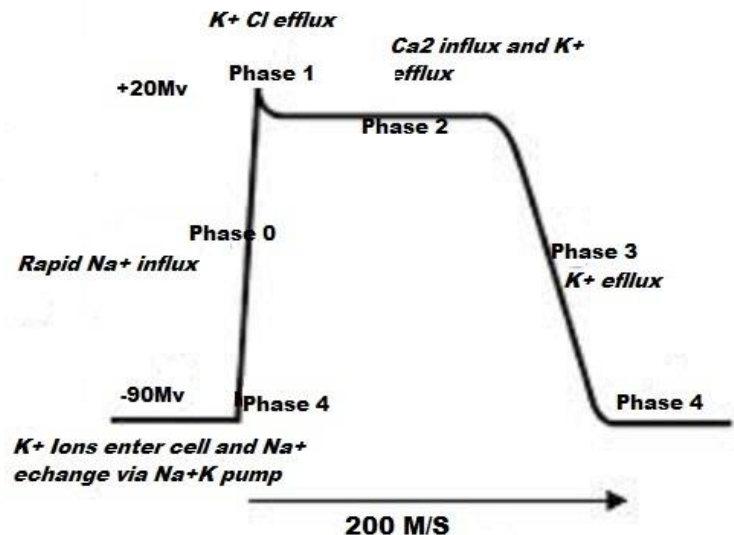
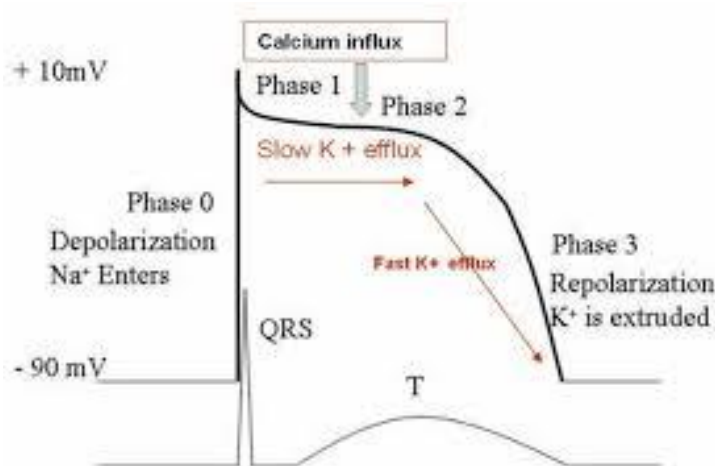
# Electrocardiography (ECG)

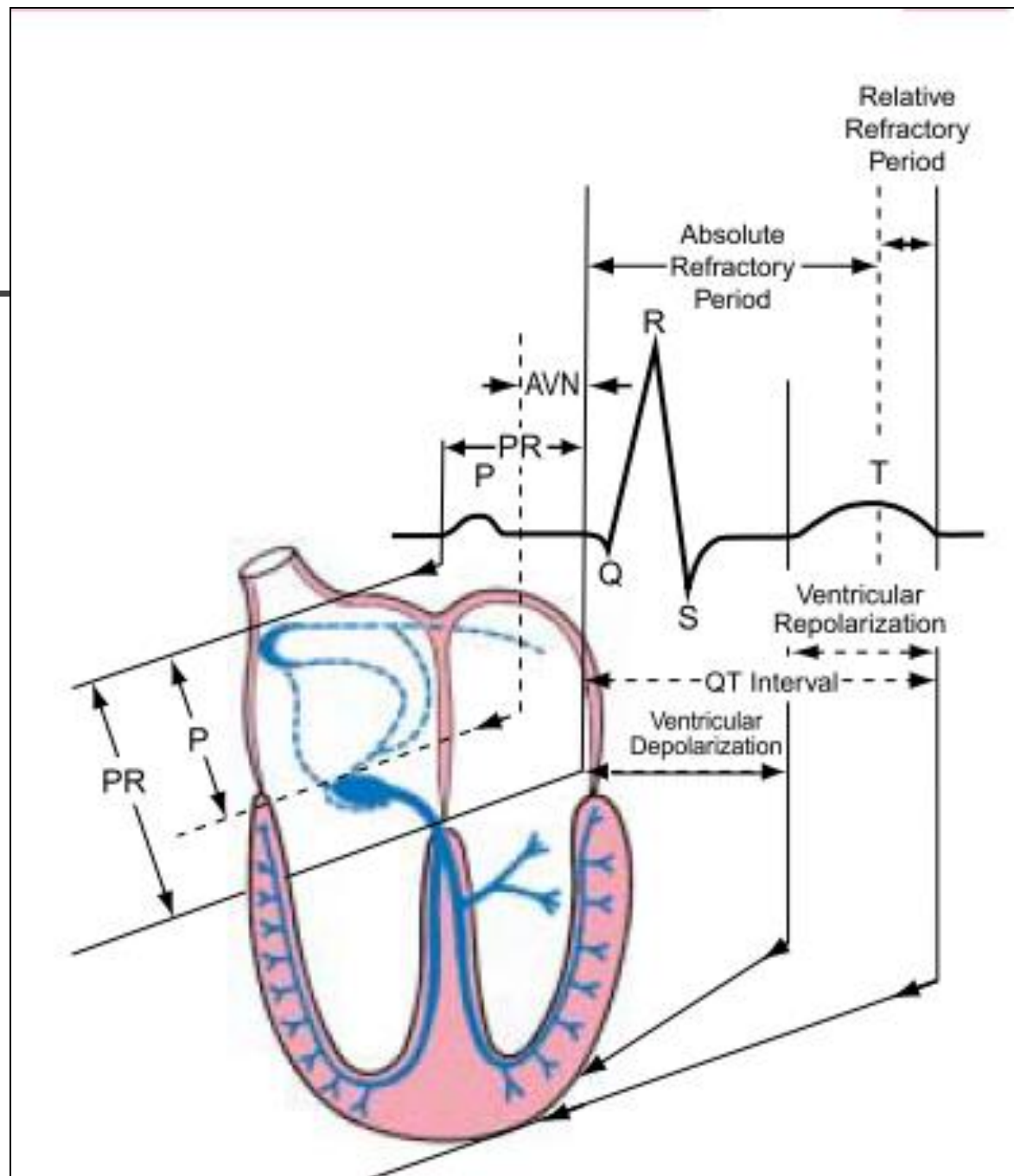


- *Electrocardiography (ECG)* = the process of recording the electrical activity of the heart, over a period of time, using electrodes placed on the skin.
- The electrodes are detecting the electrical changes determined by the heart electrophysiological pattern of depolarization and repolarization.

**Depolarization** = modification of the membrane potential, determined by the fact that the negative internal charge of the cell becomes positive.

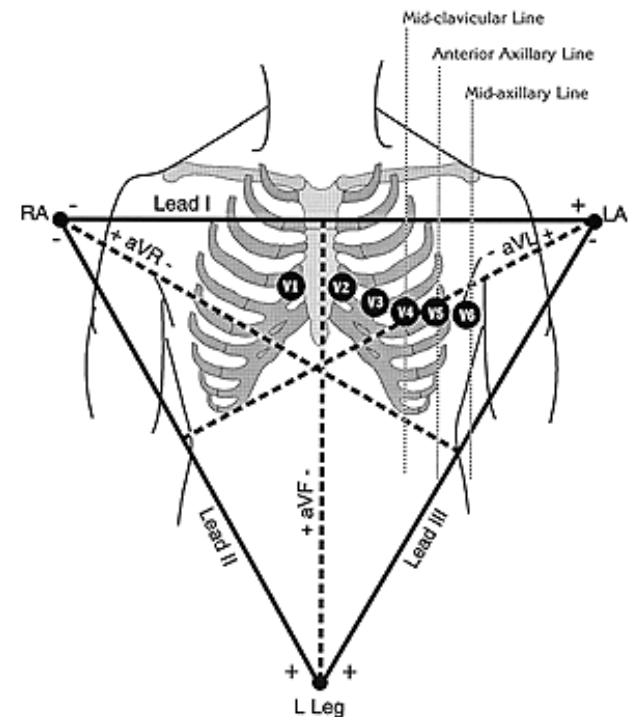
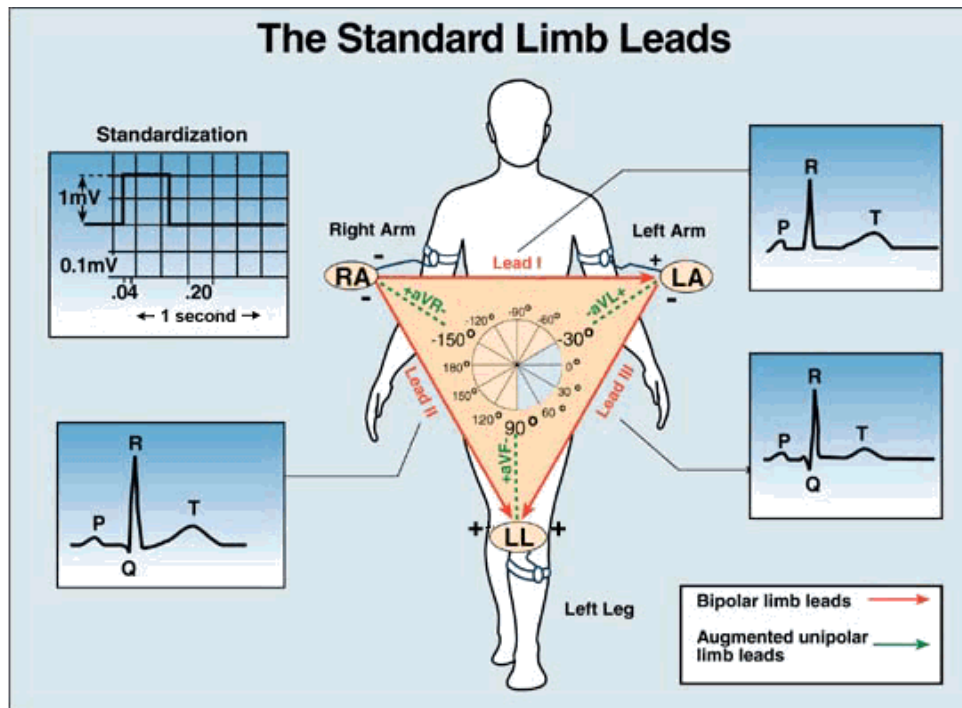
**Repolarization** = a change in membrane potential that returns to a negative value.





# ECG leads

- **Bipolar (standard) limb leads (I, II, III)** – introduced in clinical practice by Einthoven
  - they form an equilateral triangle
- **Unipolar limb leads (aVR, aVL, aVF)** – introduced by Wilson.
- **Precordial leads (V1-V6)** - unipolar leads, for that ones the electrode is located at the level of the thorax

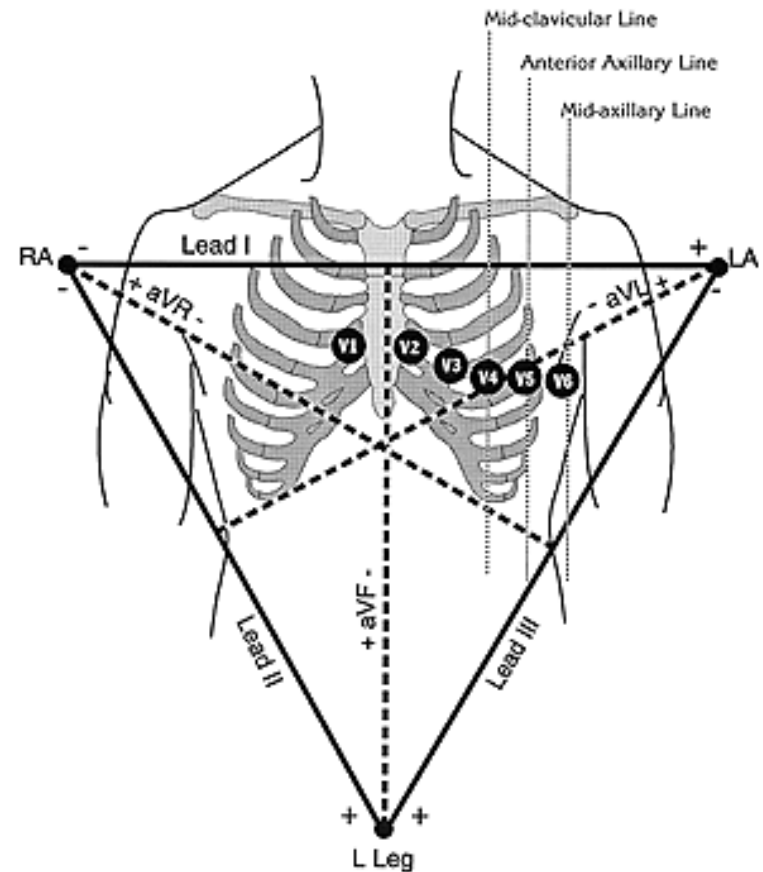
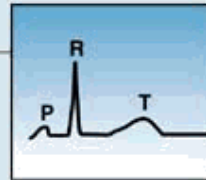
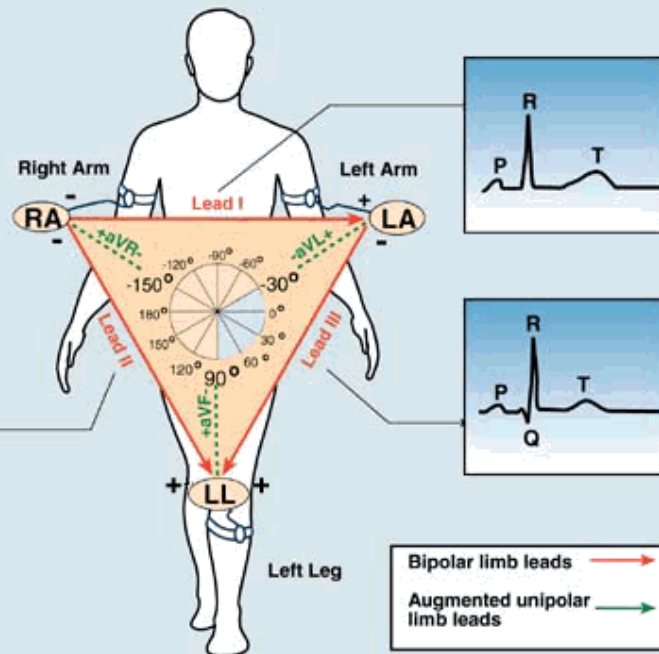
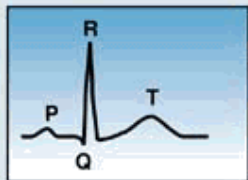
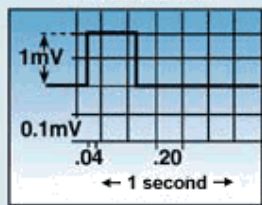


