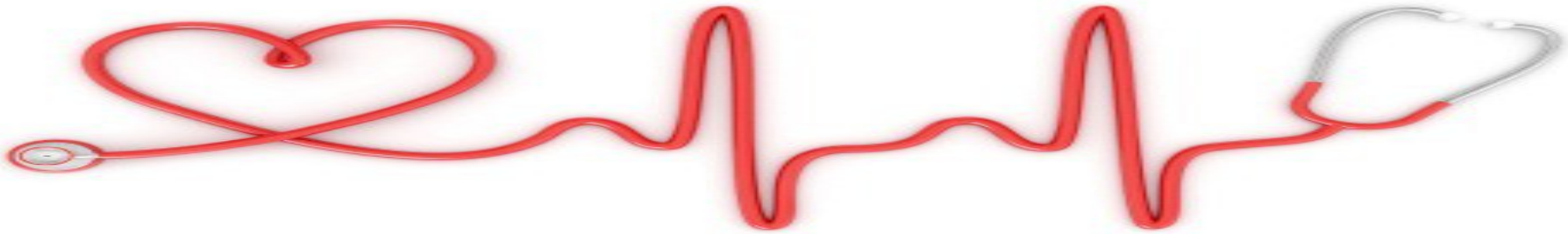
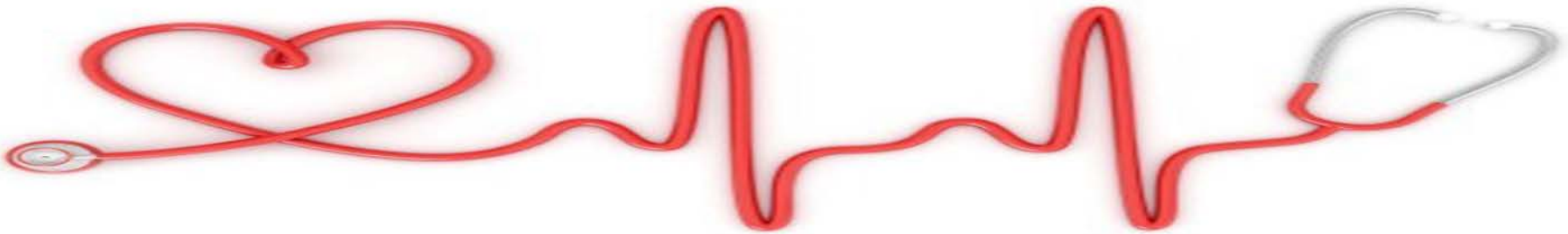


ECG Basics

Rebecca Sevigny BSN, RN, CCRN



DISCLOSURES

None of the planners or presenters of this session have disclosed any conflict or commercial interest

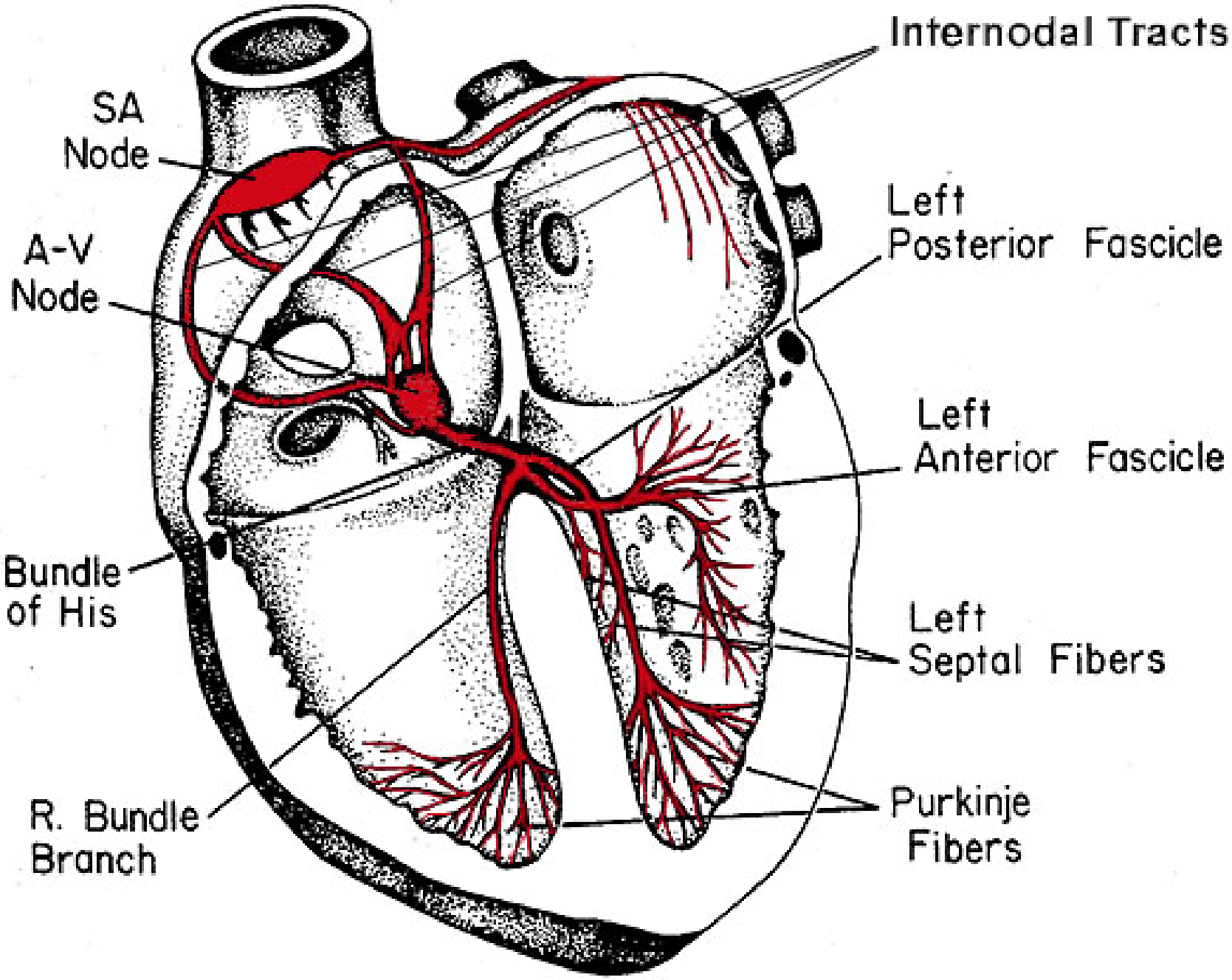
Objectives

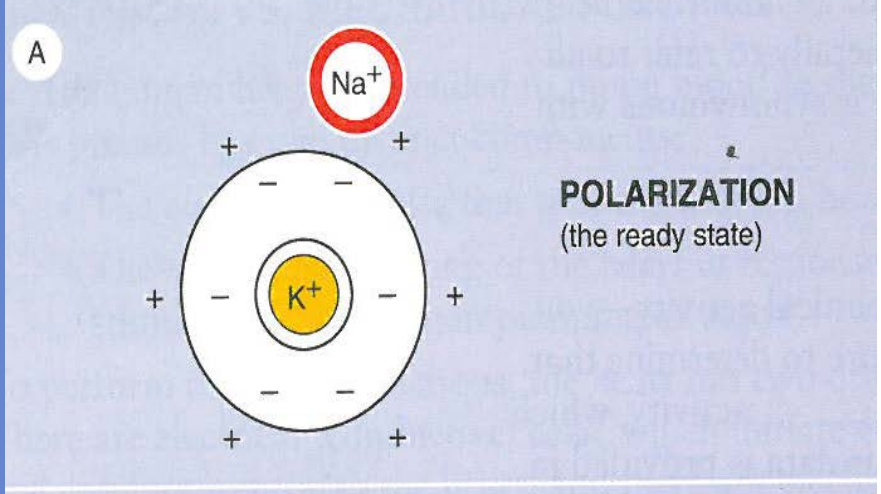
Identify the conduction system of the heart and the components of the cardiac cycle

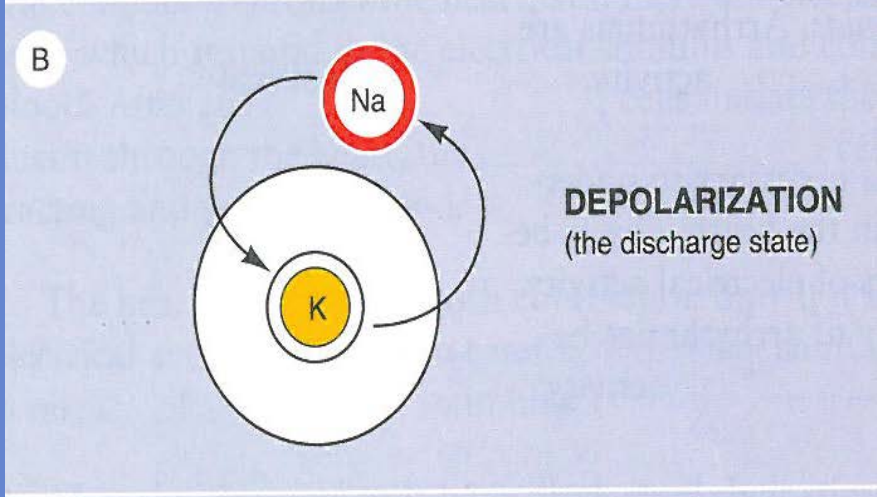
Discuss a systematic approach to rhythm interpretation

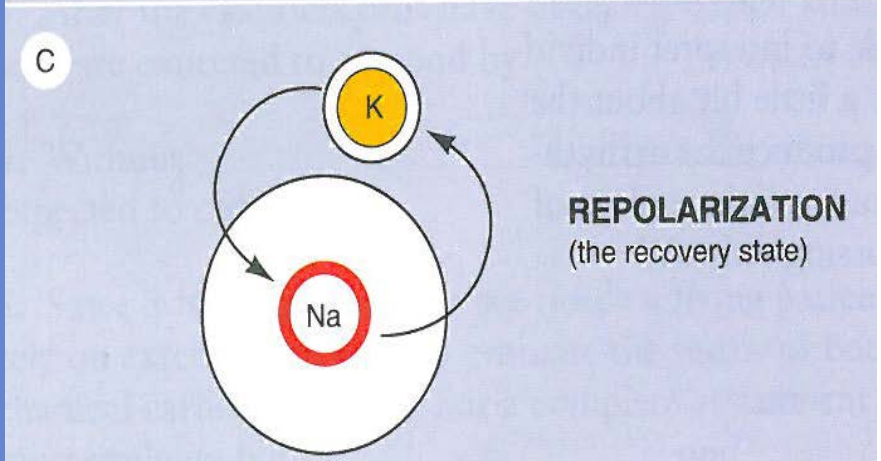
Review common cardiac arrhythmias

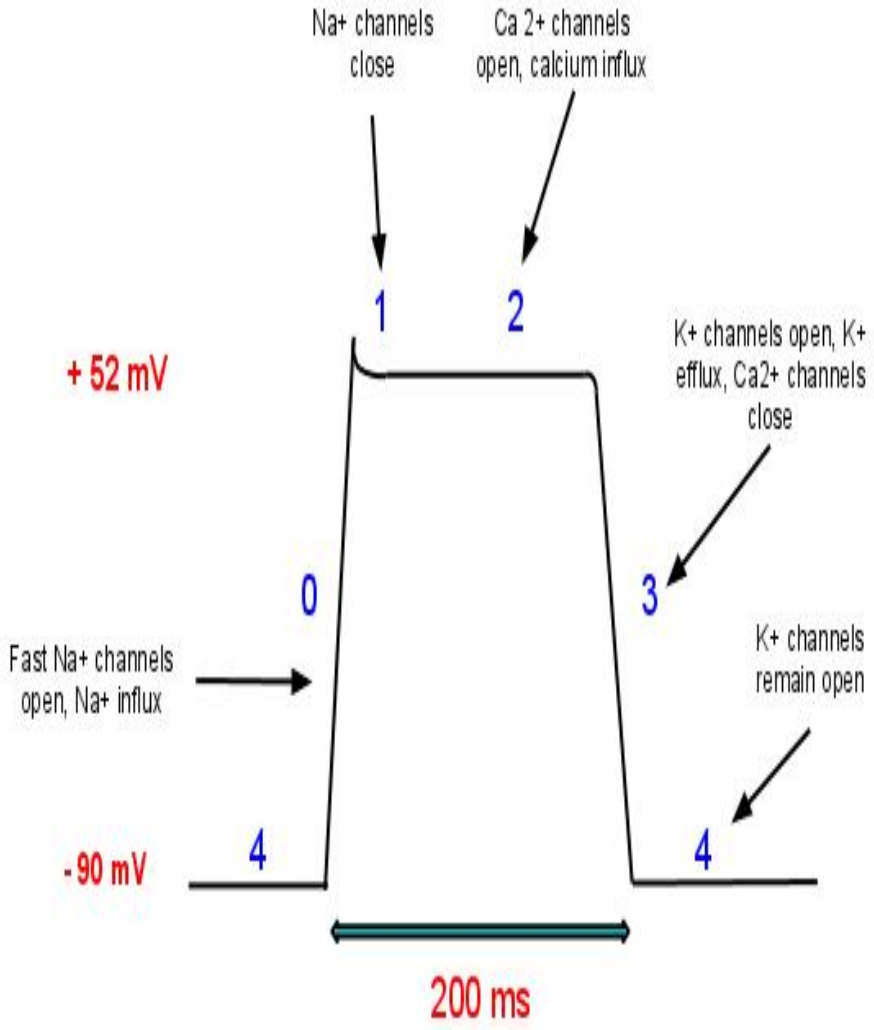
Describe the process for interpretation of a 12 lead ECG