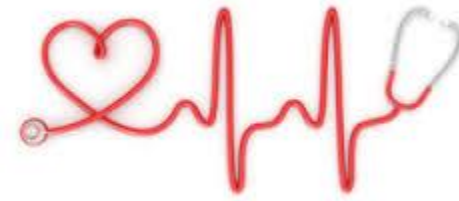


# Lead Placement

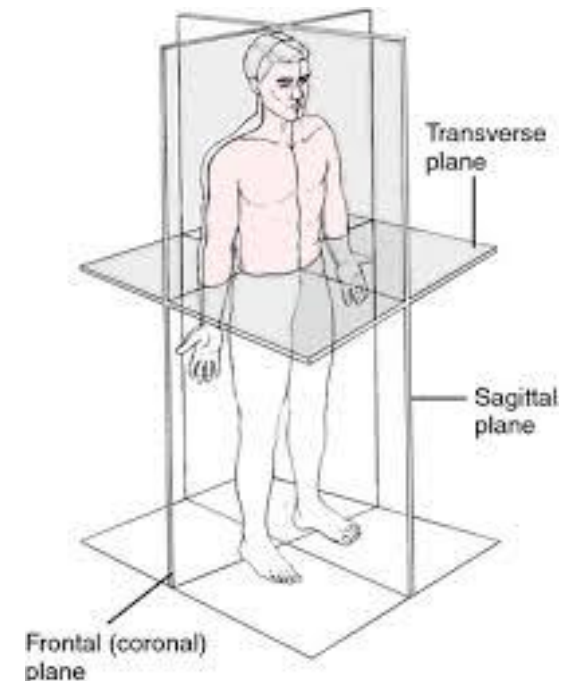
## The Standard Limb Leads

### Standardization



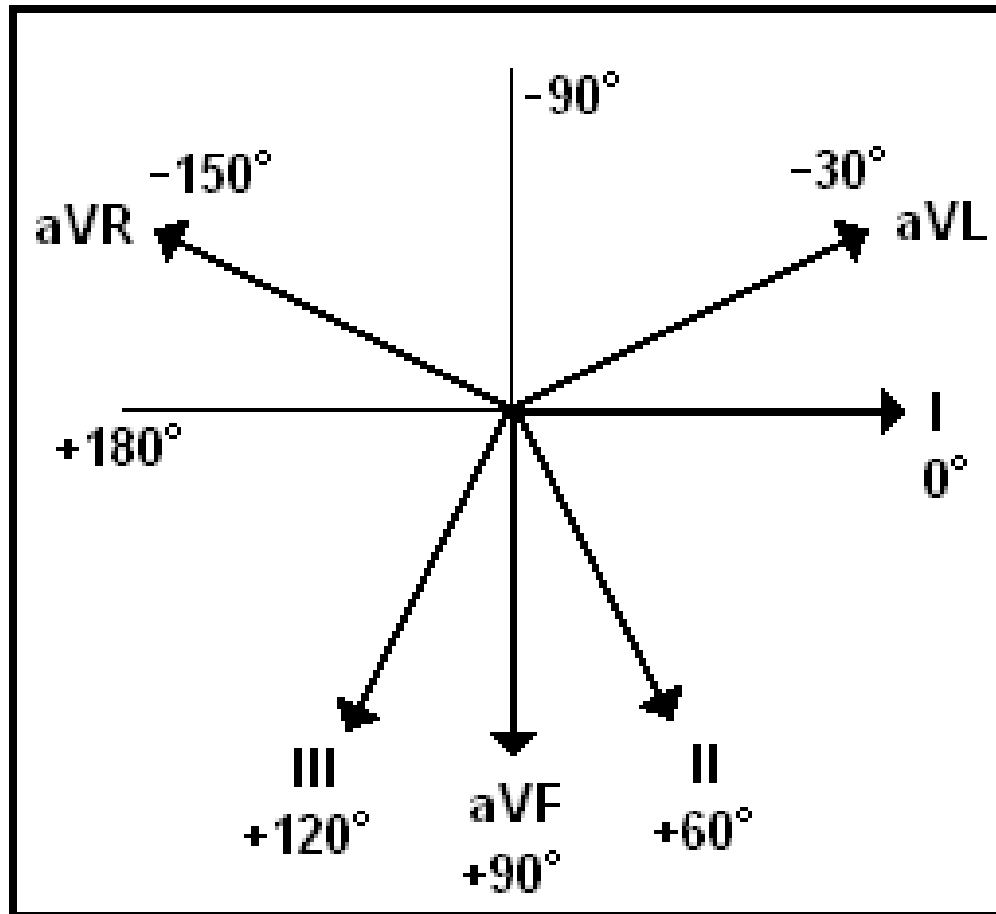


- Limb leads are recording the electrical activity from a frontal plane
- Precordial leads are recording the activity from a transverse plane.



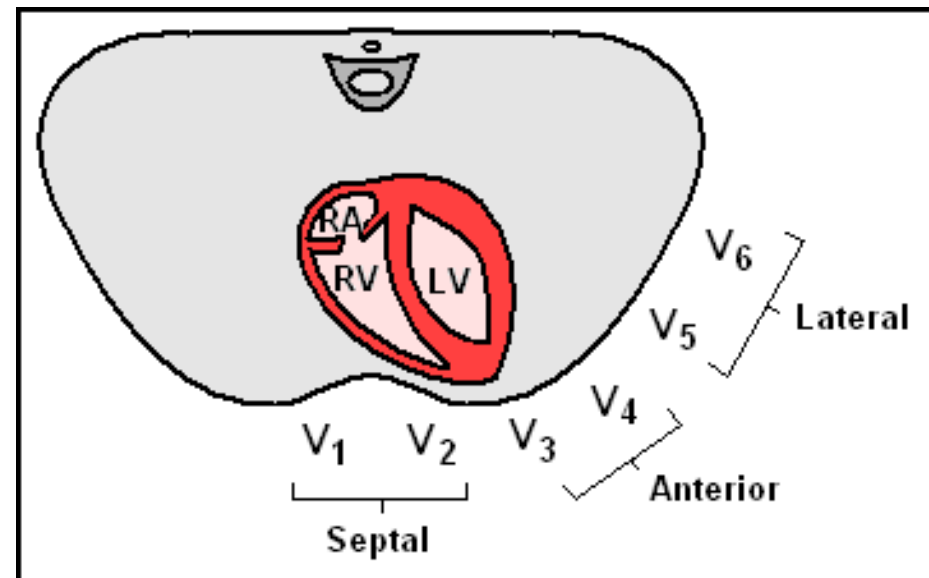
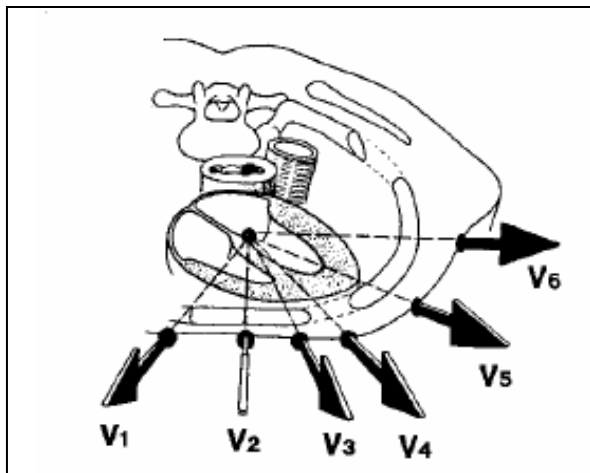
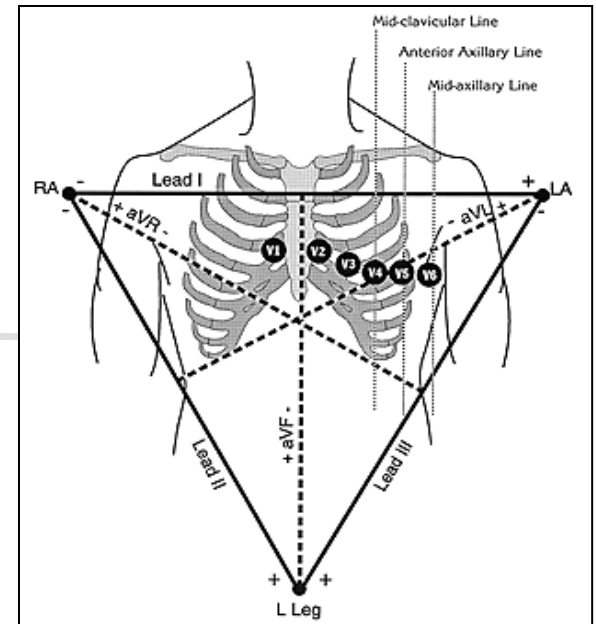


# All Limb Leads



# EKG Distributions

- Anteroseptal: V1, V2, V3, V4
- Anterior: V1–V4
- Anterolateral: V4–V6, I, aVL
- Lateral: I and aVL
- Inferior: II, III, and aVF
- Inferolateral: II, III, aVF, and V5 and V6

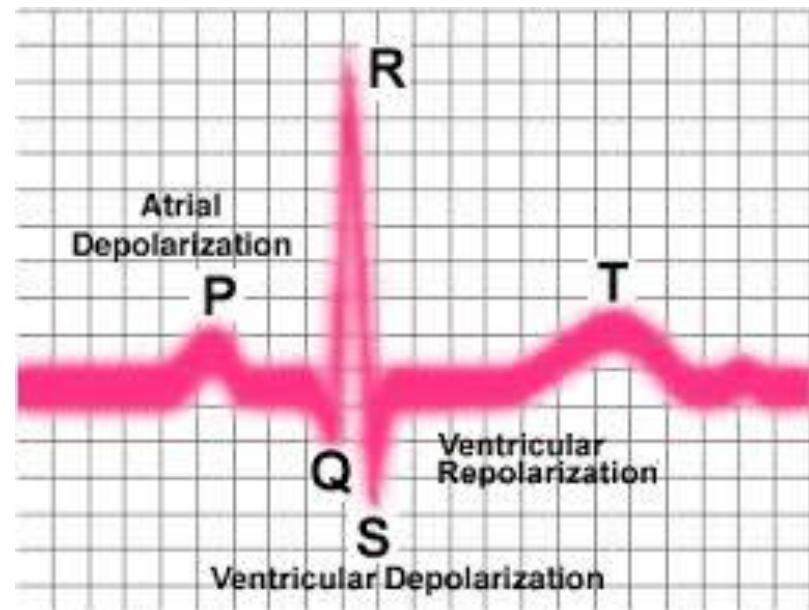
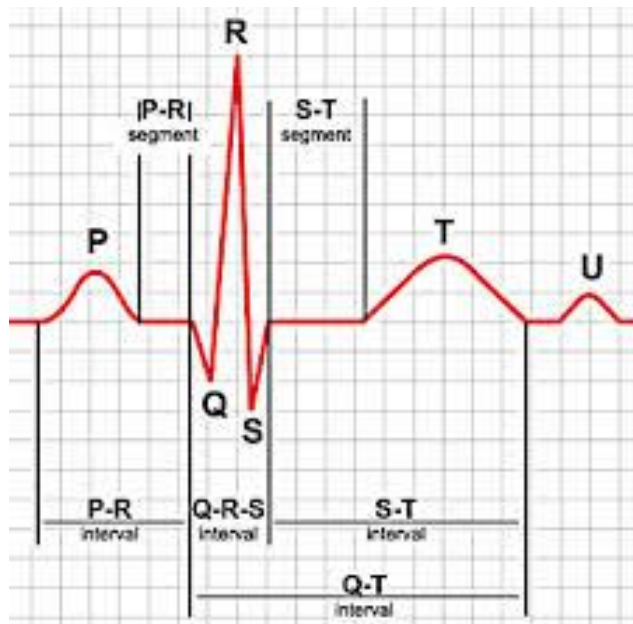


# ECG parameters

- waves: P, Q, R, S, T and U (positive or negative deflections).
- segments: between the waves
- intervals: are including segments as well as waves.

Standard ECG :

- amplitude: 1mm=0.1 mV
- duration: 1mm=0.04 s.





# Interpretation

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- Develop a systematic approach to reading EKGs and use it every time
- The system we will practice is:
  - Rate
  - Rhythm (including intervals and blocks)
  - Axis
  - Hypertrophy
  - Ischemia



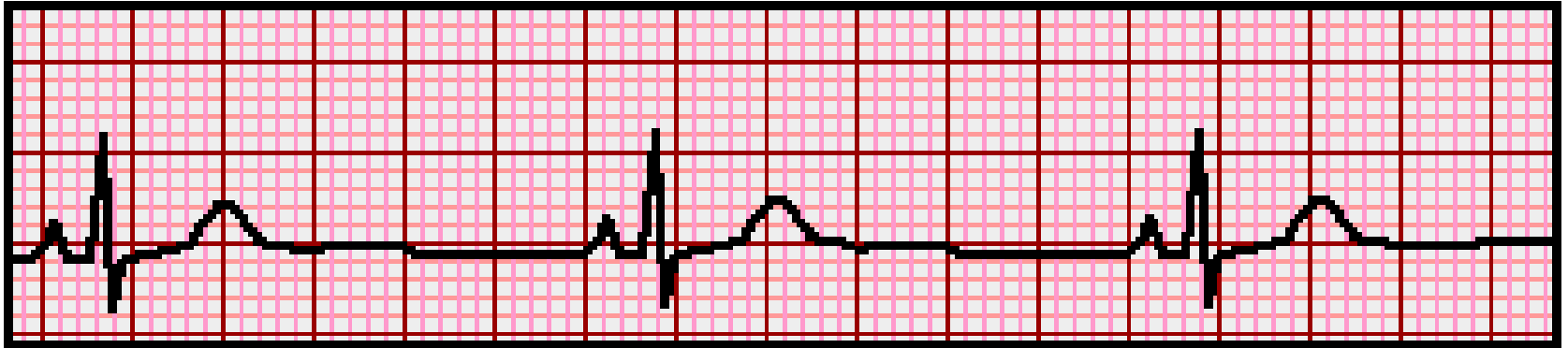
# Rate

---

- Rule of 300- Divide 300 by the number of boxes between each QRS = rate

Number of big boxes	Rate
1	300
2	150
3	100
4	75
5	60
6	50

# What is the heart rate?



[www.uptodate.com](http://www.uptodate.com)

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

# Rate

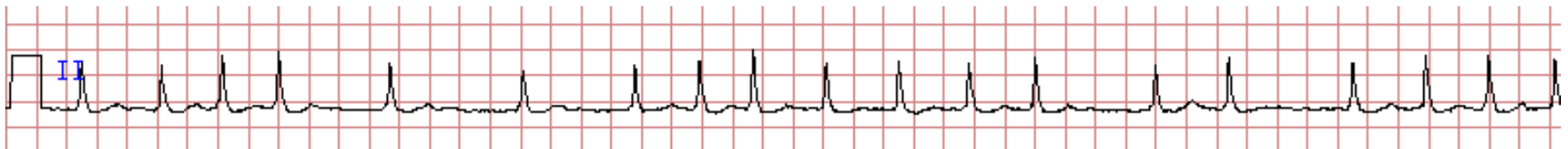
Square Counting: 300-150-100-75-60-50-42...



**Formula:**  
**1500/nr. Millimeters between 2 successive R waves**

**1500/RR (mm)**  
-(1mm = 0,04s)

Count QRS in 10 second rhythm strip x 6







# Rate

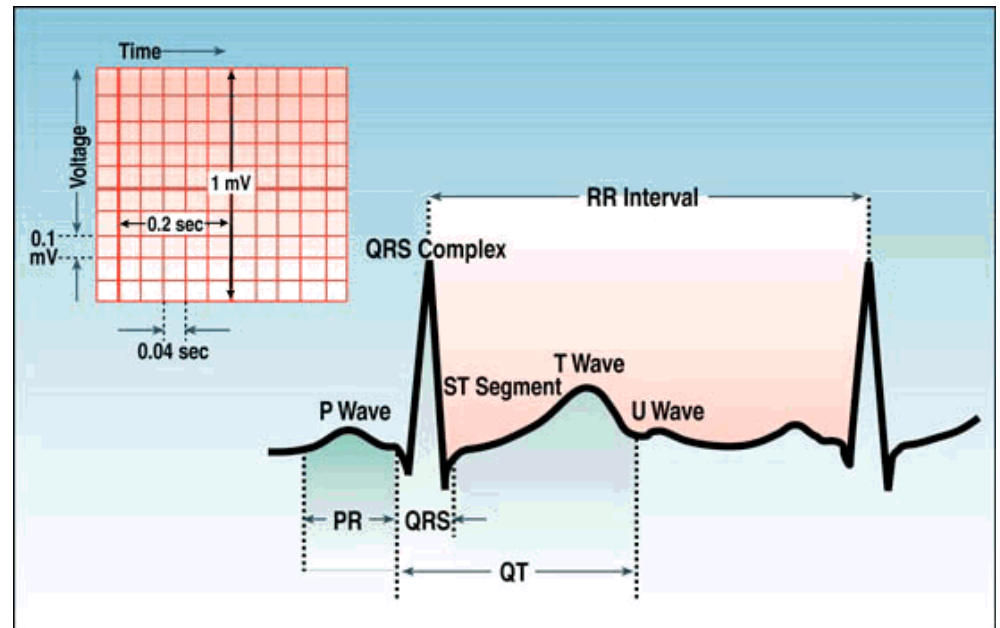
---

- HR of 60-100 per minute is normal
- $\text{HR} > 100 = \text{tachycardia}$
- $\text{HR} < 60 = \text{bradycardia}$

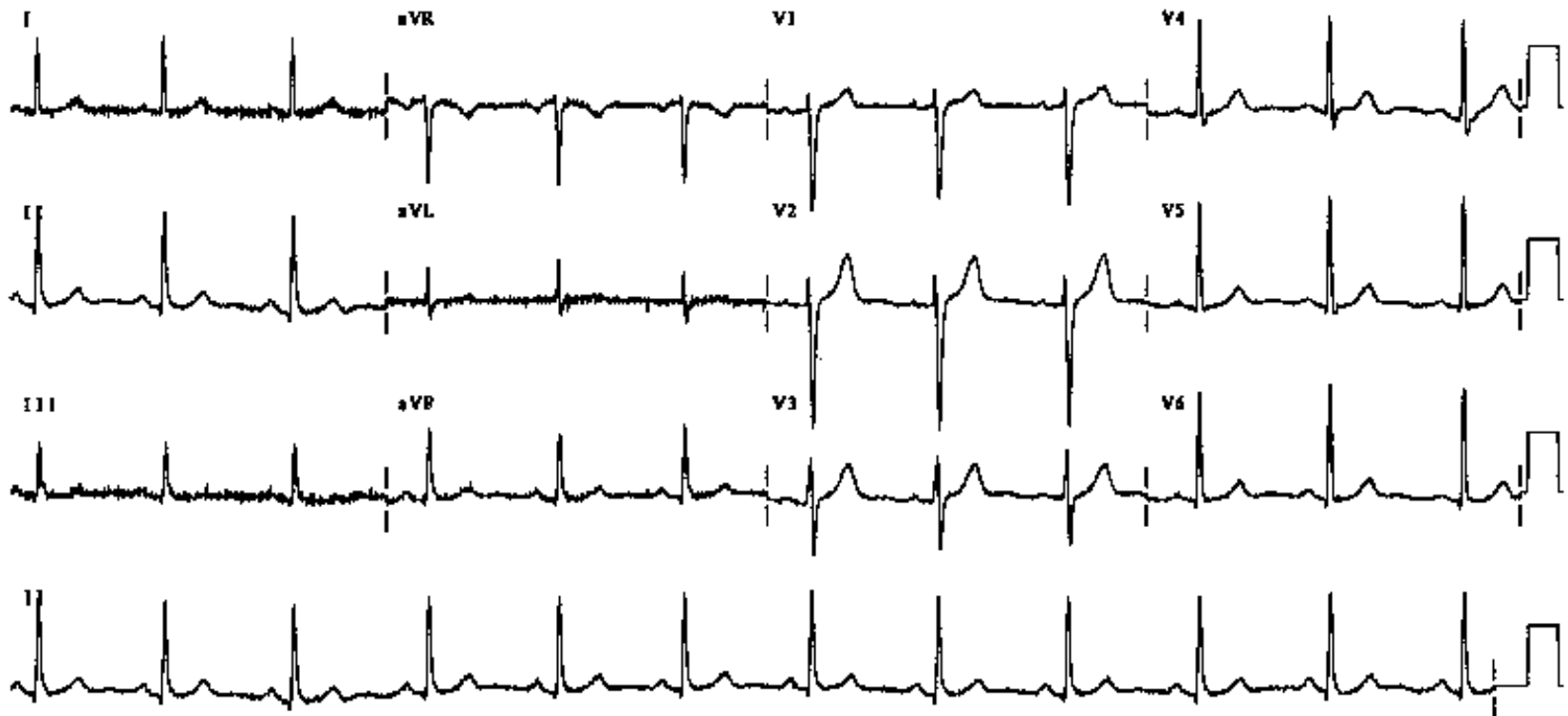
# Rhythm

## ■ Sinus

- Originating from SA node
- P wave before every QRS
- P wave in same direction as QRS



# Normal sinus rhythm



# Normal Intervals

## ■ PR

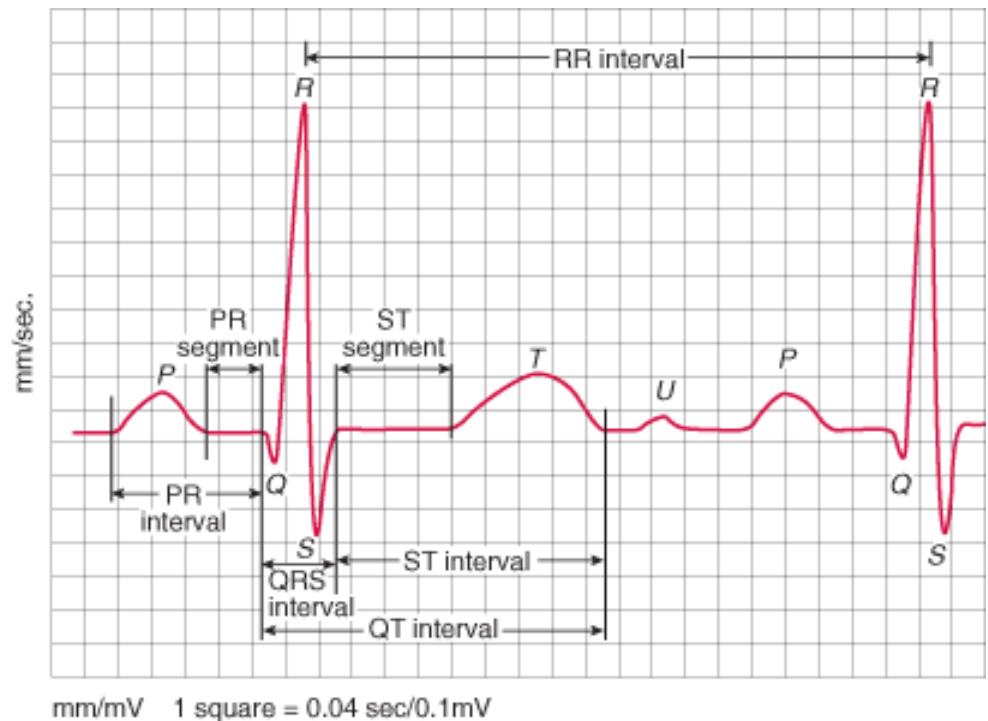
- 0.20 sec (less than one large box)

## ■ QRS

- 0.08 – 0.10 sec (1-2 small boxes)

## ■ QT

- 450 ms in men, 460 ms in women
- Based on sex / heart rate
- Half the R-R interval with normal HR





# Prolonged QT

---

- Normal
  - Men 450ms
  - Women 460ms
- Corrected QT (QTc)
  - $QTm/\sqrt{(R-R)}$
- Causes
  - Drugs (Na channel blockers)
  - Hypocalcemia, hypomagnesemia, hypokalemia
  - Hypothermia
  - AMI
  - Congenital
  - Increased ICP



# Blocks

---

- AV blocks
  - First degree block
    - PR interval fixed and  $> 0.2$  sec
  - Second degree block, Mobitz type 1 – Luciani Wenckebach period
    - PR gradually lengthened, then drop QRS
  - Second degree block, Mobitz type 2
    - PR fixed, but drop QRS randomly
  - Type 3 block
    - PR and QRS dissociated

# What is this rhythm?

First degree AV block

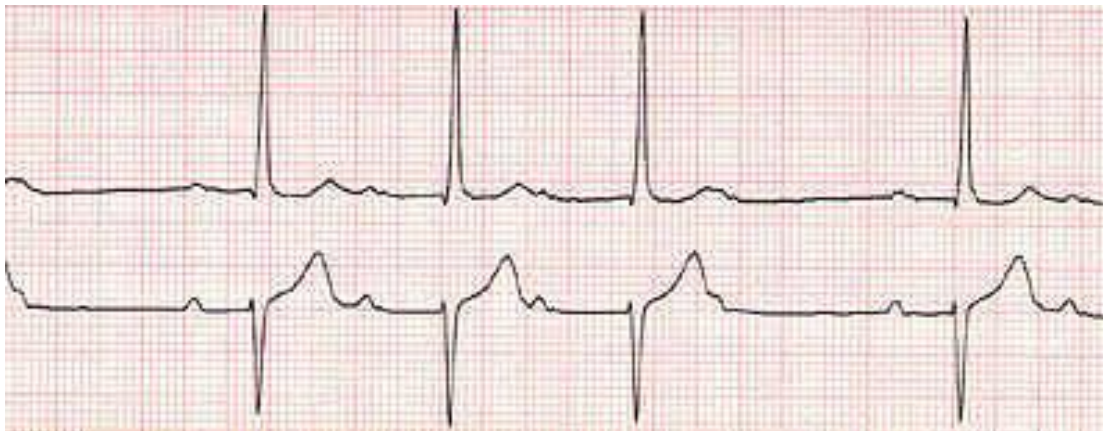
PR is fixed and longer than 0.2 sec





# What is this rhythm?

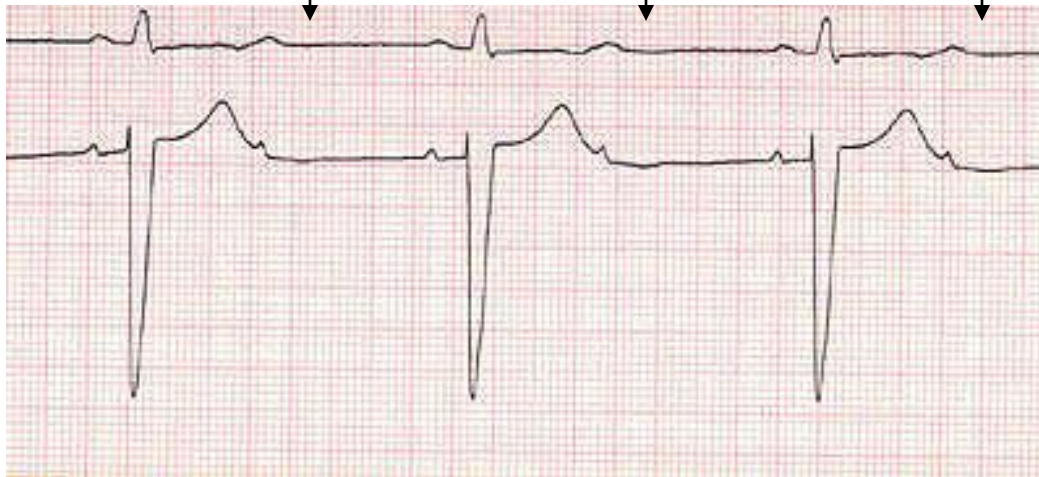
Type 1 second degree block (Wenckebach)



# What is this rhythm?

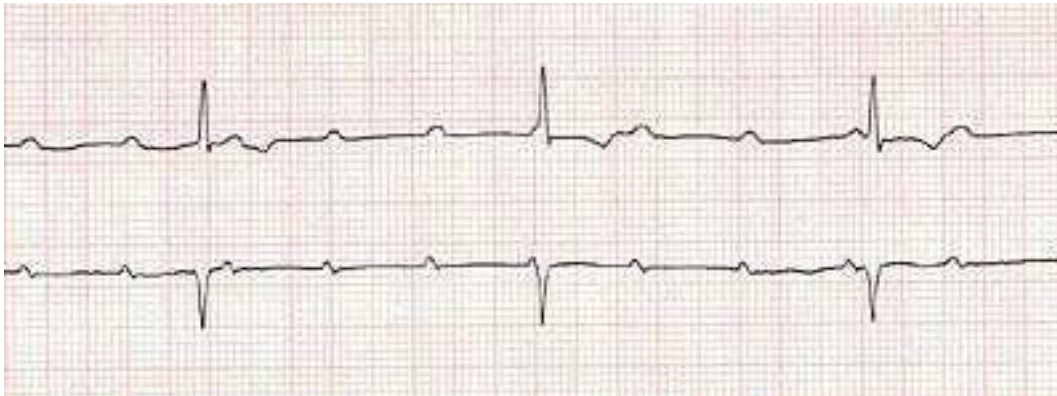
Type 2 second degree AV block

Dropped QRS



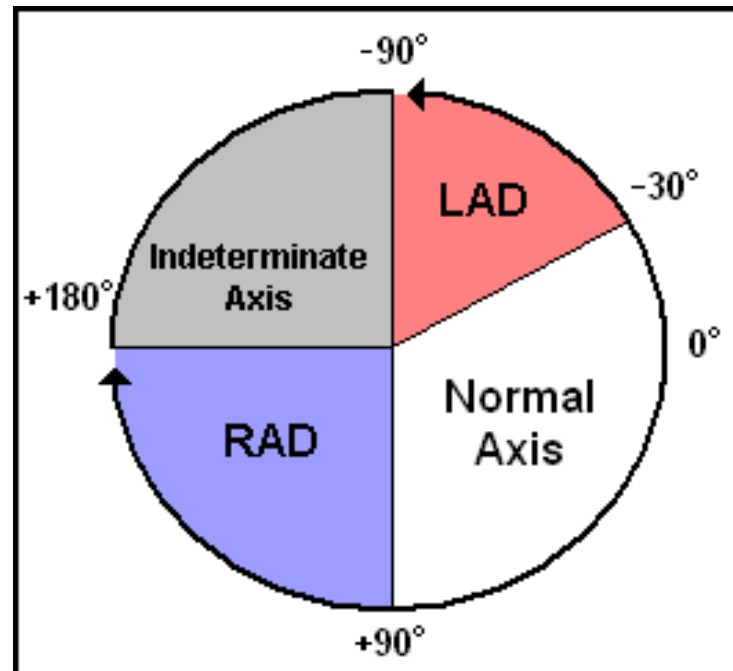
# What is this rhythm?