Internodal Tracts
SA Node
A-V Node
Left Posterior Fascicle
Left Anterior Fascicle
Bundle of His
Left Septal Fibers
R. Bundle Branch
Purkinje Fibers


A
Na+
K+
POLARIZATION
(the ready state)


B
Na
K
DEPOLARIZATION
(the discharge state)

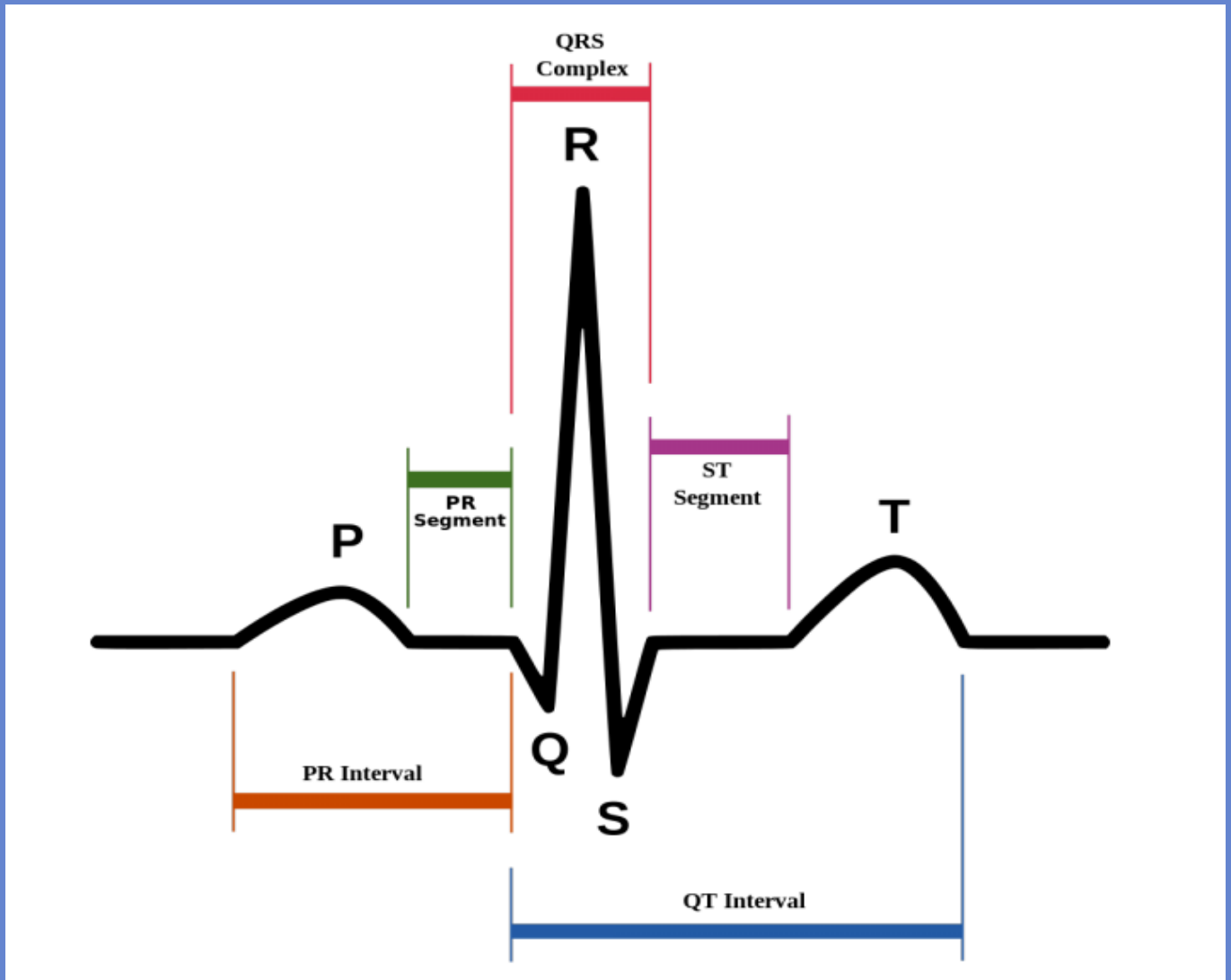

C
K
Na
REPOLARIZATION
(the recovery state)


Na+ channels close
Ca 2+ channels open, calcium influx
1
2
+ 52 mV
K+ channels open, K+ efflux, Ca2+ channels close
0
3
Fast Na+ channels open, Na+ influx
K+ channels remain open
4
4
- 90 mV
200 ms