3<sup>rd</sup> degree heart block (complete)



# The QRS Axis

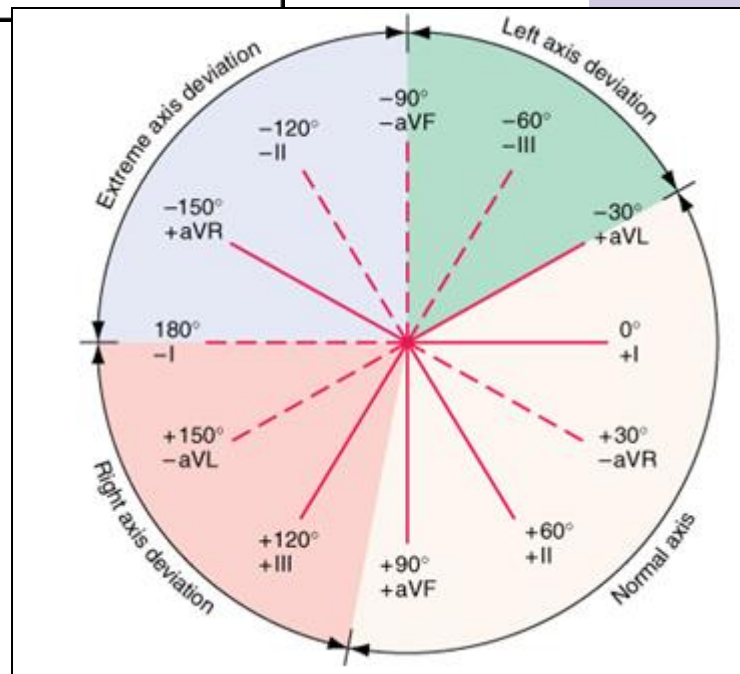
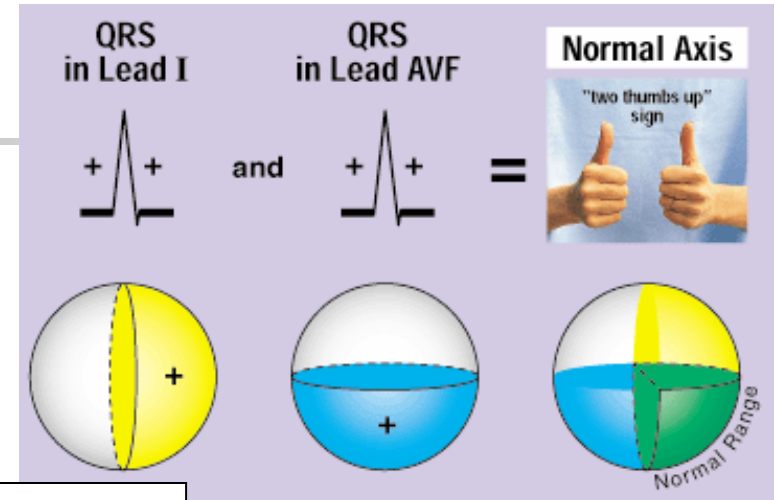
- Represents the overall direction of the heart's activity
- Axis of  $-30^\circ$  to  $+90^\circ$  degrees is normal



# The Quadrant Approach

- QRS up in I and up in aVF = Normal

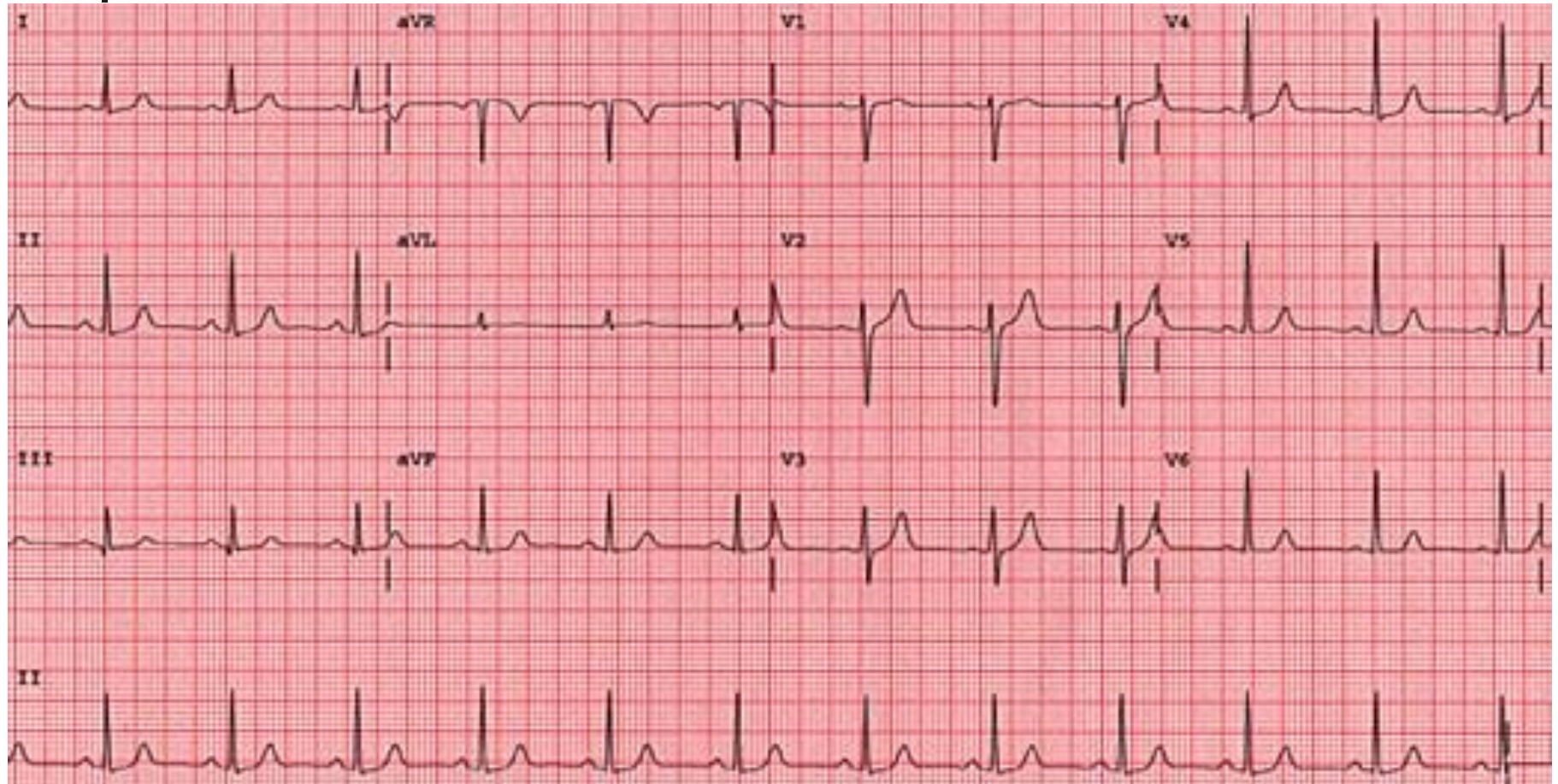
		Lead aVF	
		Positive	Negative
Lead I	Positive	Normal Axis	LAD
	Negative	RAD	Indeterminate Axis





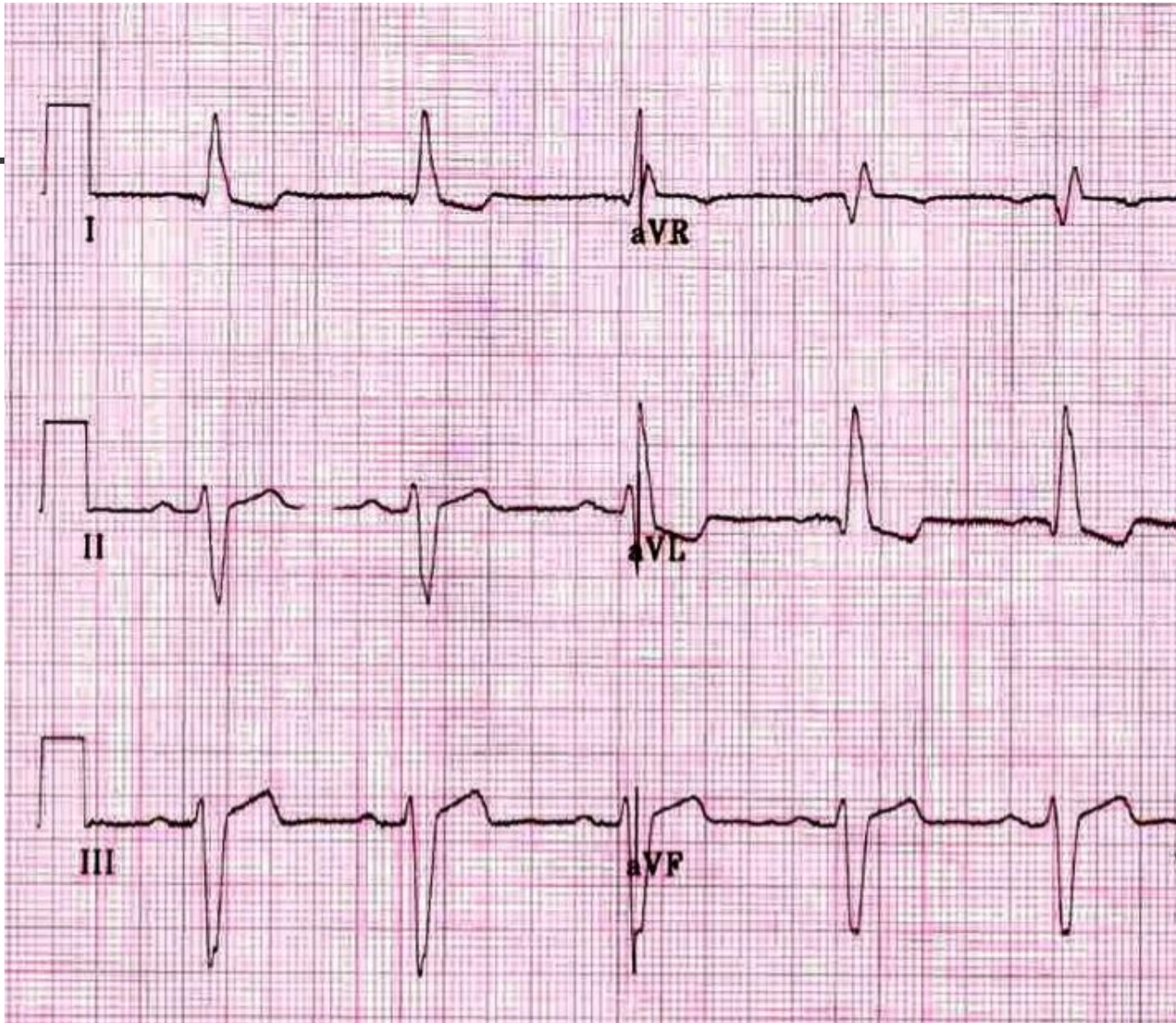
# What is the axis?