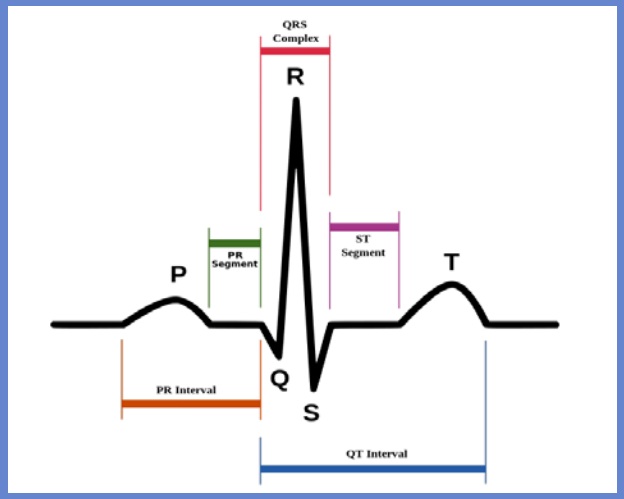
Pacemakers

60-100	• SA Node
40-60	• AV Junction
20-40	• Purkinje

Conduction: Normal P-QRS-T

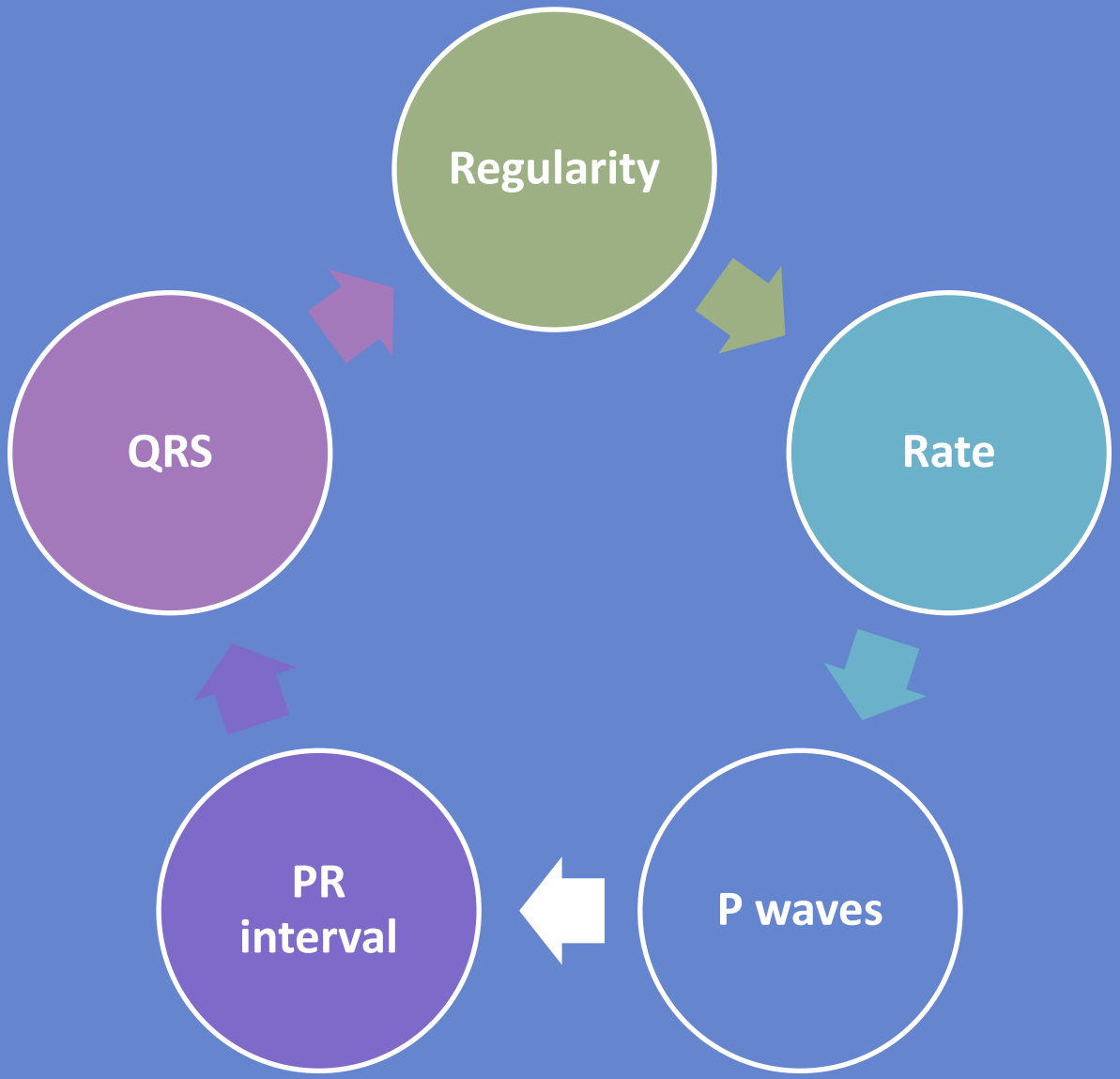


Normal P-QRS-T

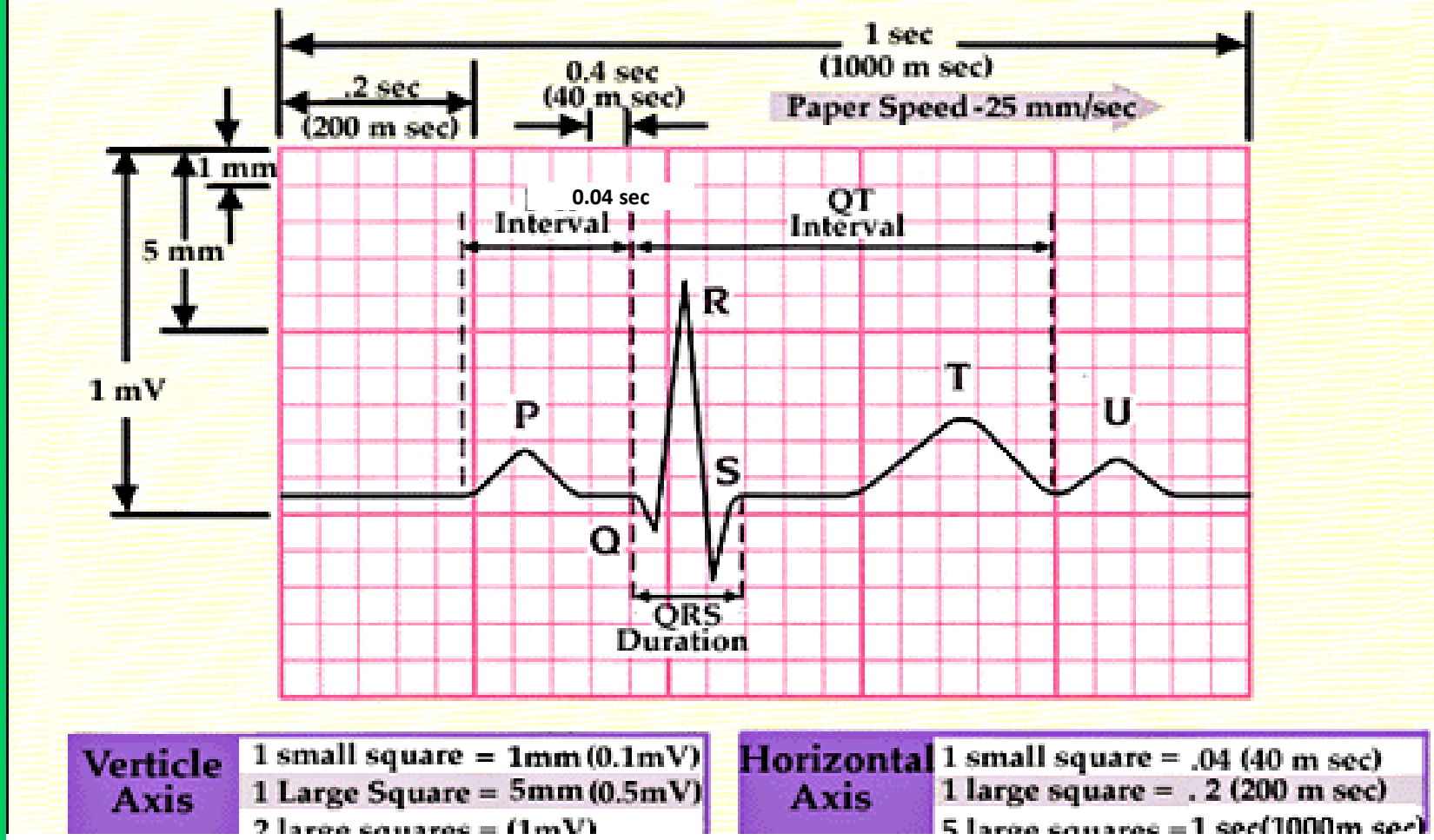


	P Wave	PR Interval	QRS Complex	ST Segment
Represents	Atrial depolarization	atrial depolarization and delay at the AV Node (AV conduction time)	Ventricular depolarization	Interval between ventricular depolarization and repolarization
Duration	< 0.12 seconds	0.11 - 0.20 seconds	0.06 - 0.11 seconds	Measure from end of QRS (J-point) to beginning of T wave
Height	< 2.5 mm	Measure start of P wave to start of QRS	Q- First negative deflection R- First positive deflection S- Negative deflection after R wave	
Shape	Smooth	Prolonged indicates a conduction block Shortened indicates accelerated conduction or junctional in origin		In relation to iso-electric line: Depression/Negative indicates ischemia Elevation/Positive indicates injury
Orientation	Positive in Leads I,II,aVF, V4 Negative in aVR			

Analyzing Rhythms



ECG Paper



2 large squares = 1 mV

5 large squares = 1 sec (1000msec)

METHOD	DIRECTIONS	FEATURES
A	Count the number of R waves in a 6-second strip and multiply by 10.	• Not very accurate • Used only with very quick estimate
B	Count the number of large squares between two consecutive R waves and divide into 300. or *Memorize this scale:* 1 large square = 300 bpm 2 large squares = 150 bpm 3 large squares = 100 bpm 4 large squares = 75 bpm 5 large squares = 60 bpm 6 large squares = 50 bpm	• Very quick • Not very accurate with fast rates • Used only with regular rhythms
C	Count the number of small squares between two consecutive R waves and divide into 1,500.	• Most accurate • Used only with regular rhythms • Time-consuming

Rate practice

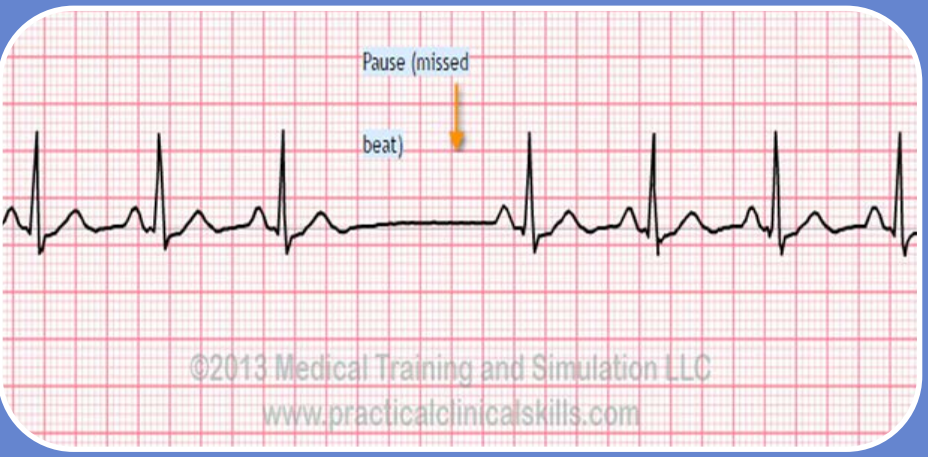
Guess the Rhythm

Rate	**60-100**
Regularity	**Varies with respirations**
P wave	**Normal**
QRS	**Normal**
Grouping	**None**
Dropped beats	**None**

Sinus Arrhythmia

Sinus Block & Pause

Rhythm	Irregular when SA block occurs
Rate	Normal or Slow
P wave	Normal
PR Interval	Normal (0.12-0.20sc.)
QRS	Normal (0.06-0.10sc.)
Notes	Pause time is an integer multiple of the P-P interval.



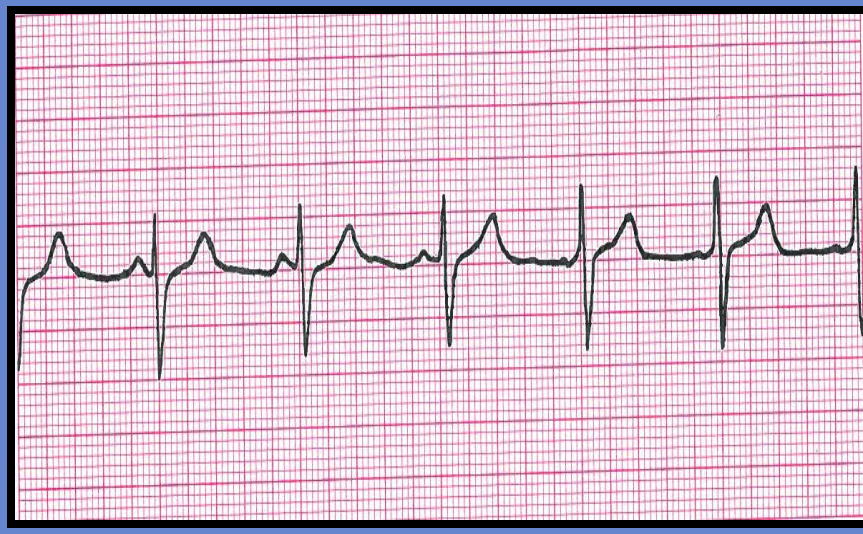
Rhythm

Rhythm	Irregular due to pause
Rate	Normal to Slow
P wave	Normal
PR Interval	Normal (0.12-0.20sc.)
QRS	Normal (0.06-0.10sc.)
Notes	Pause time is not an integer multiple of the P-P interval

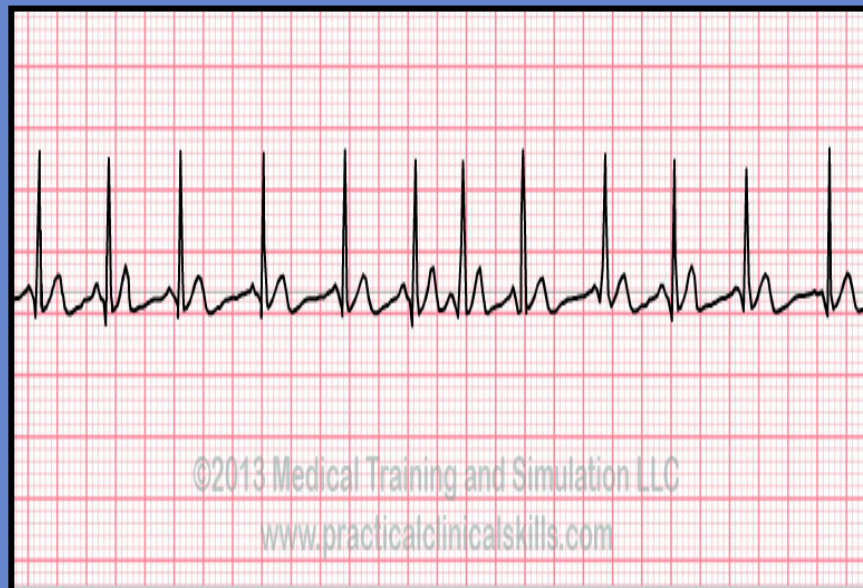
Rhythm

WAP & MAT

Rhythm	**May be irregular**
Rate	Normal (60-100)
P wave	Changing shape from beat to beat. At least 3 different shapes
PR Interval	Variable
QRS	Normal (0.06-0.10sc.)
Notes	If HR exceeds 100 may be MAP

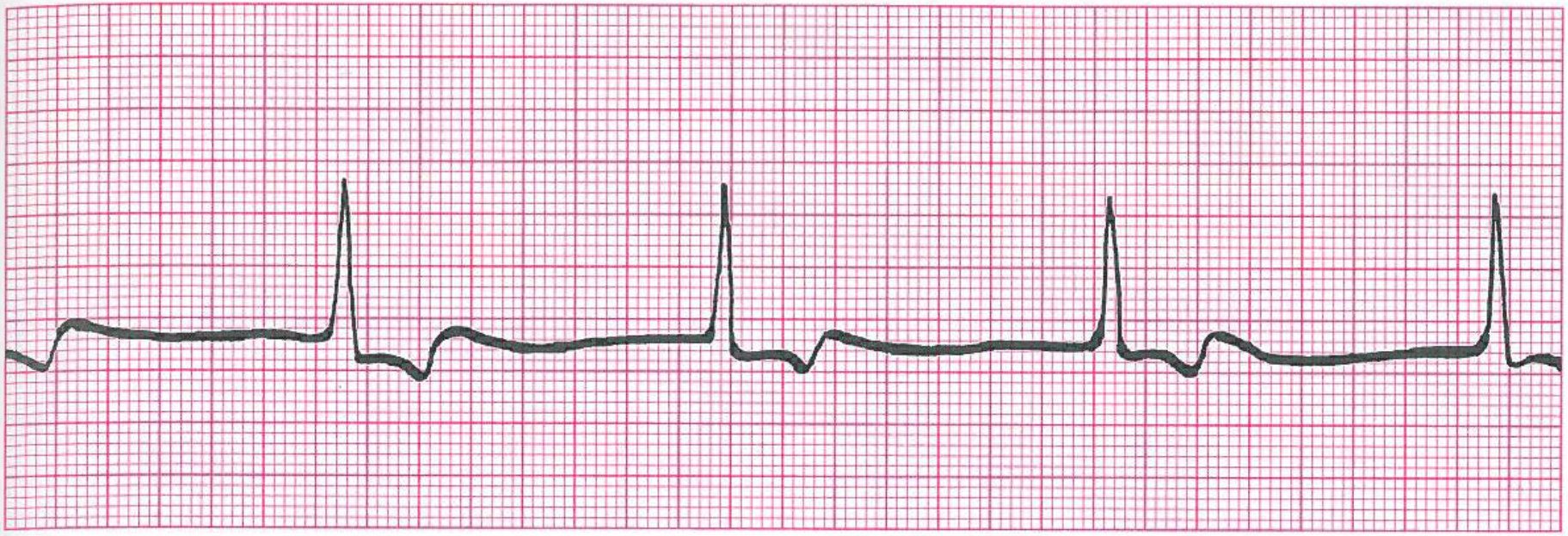


Rhythm	**Irregular**
Rate	> 100
P wave	Changing shape from beat to beat. At least 3 different shapes
PR Interval	Variable
QRS	Normal (0.06-0.10sc.)
Notes	T wave often distorted



A-fib & Flutter

Rules for Junctional Escape Rhythm



Junctional Escape Rhythm

Regularity: The R–R intervals are constant. The rhythm is regular.

Rate: Atrial and ventricular rates are equal. The inherent rate of the AV junction is 40–60 bpm.

P Waves: The P wave can come before or after the QRS complex, or it can be lost entirely within the QRS complex. If visible, the P wave will be inverted.

PRI: If the P wave precedes the QRS complex, the PRI will be less than 0.12 second. If the P wave falls within the QRS complex or follows it, there will be no PRI.

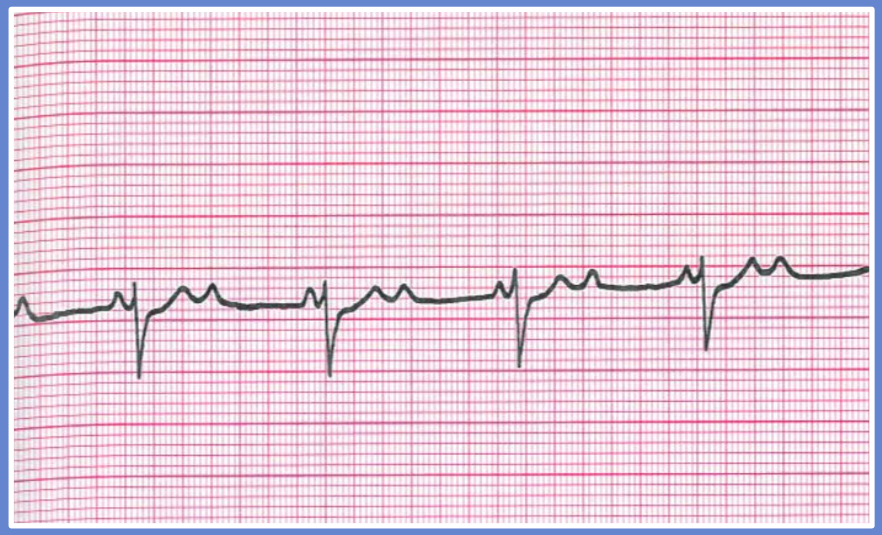
QRS: The QRS complex measurement will be less than 0.12 second.

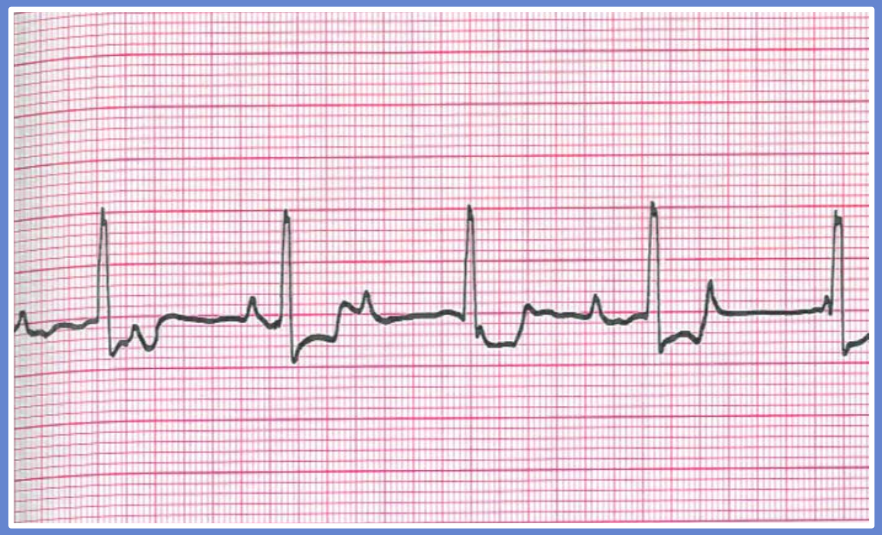
Rhythm	Regular
Rate	Underlying rate
P wave	Normal
PR Interval	> 0.20 sc
QRS	Normal (0.06-0.10sc.)
Notes	Impulses through AV node are delayed not blocked. No missed beats

Rhythm	Irregular with progressively longer PR interval lengthening
Rate	Underlying rate
P wave	Normal
PR Interval	Progressively longer until QRS dropped then cycle repeats
QRS	Normal (0.06-0.10sc.)
Notes	

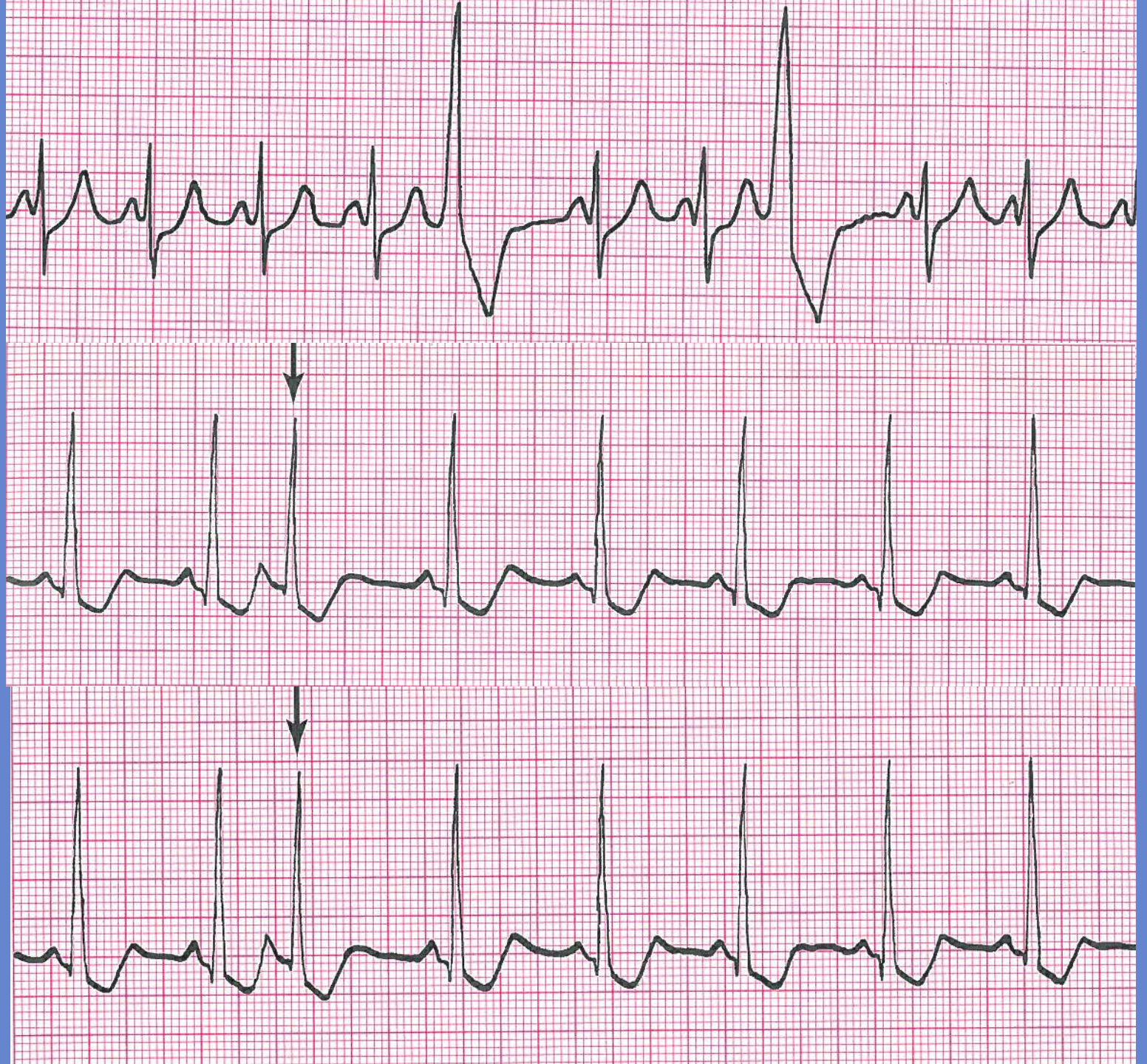
Rhythm	Regular or Irregular depending on conduction ratio
Rate	Atrial rate usually normal (60-100) Ventricular rate slow (<60)
P wave	Normal4.75
PR Interval	Constant on conducted beats. May be > 0.20sc
QRS	Normal (0.06-0.10sc.)

Rhythm	Regular atrial and ventricular
Rate	Atrial rate usually normal and ventricular rate 40-60 if junctional & 20-40 if ventricular
P wave	Normal
PR Interval	Not applicable
QRS	Normal if junctional (0.06-0.10sc.) or > 0.12 if ventricular
Notes	Complete block at AV node