Normal- QRS up in I and aVF





# What is the axis?

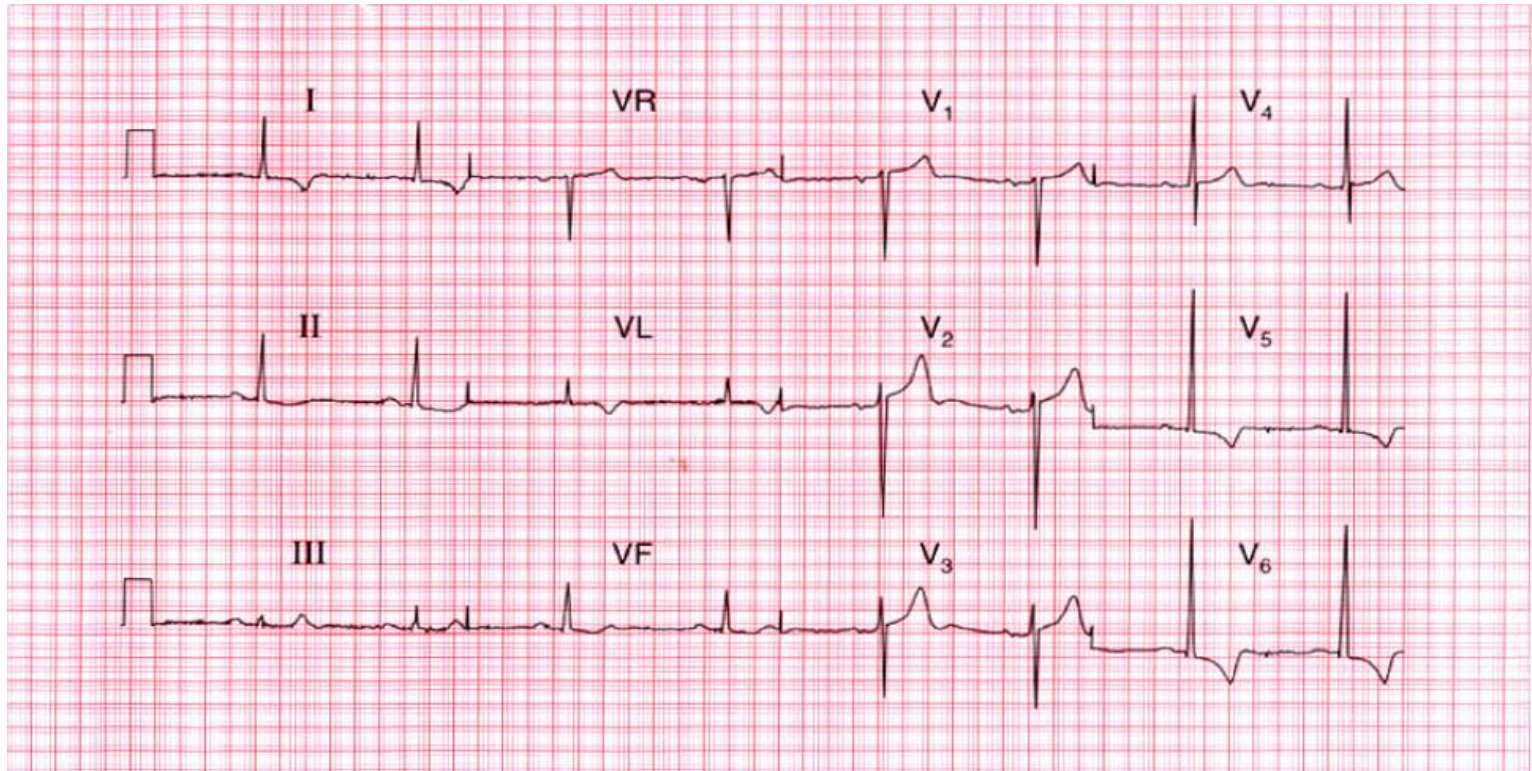




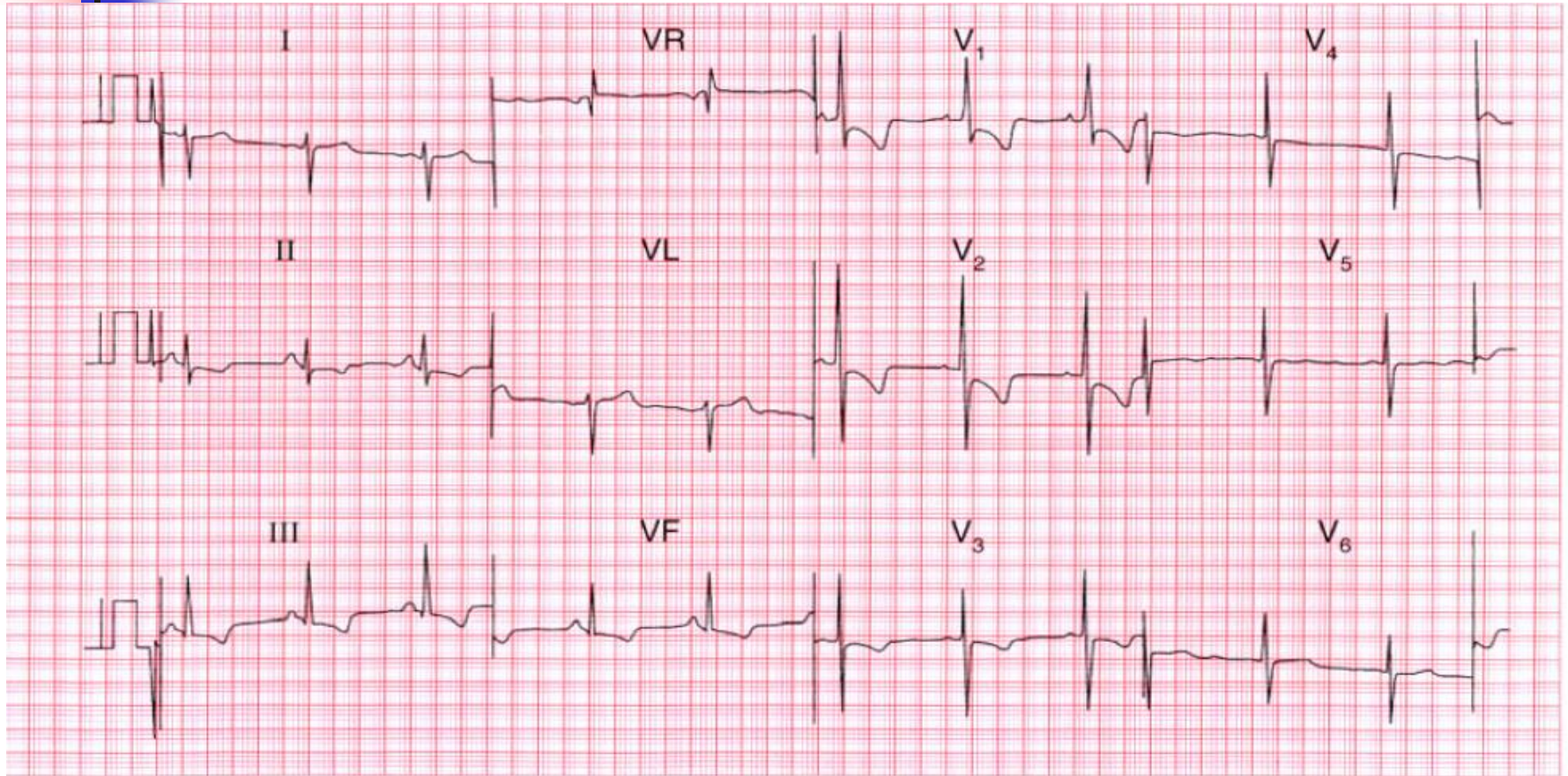
# Hypertrophy:

## Left ventricle hypertrophy

- Add the larger S wave of V1 or V2 in mm, to the larger R wave of V5 or V6.
- Sum is  $> 35\text{mm}$  = LVH

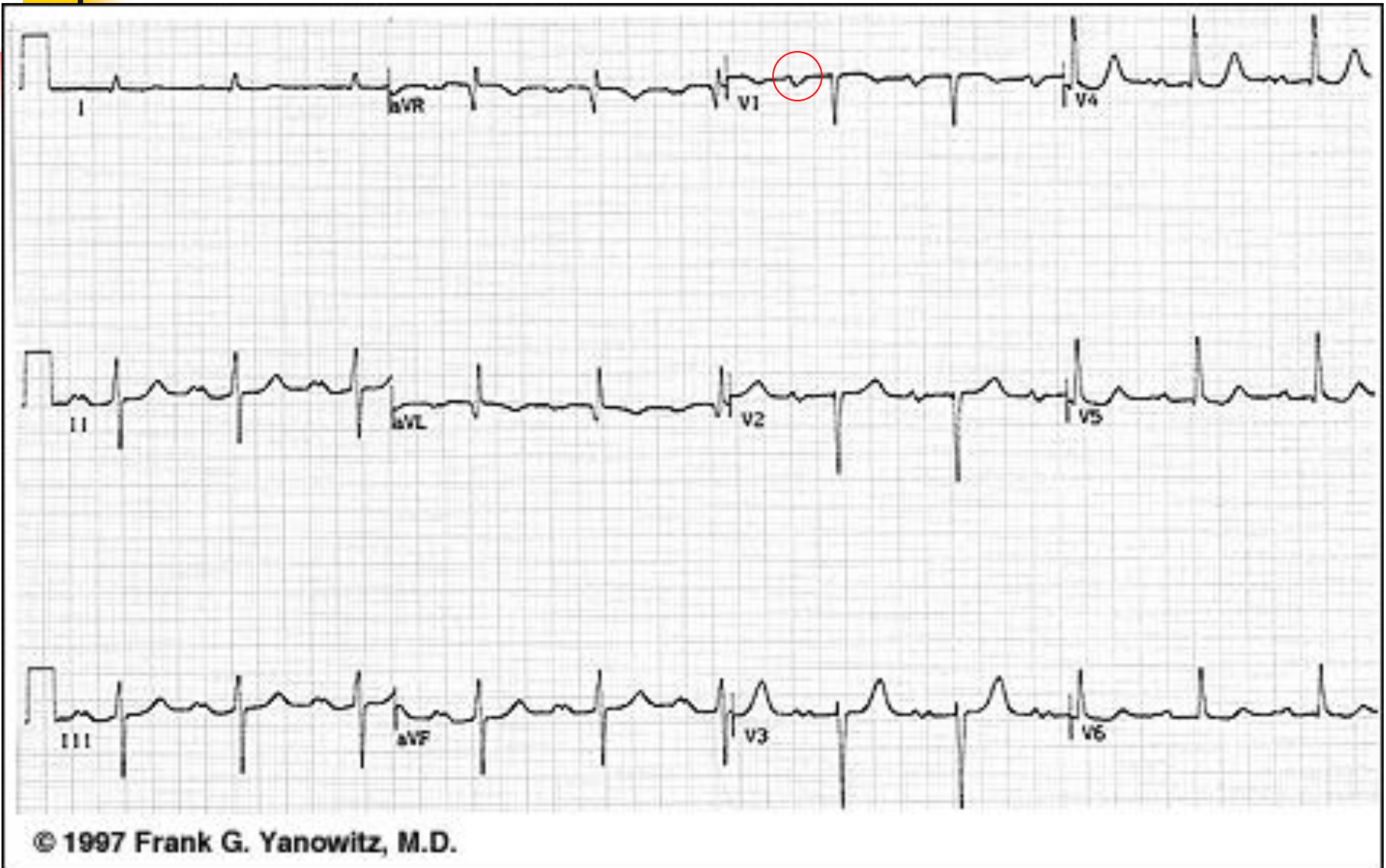


# Right ventricle hypertrophy (R>S in V1)

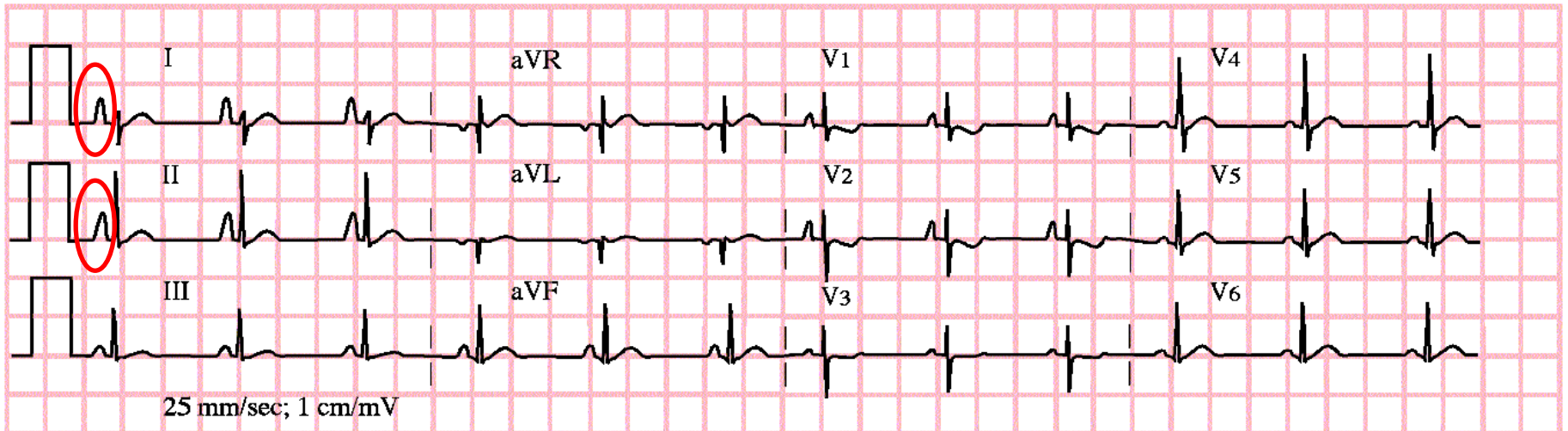




# Left atrial hypertrophy

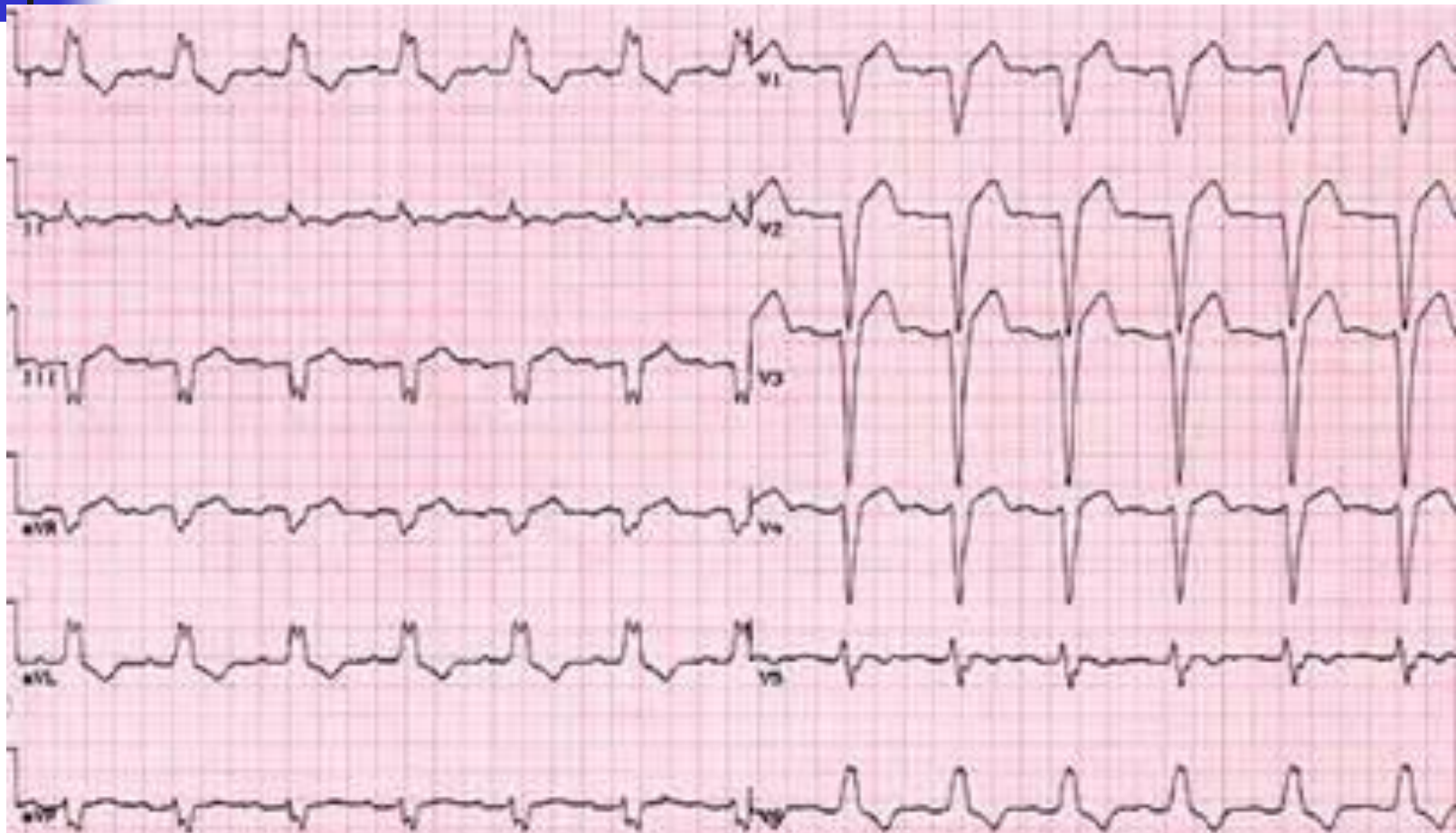


# Right atrial hypertrophy



# Left Bundle branch

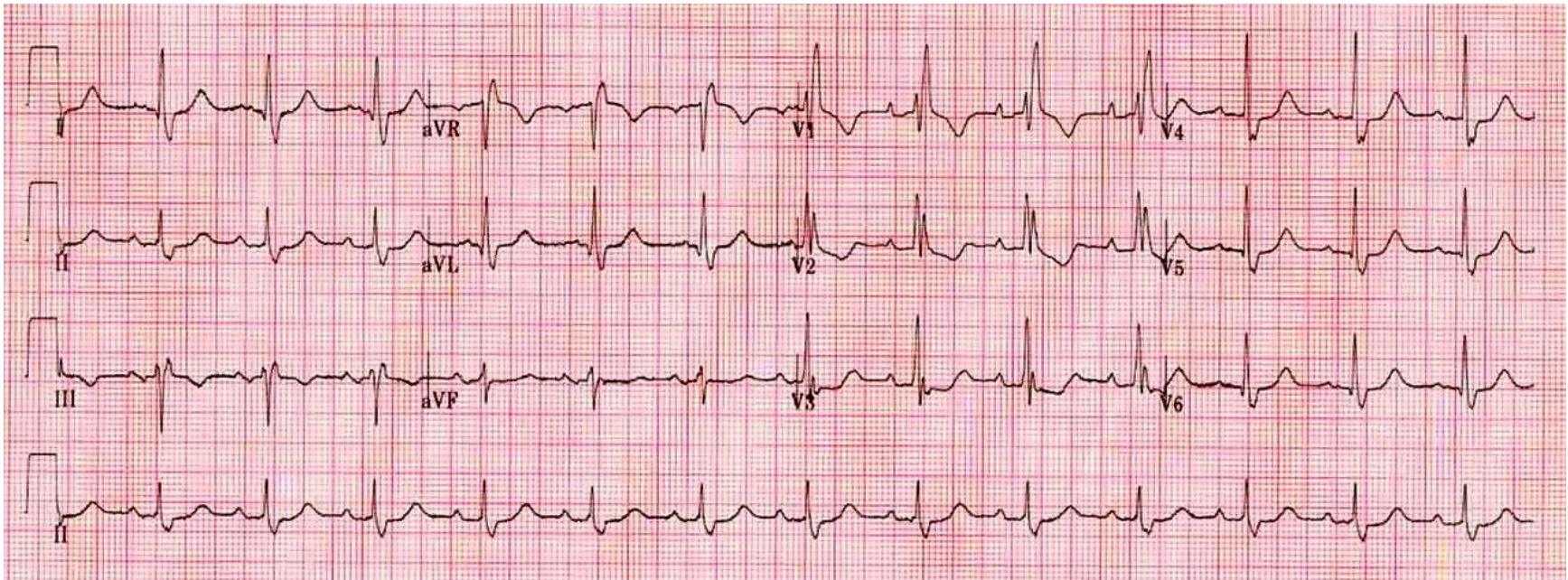
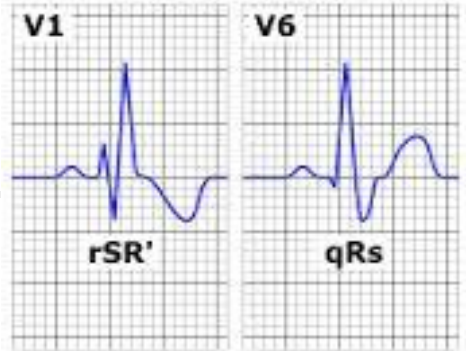
Left bundle branch block characteristics



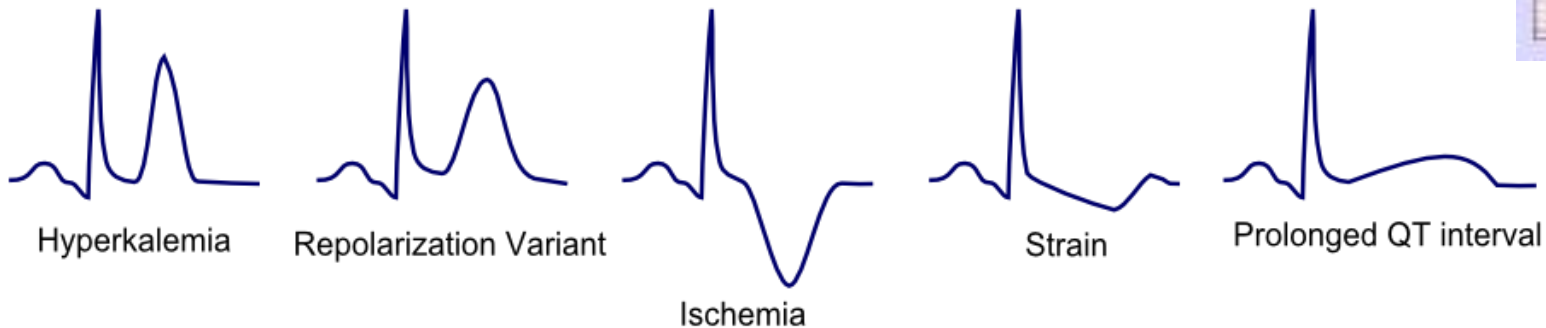
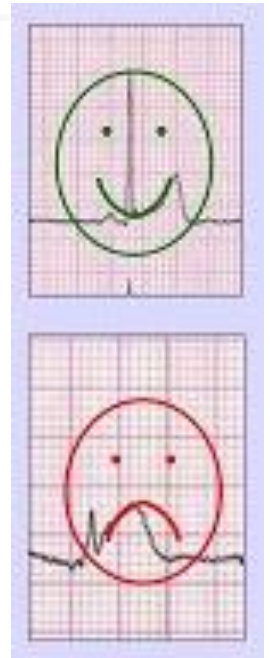
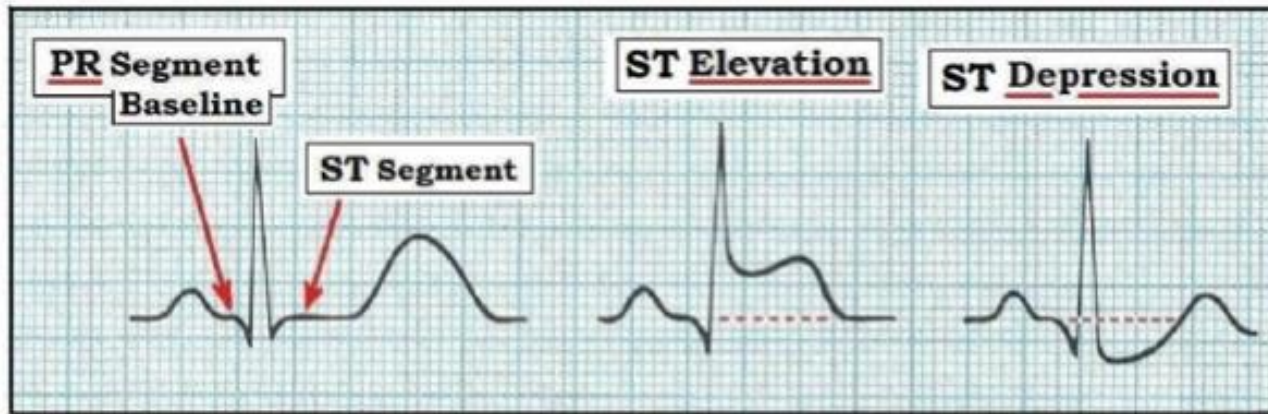