PREMATURE

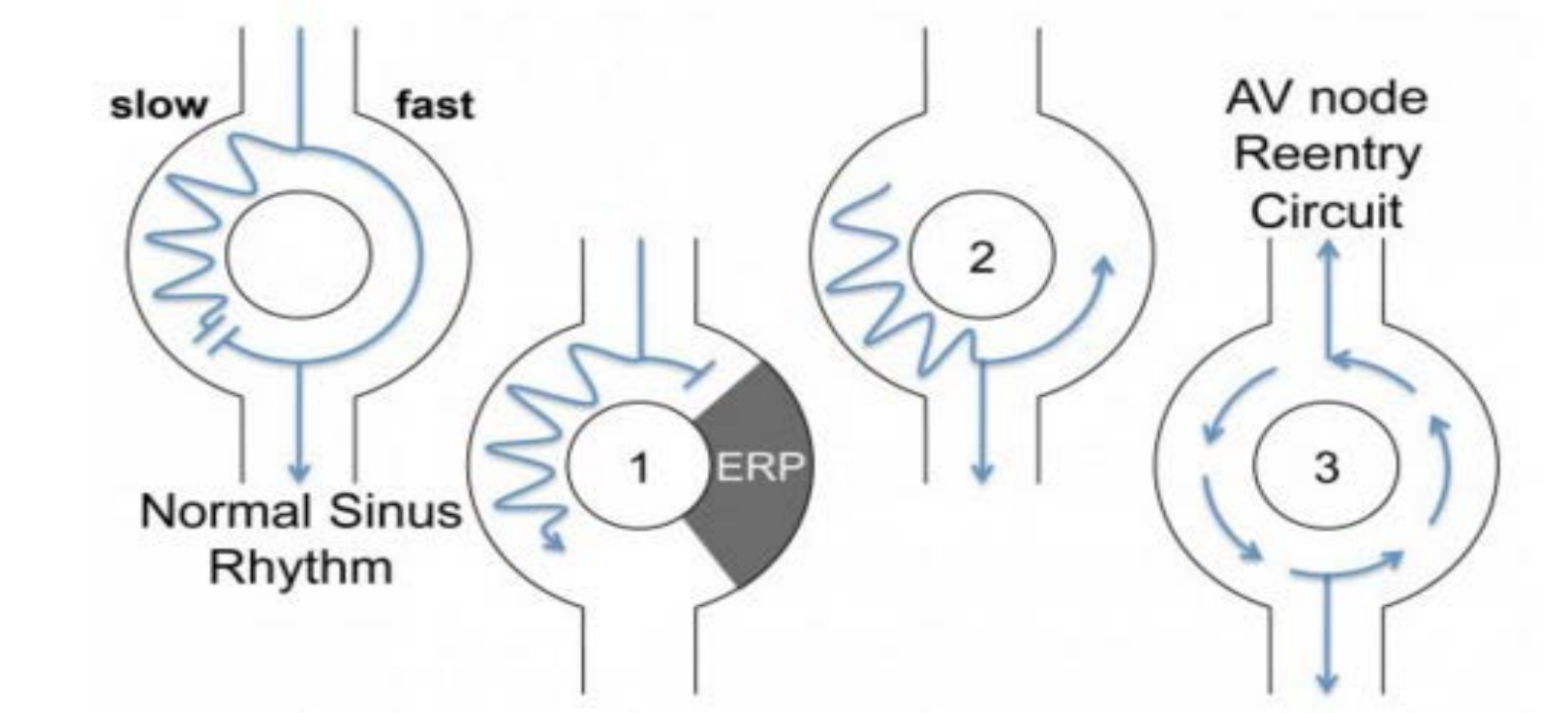


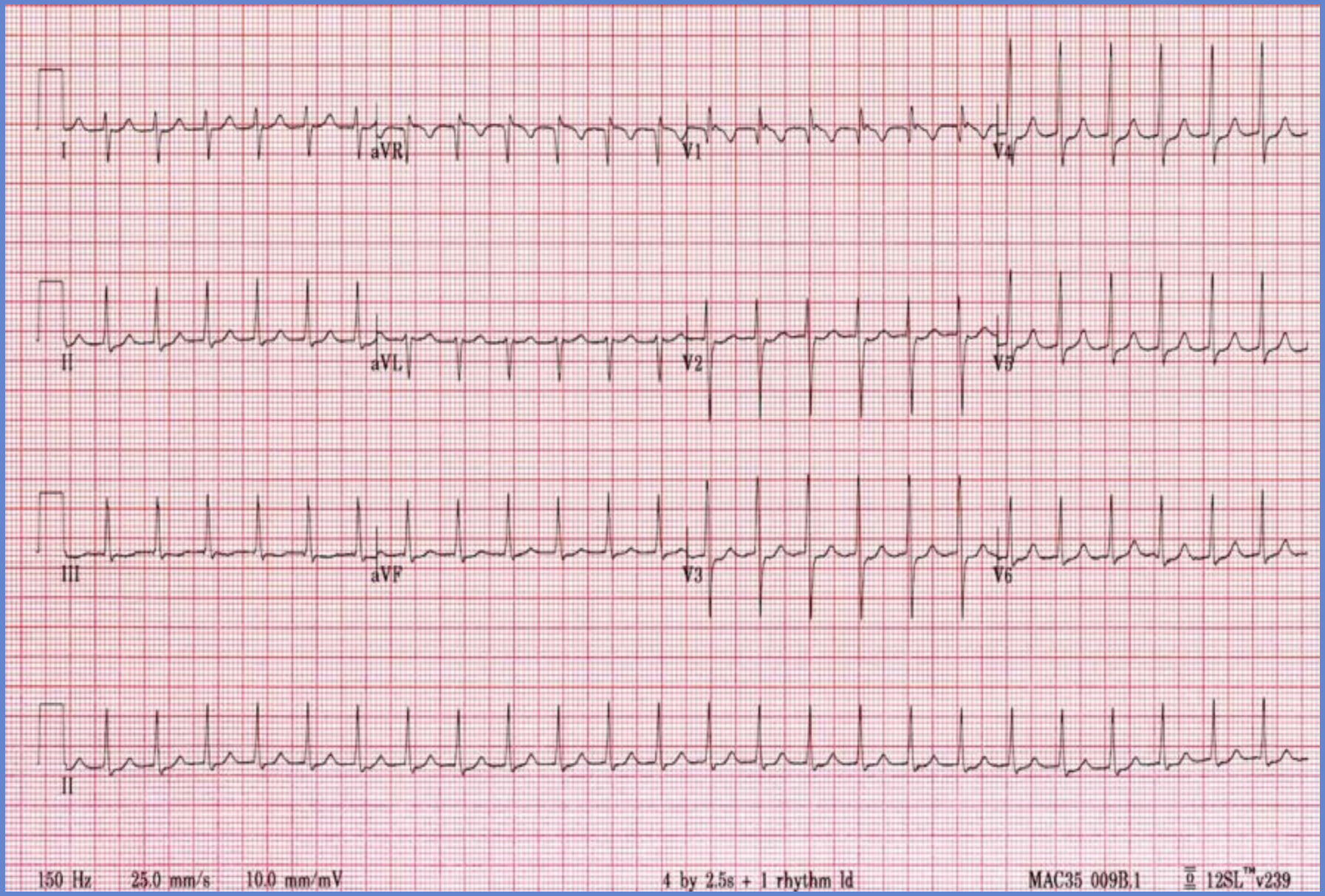
BEATS

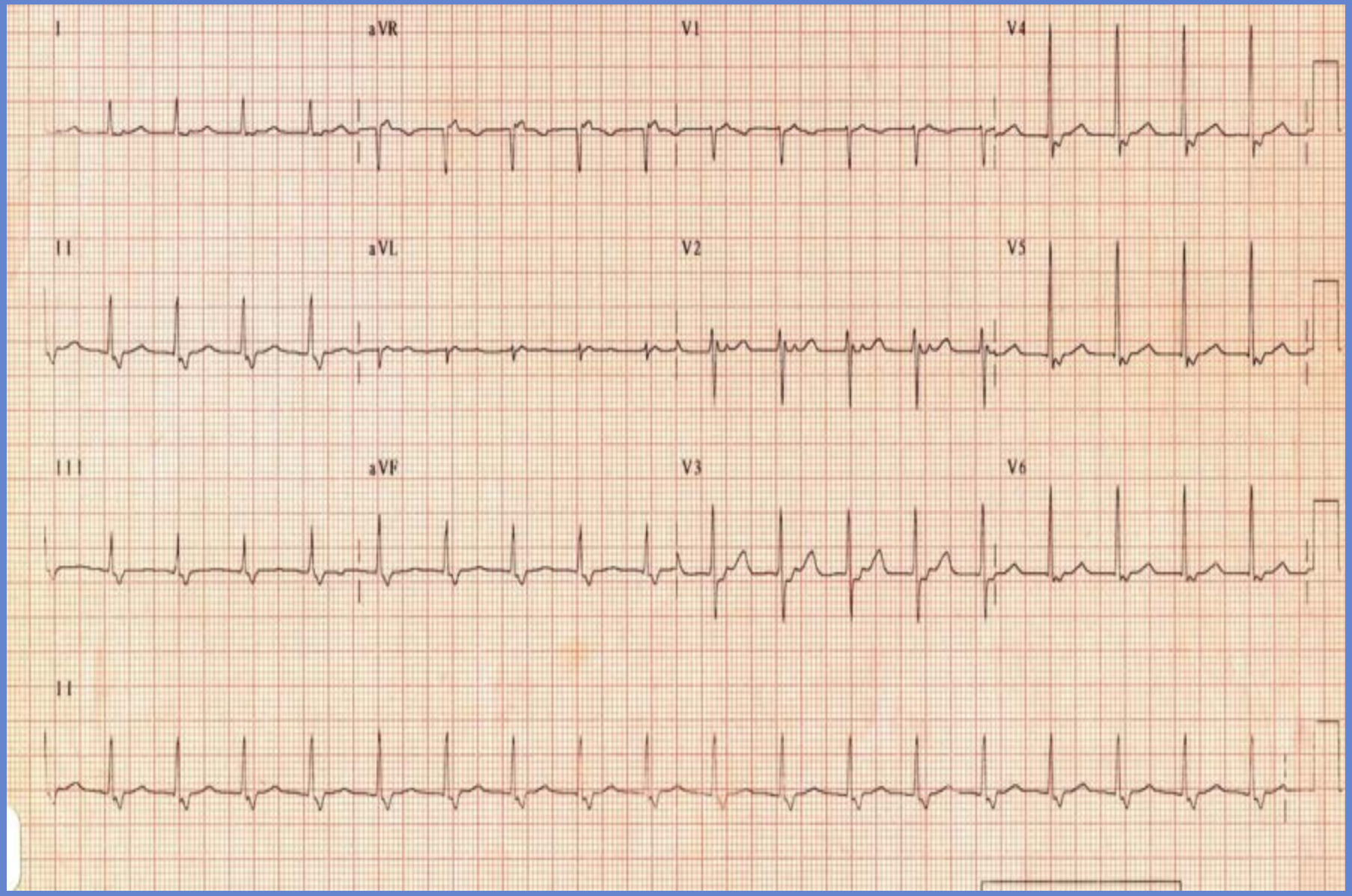
SVT

	Regular	Irregular
Atrial	**Sinus tachycardia** **Atrial tachycardia** **Atrial flutter** **Inappropriate sinus tachycardia** **Sinus node re-entrant tachycardia**	Atrial fibrillation Atrial flutter with variable block Multifocal atrial tachycardia
Atrioventricular	Atrioventricular re-entry tachycardia (AVRT) **AV nodal re-entry tachycardia (AVNRT)** Automatic junctional tachycardia	

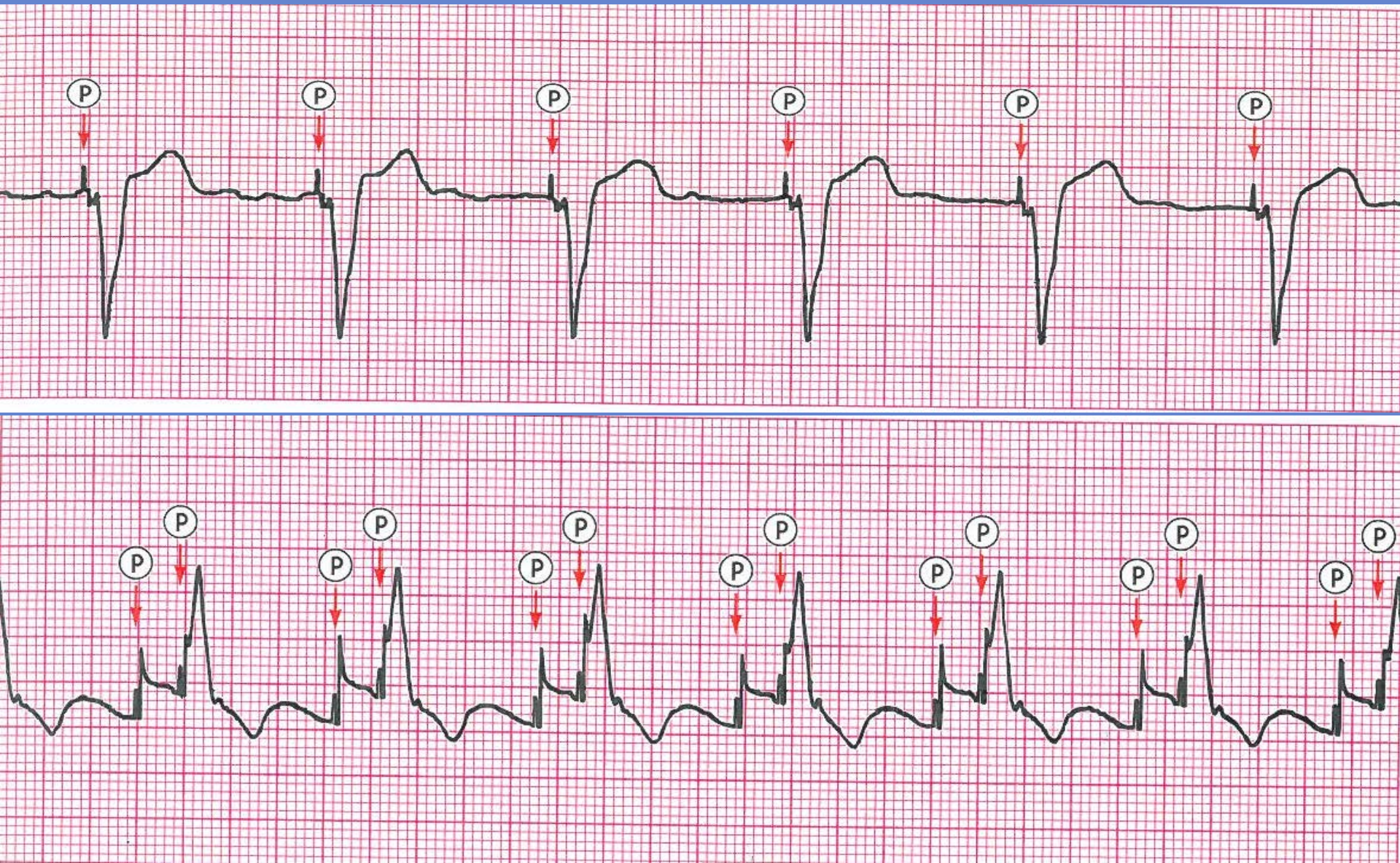
Slow-Fast AVNRT

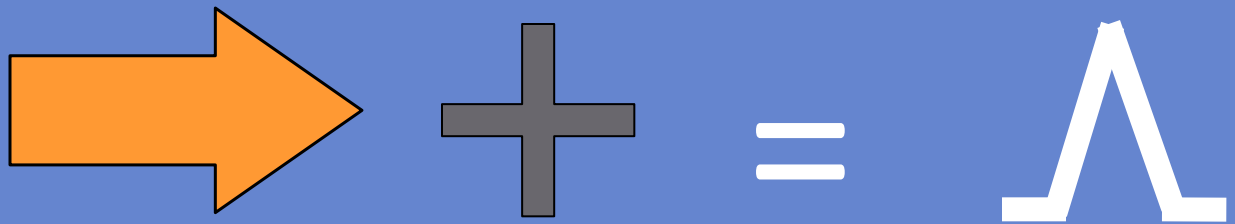



I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
150 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 1 rhythm ld
MAC35 009B.1
12SL™v239