# Right Bundle Branch

Right bundle branch block characteristics



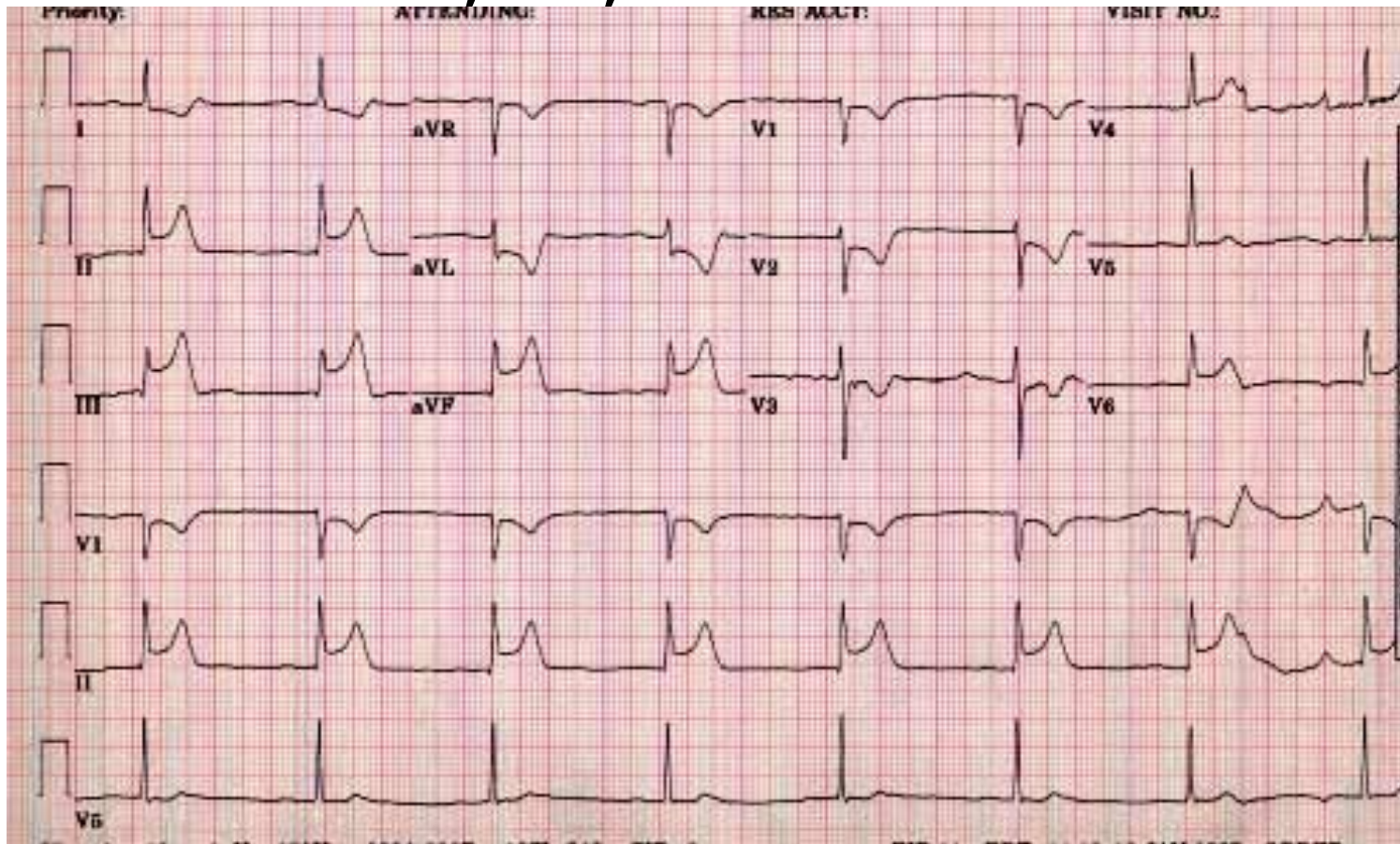
# Ischemia: ST segment



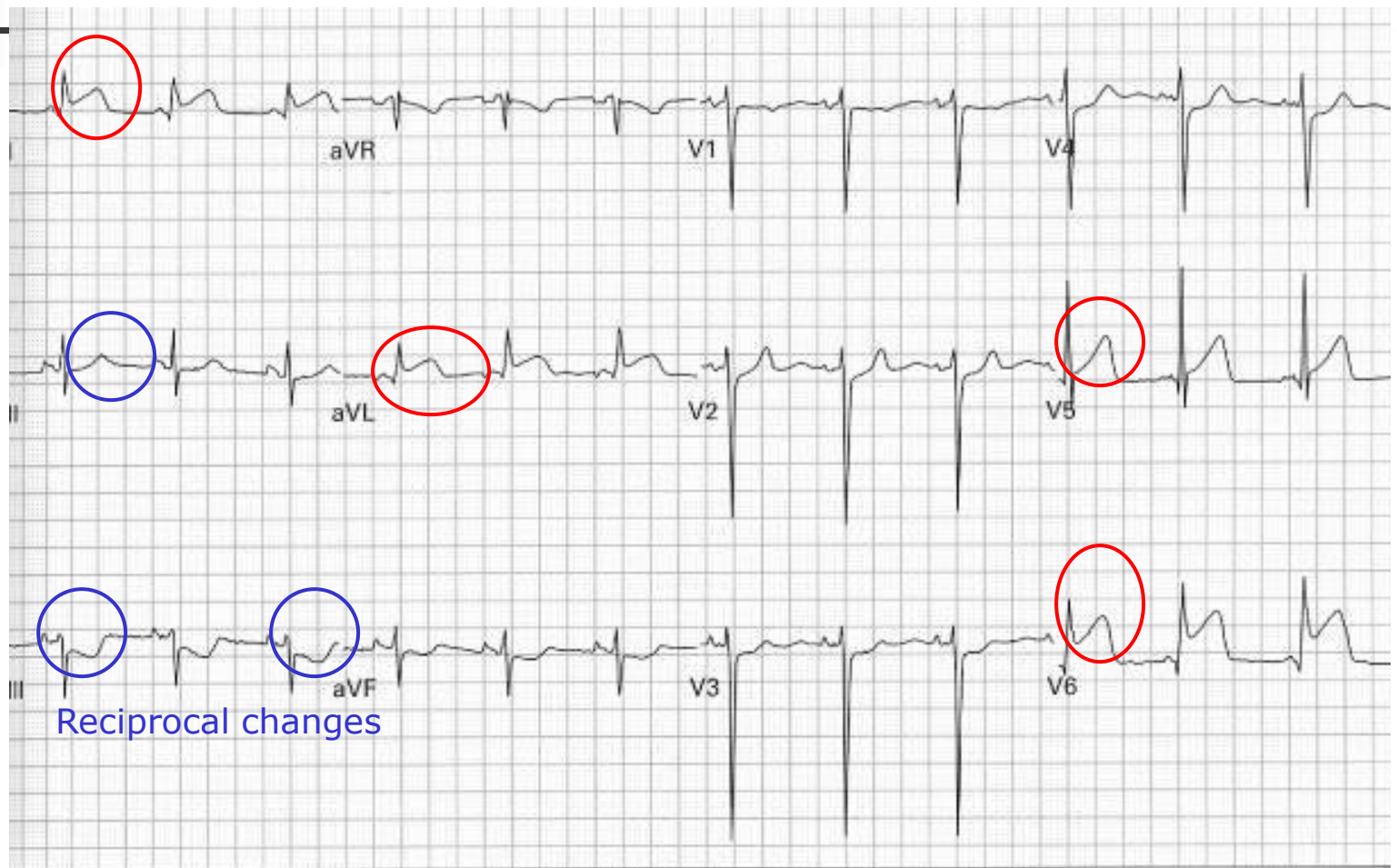


# What is the diagnosis?

Acute inferior MI with ST elevation  
in leads II, III, aVF

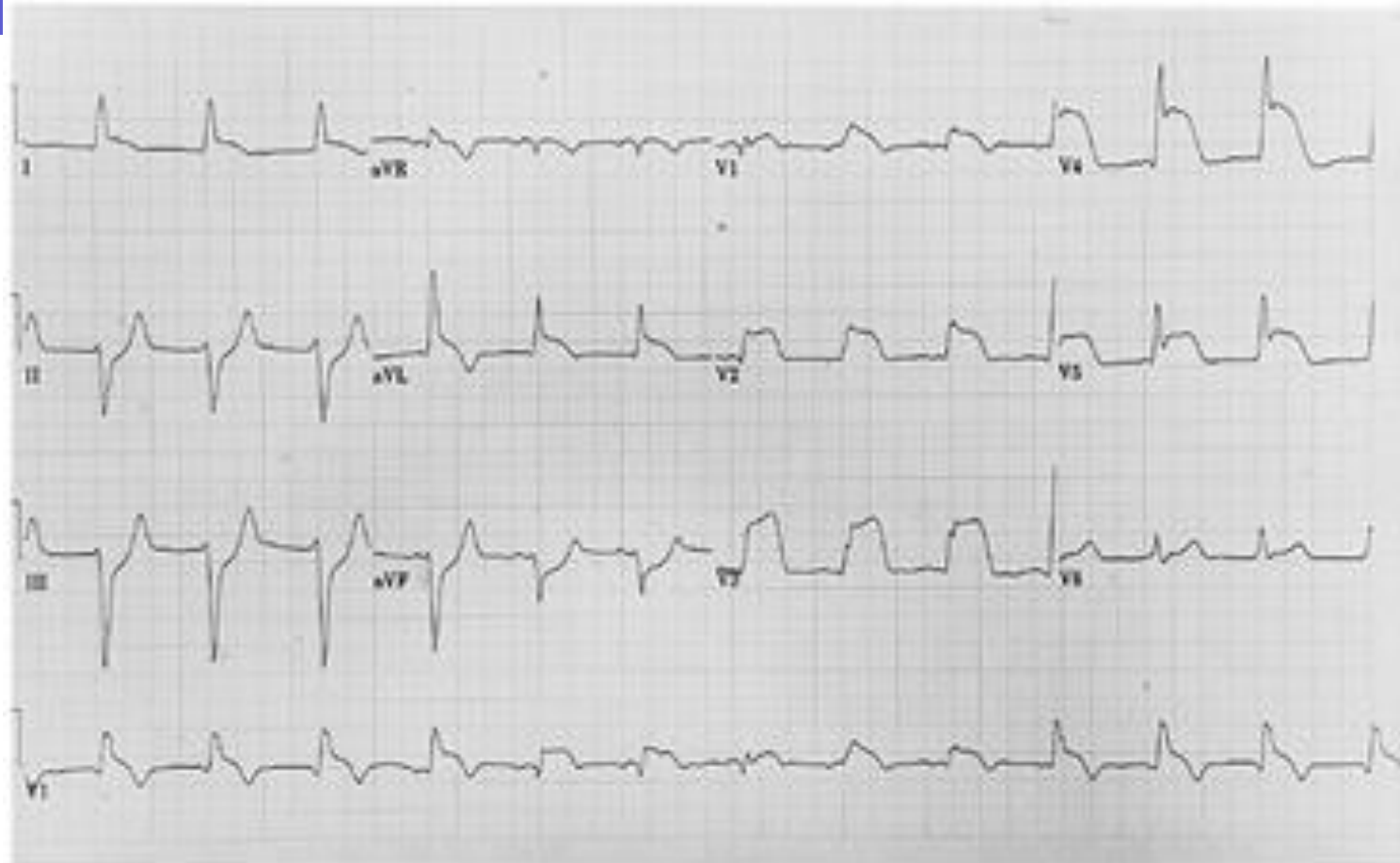


# Lateral MI



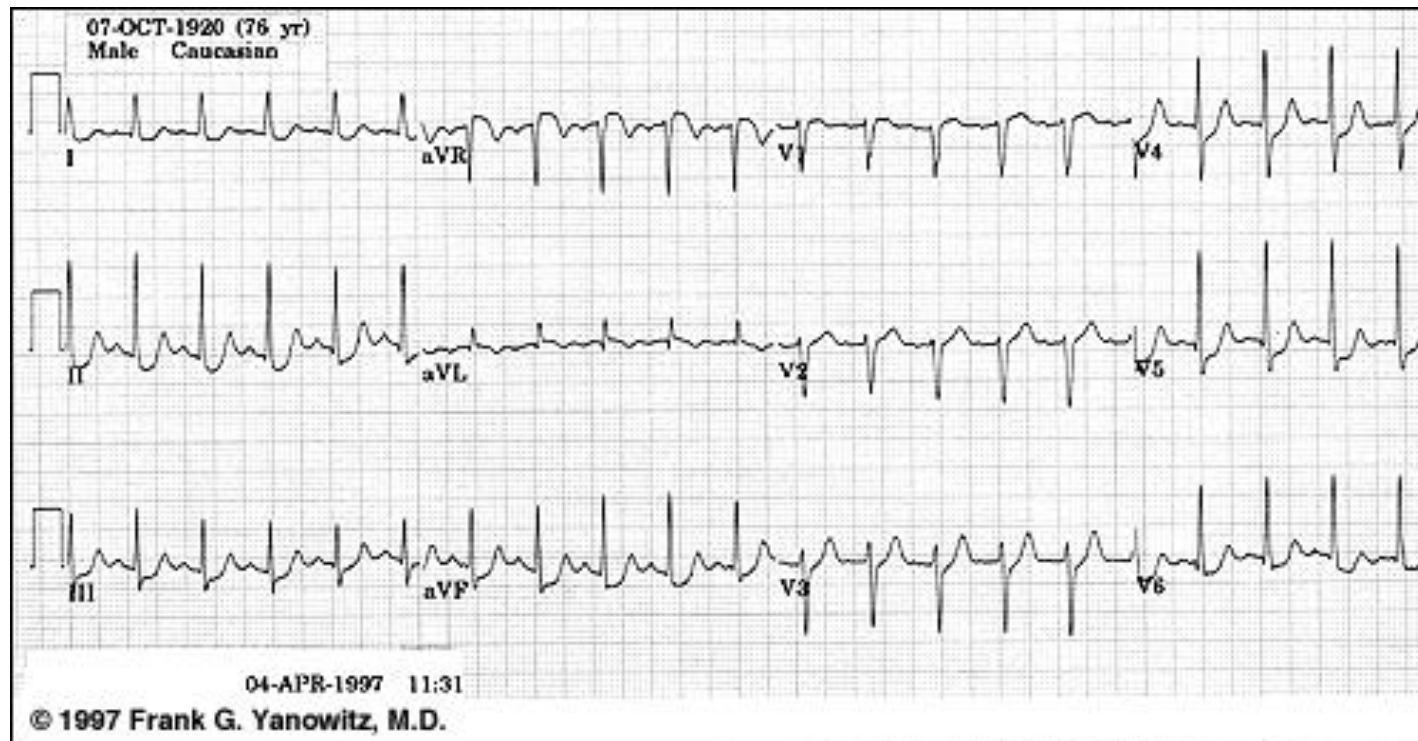
10. 43 year old man reports eight hours of left chest and arm pain

# Anterior MI



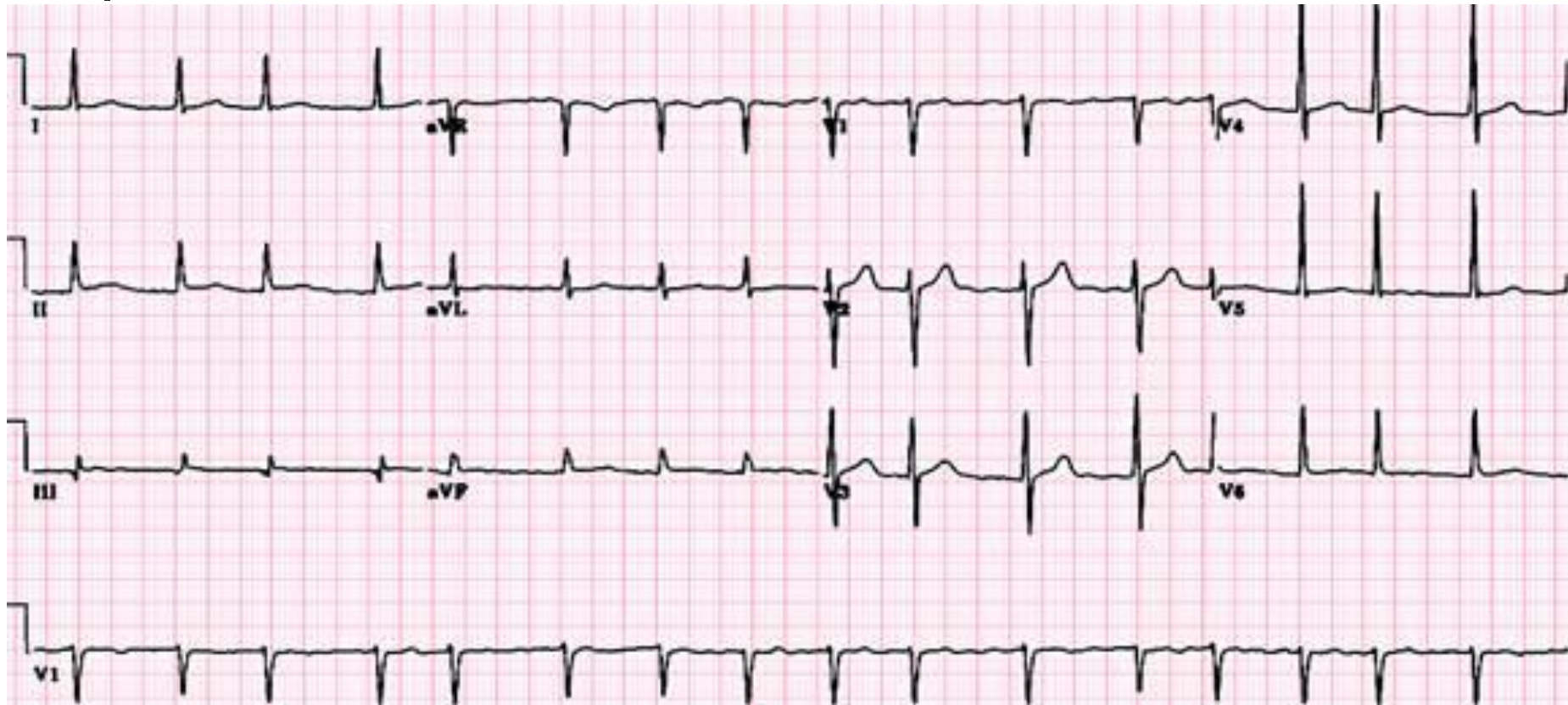
# What do you see in this EKG?

ST depression II, III, aVF, V3-V6 = ischemia

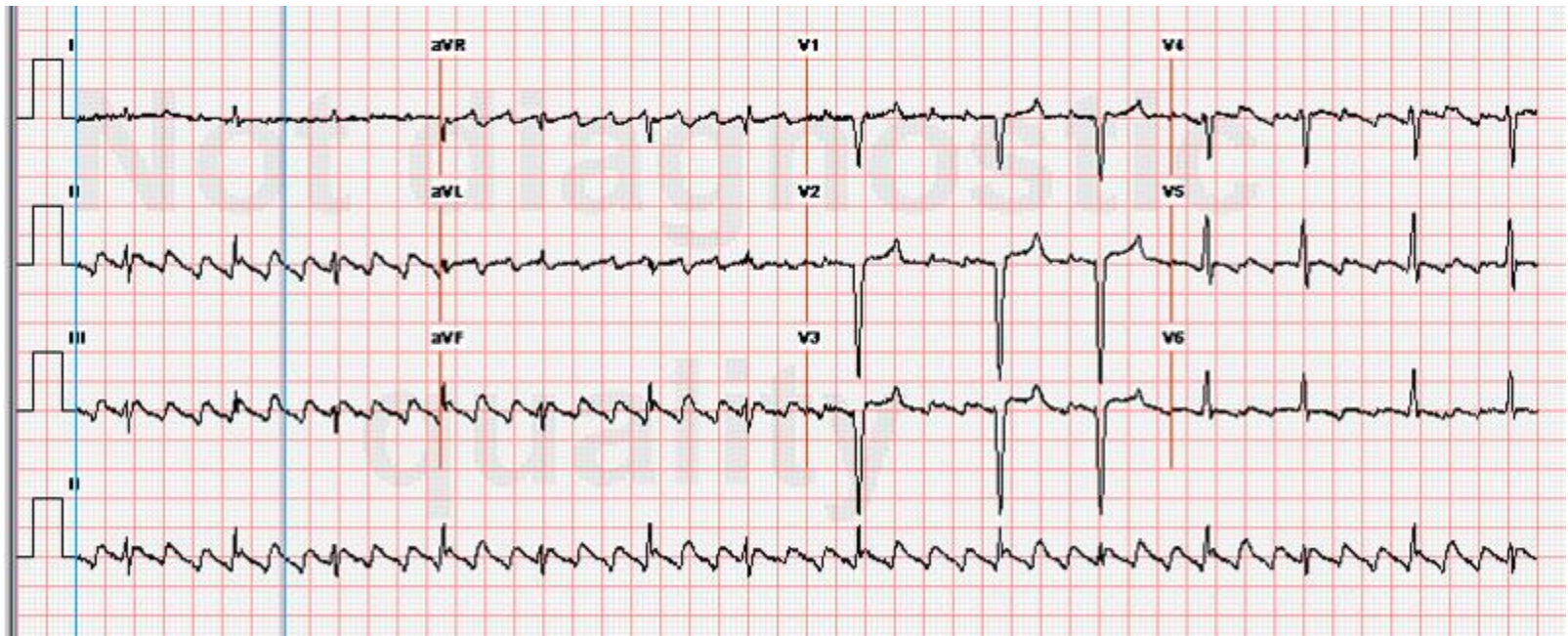




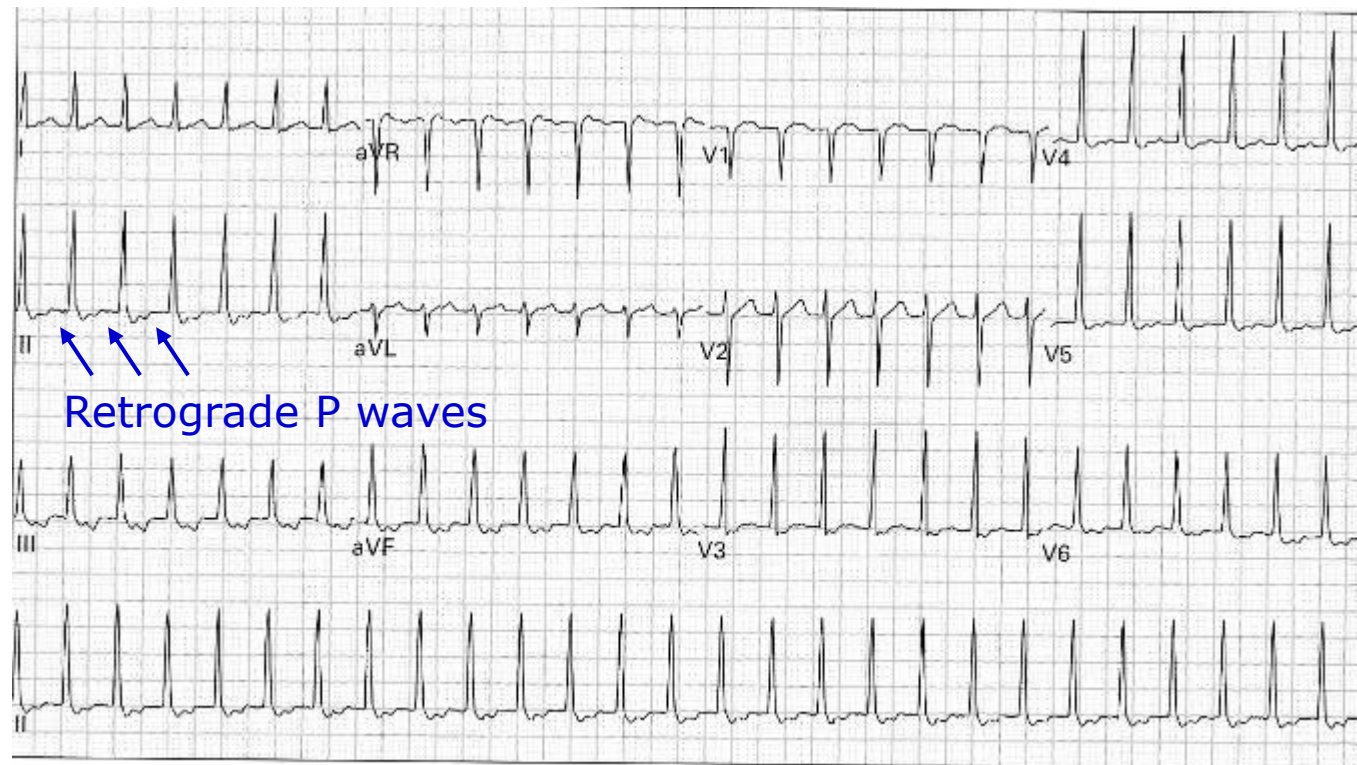
# Atrial fibrillation



# Atrial flutter



# Supraventricular Tachycardia

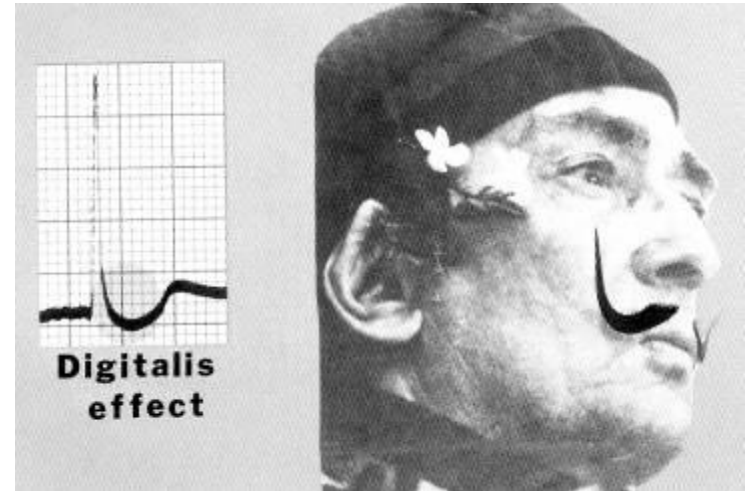
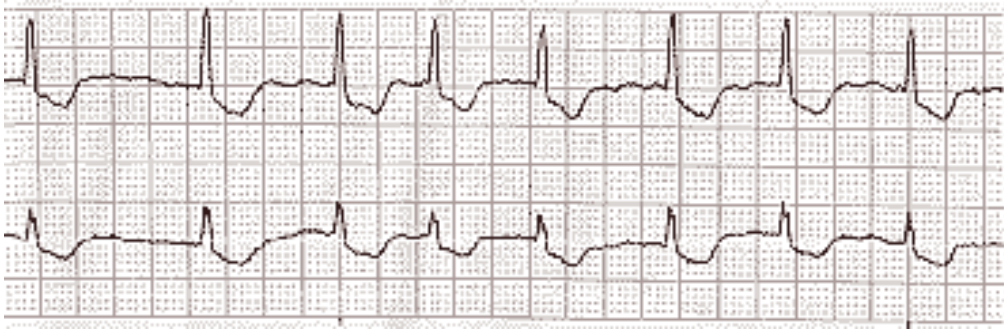