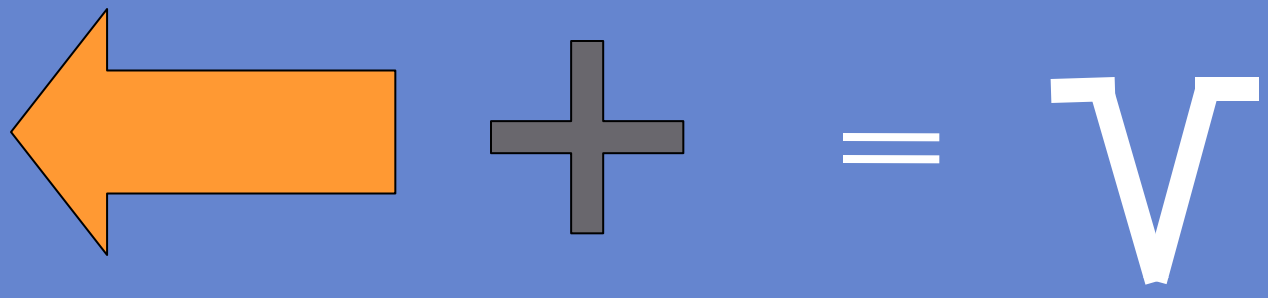

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

Paced beats

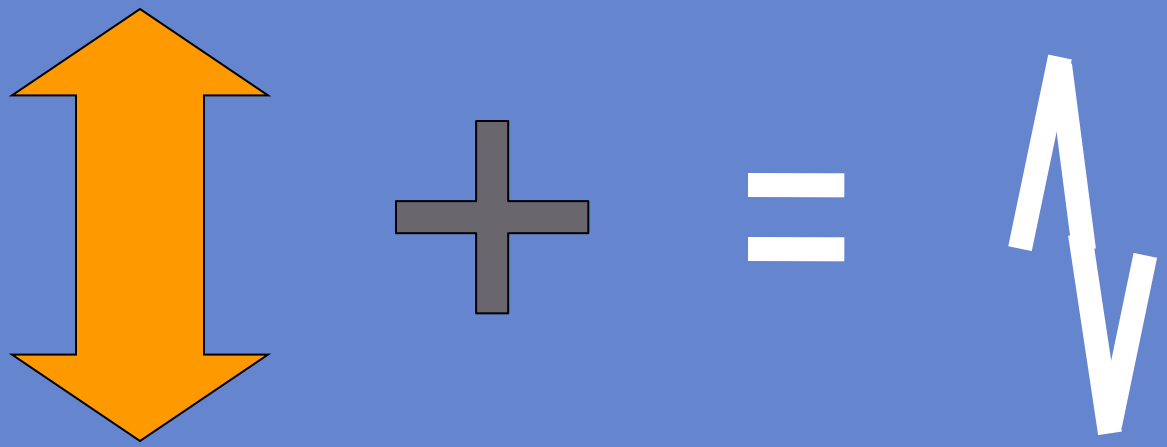




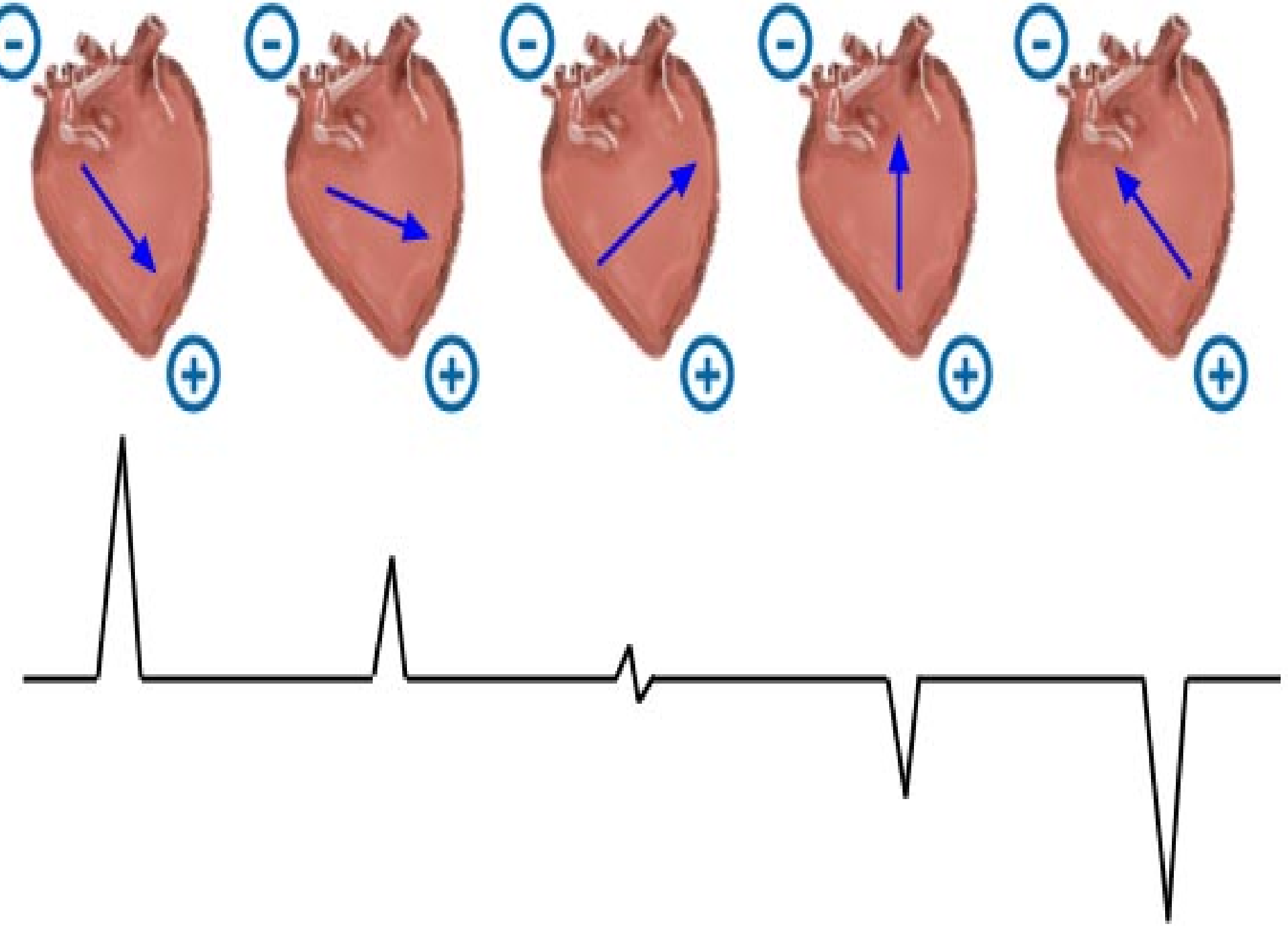
Electrical current flowing <u>toward</u> a positive electrode produces an <u>upward</u> deflection



Electrical current flowing away from a positive electrode produces a downward deflection

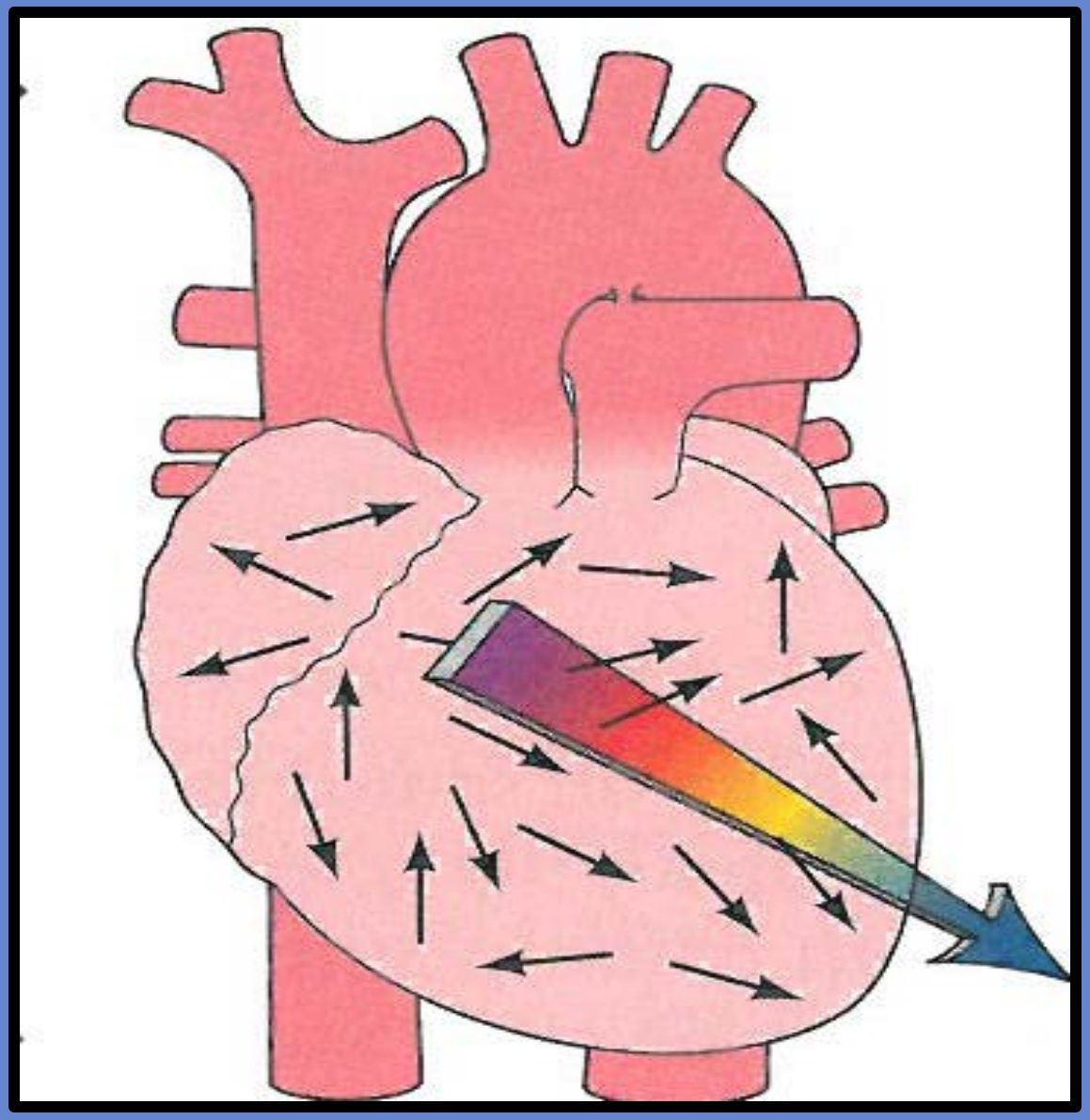


Electrical current flowing perpendicular to a positive electrode produces a biphasic deflection

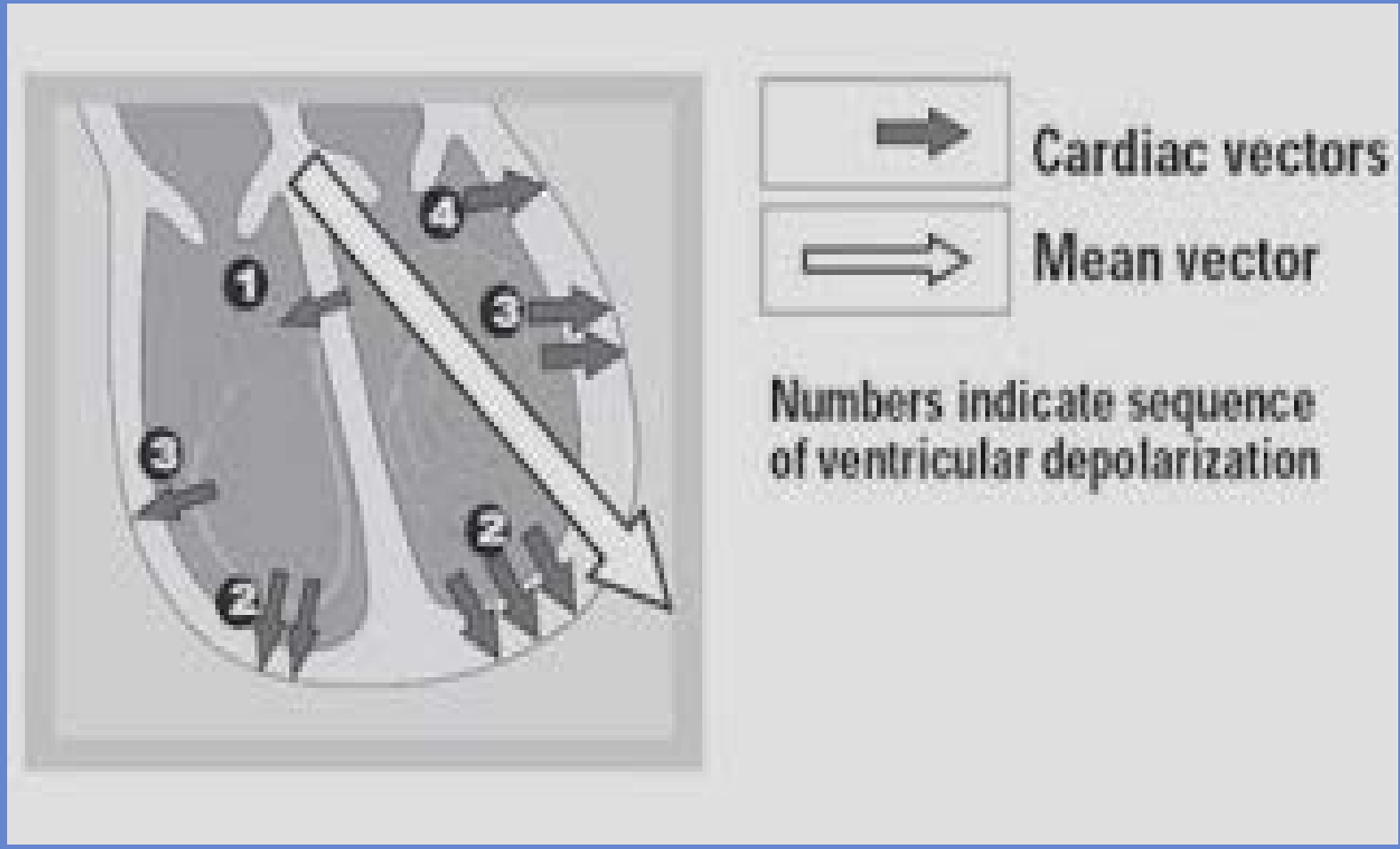


Vectors

- Each cell has its own electrical impulse
- Vary in strength and direction
- According to physics can add and subtract vectors
- The sum of all of these is the electrical axis of the ventricle



Ventricular Depolarization



Lead Placement

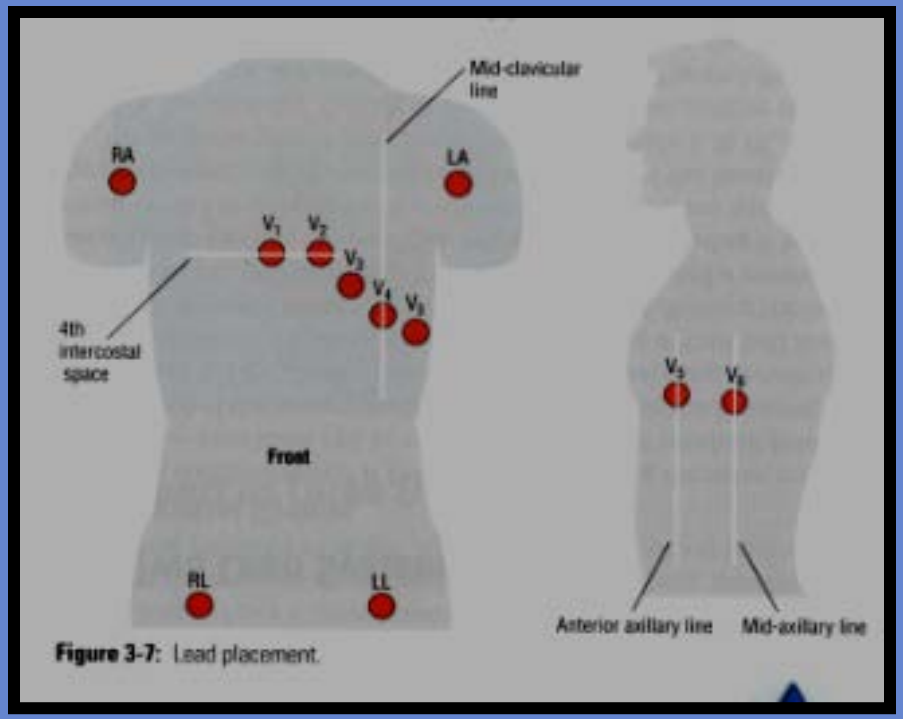
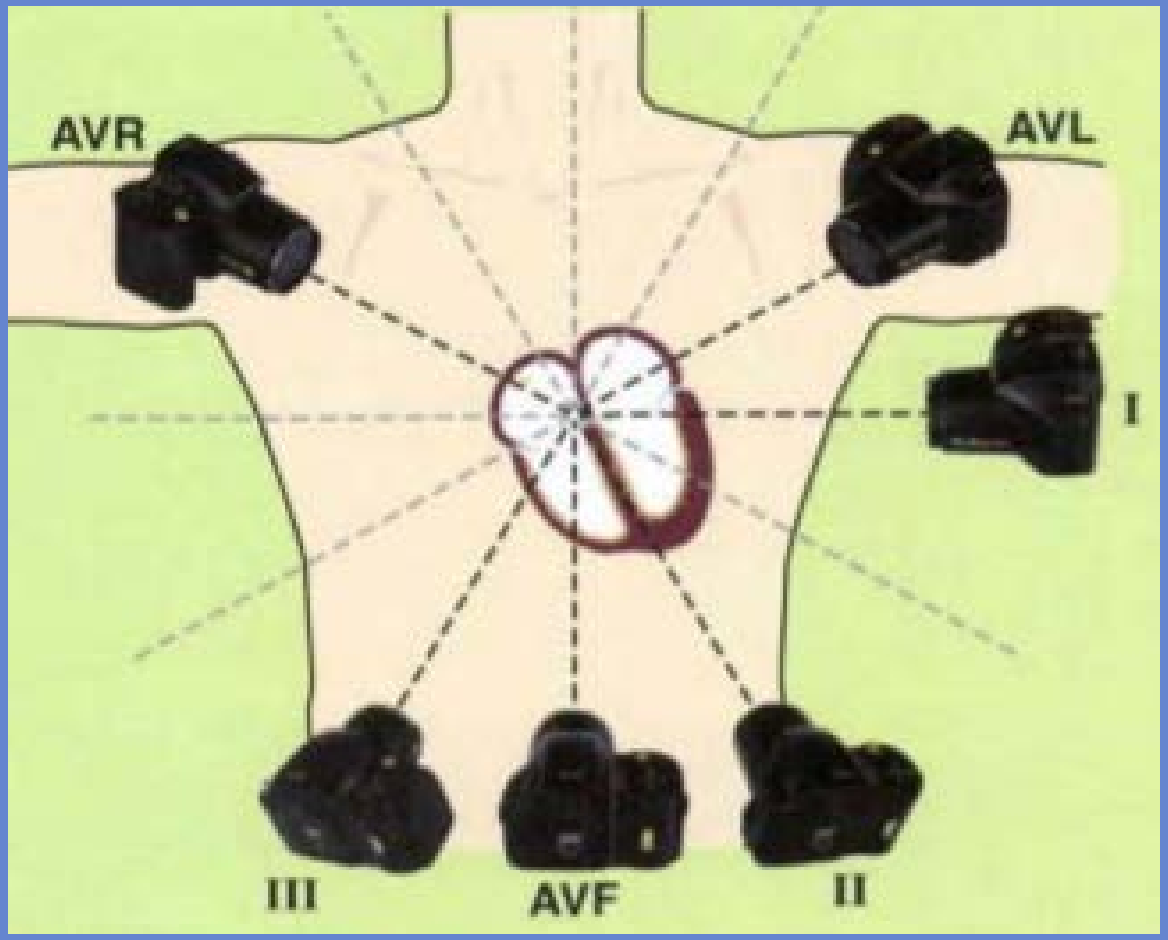


Figure 3-7: Lead placement.

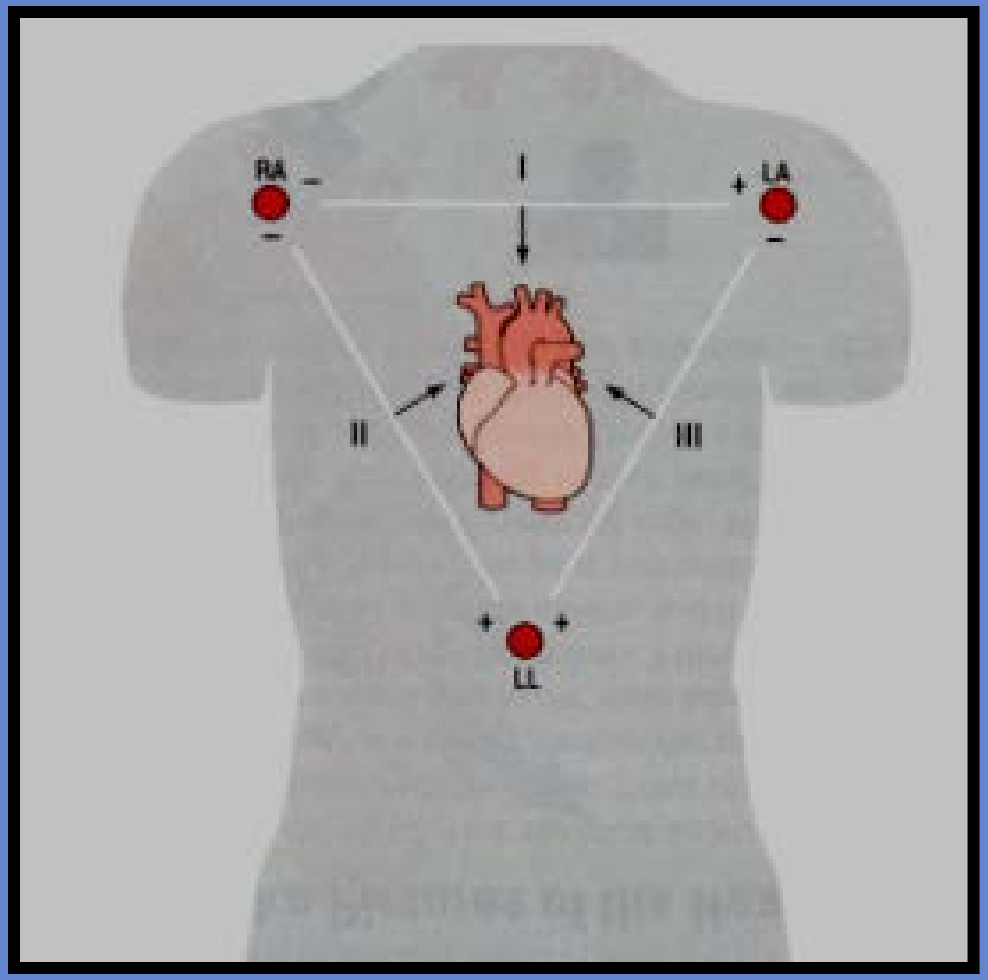
- Limb leads 10 cm from heart
- Precordial leads placed exact
- V1&V2 each side of sternum 4th intercostal
- V4 5th intercostal mid-clavicular line