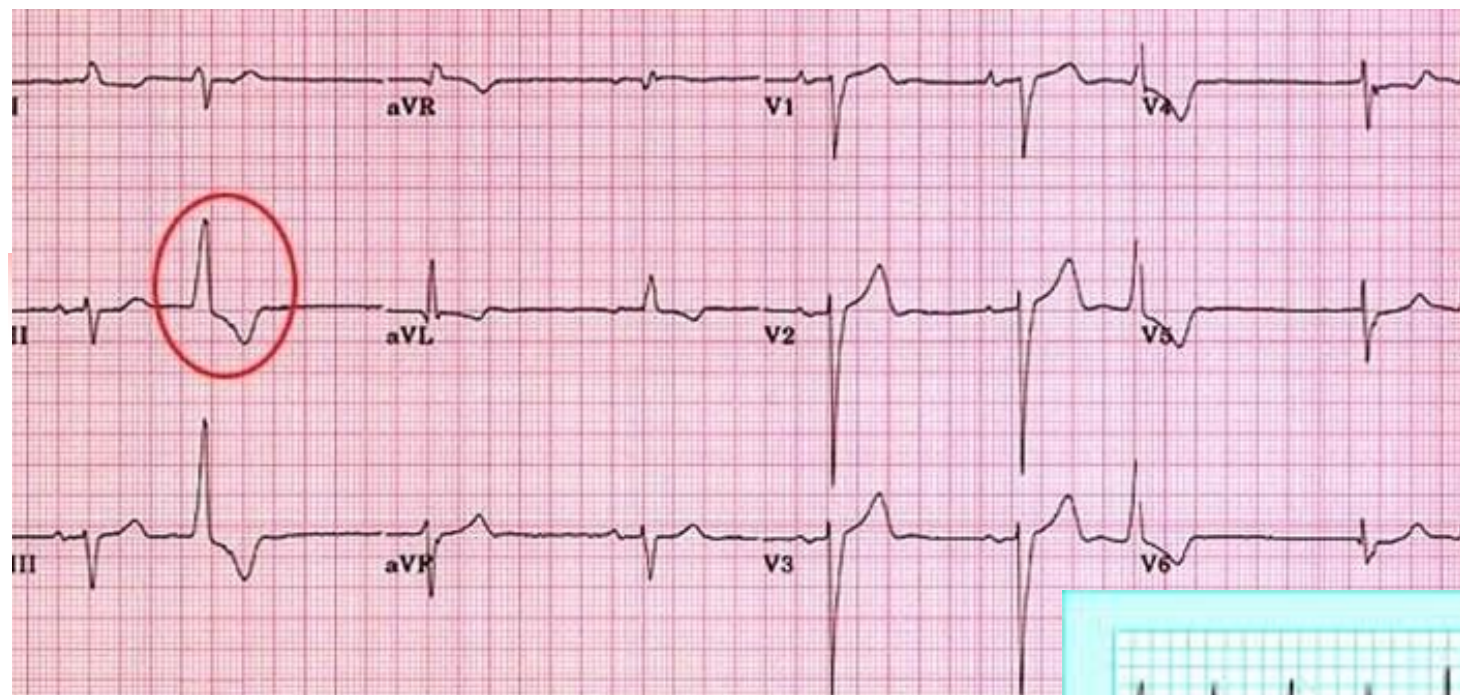
27, 40 year old woman with palpitations and lightheadedness

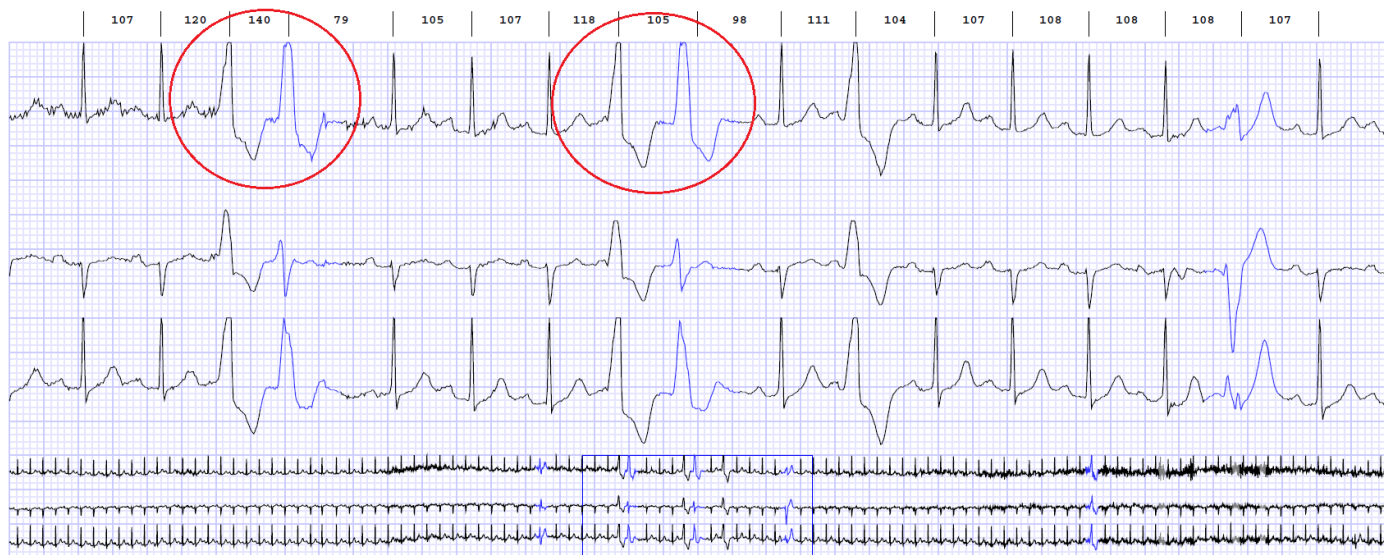
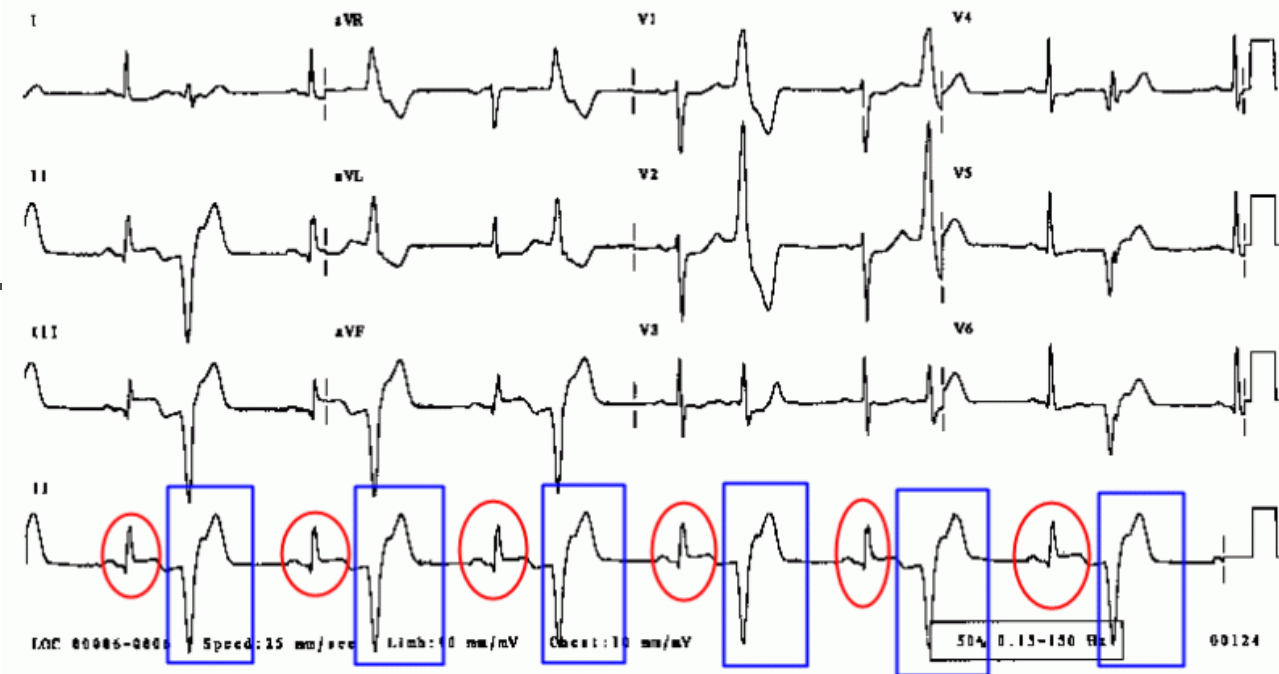
Narrow complex, regular; retrograde P waves, rate <220



# Digitalis

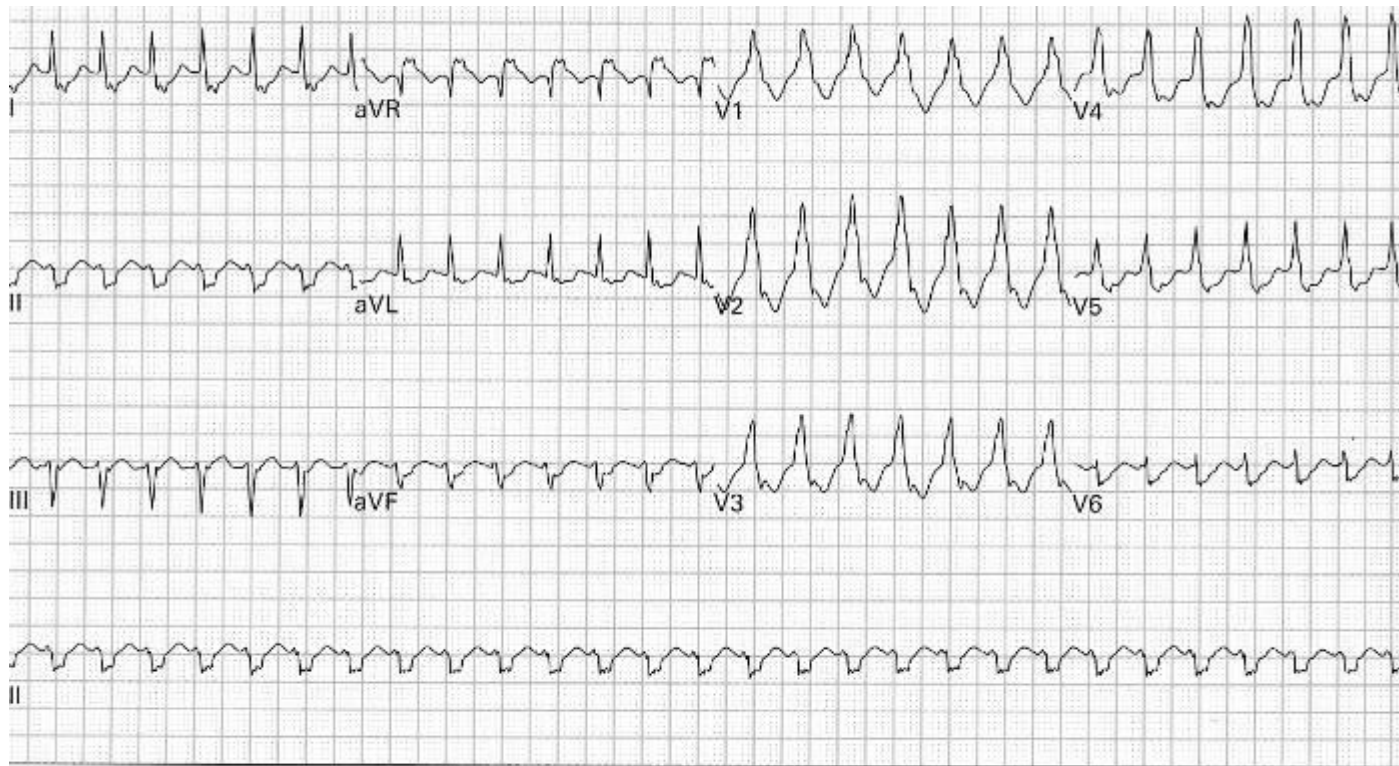






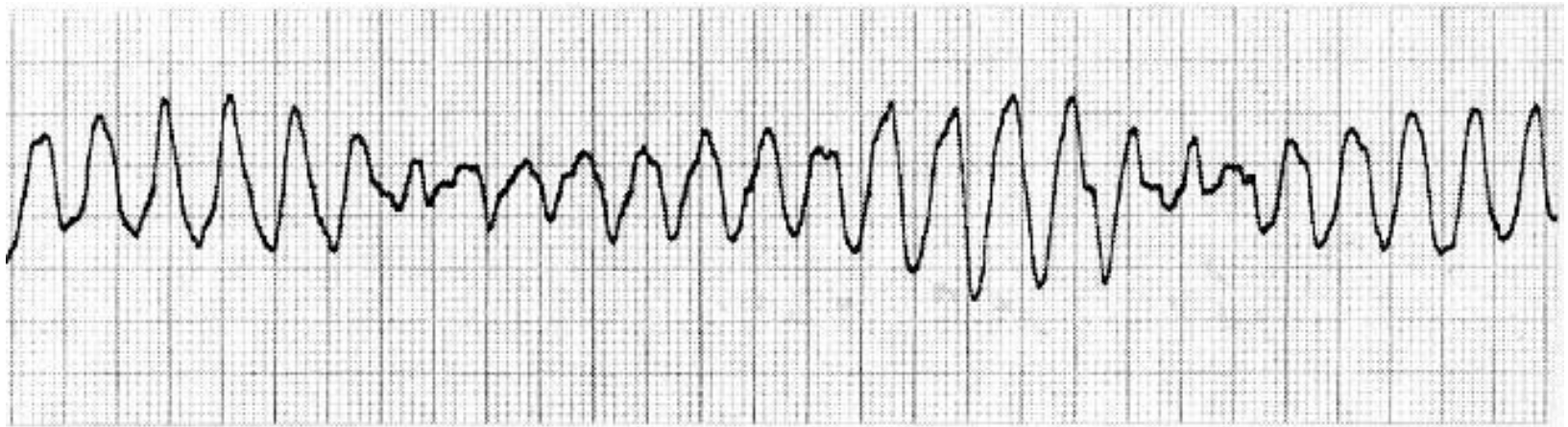


# Ventricular Tachycardia



19. 74 year old man with chest pain and palpitations

# Torsades de Pointes



Notice twisting pattern

Treatment: Magnesium 2 grams IV