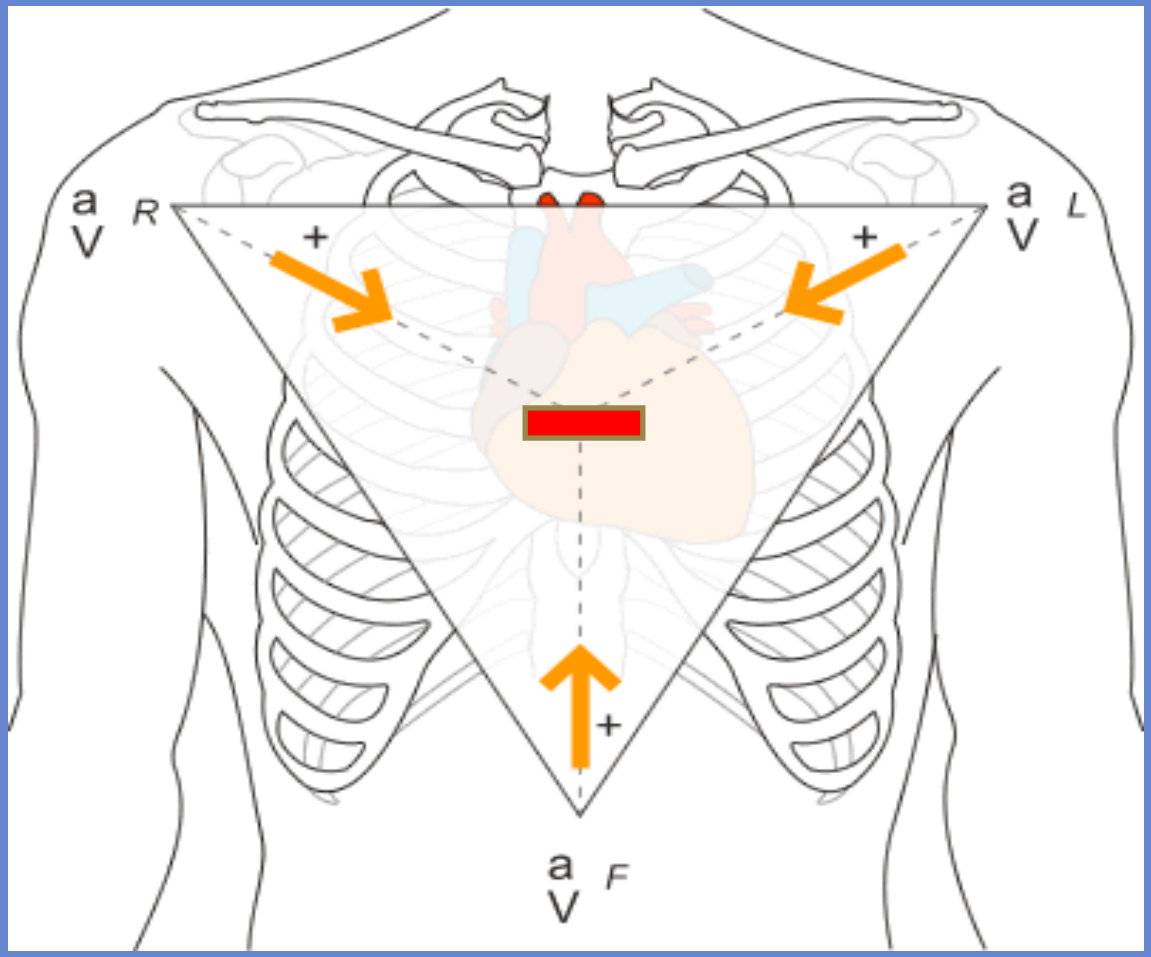
Pictures of the Heart

- Electrodes are like cameras
- Pick up the electrical activity of vectors and turns it into waves
- 3-D image of the heart

Leads I, II, & III

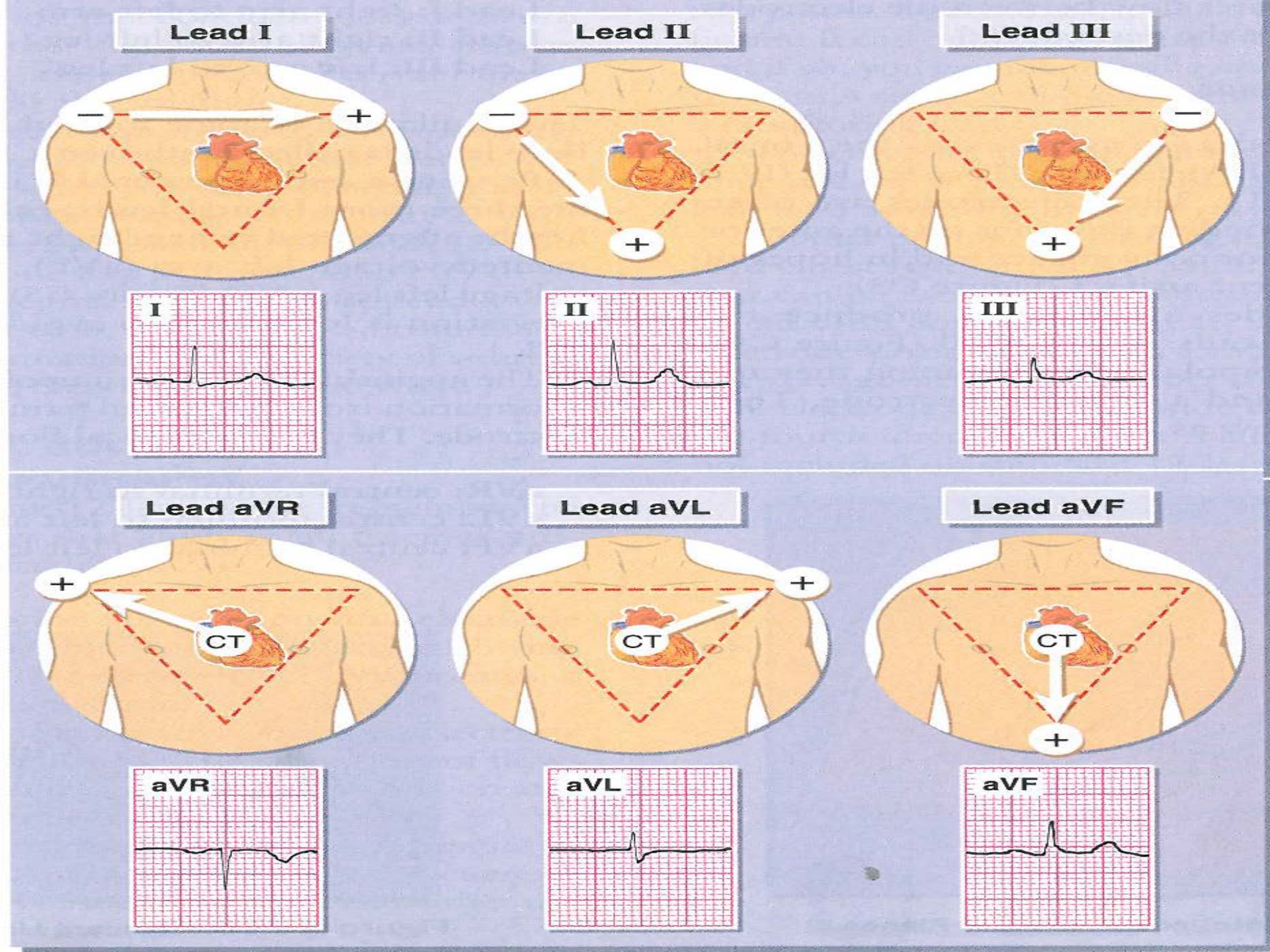


aVR, aVL, & aVF

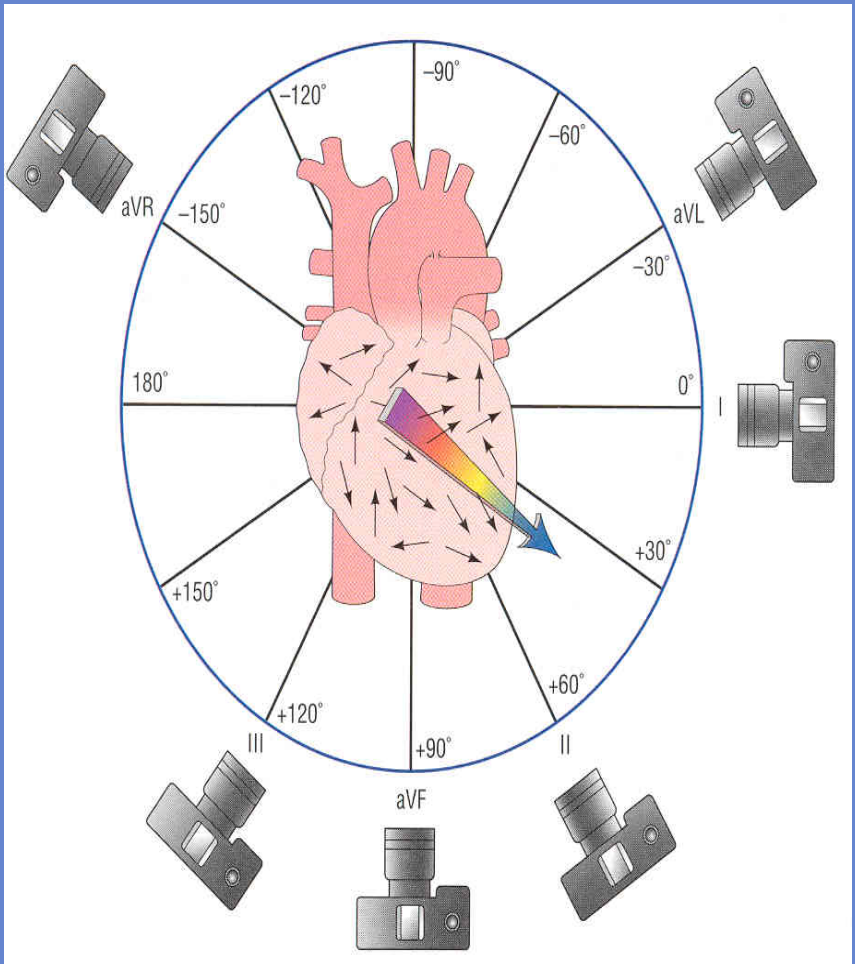


Manipulation of Leads

- Positive and negative poles for leads I, II, & III
- In physics two vectors (leads) are equal as long as they are parallel and same polarity
- Move the leads to pass through the center of the heart
- With vector manipulation ECG machine creates aVR, aVL, & aVF

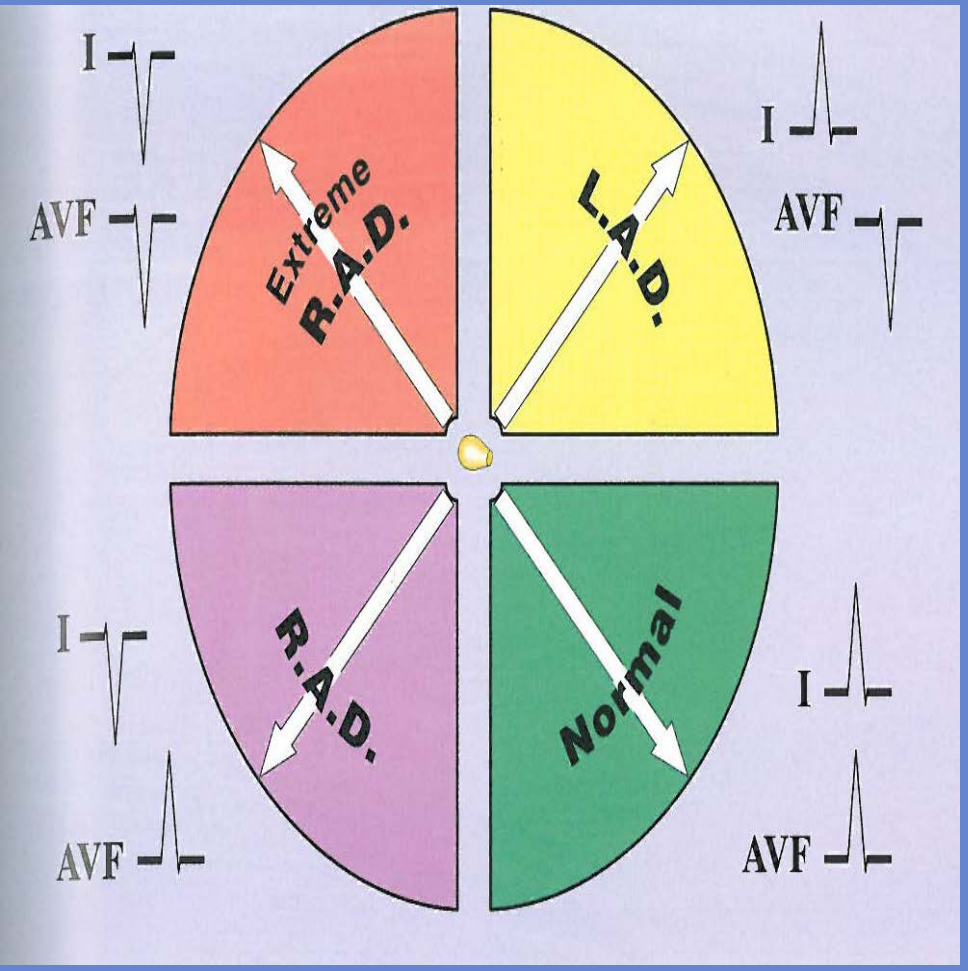

Lead I
Lead II
Lead III
I
II
III
Lead aVR
Lead aVL
Lead aVF
CT
CT
CT
aVR
aVL
aVF

Hexaxial System



- Used to determine electrical axis
- What is the normal axis for the heart?
- -30 to +90

Electrical Axis



Right Axis Deviation

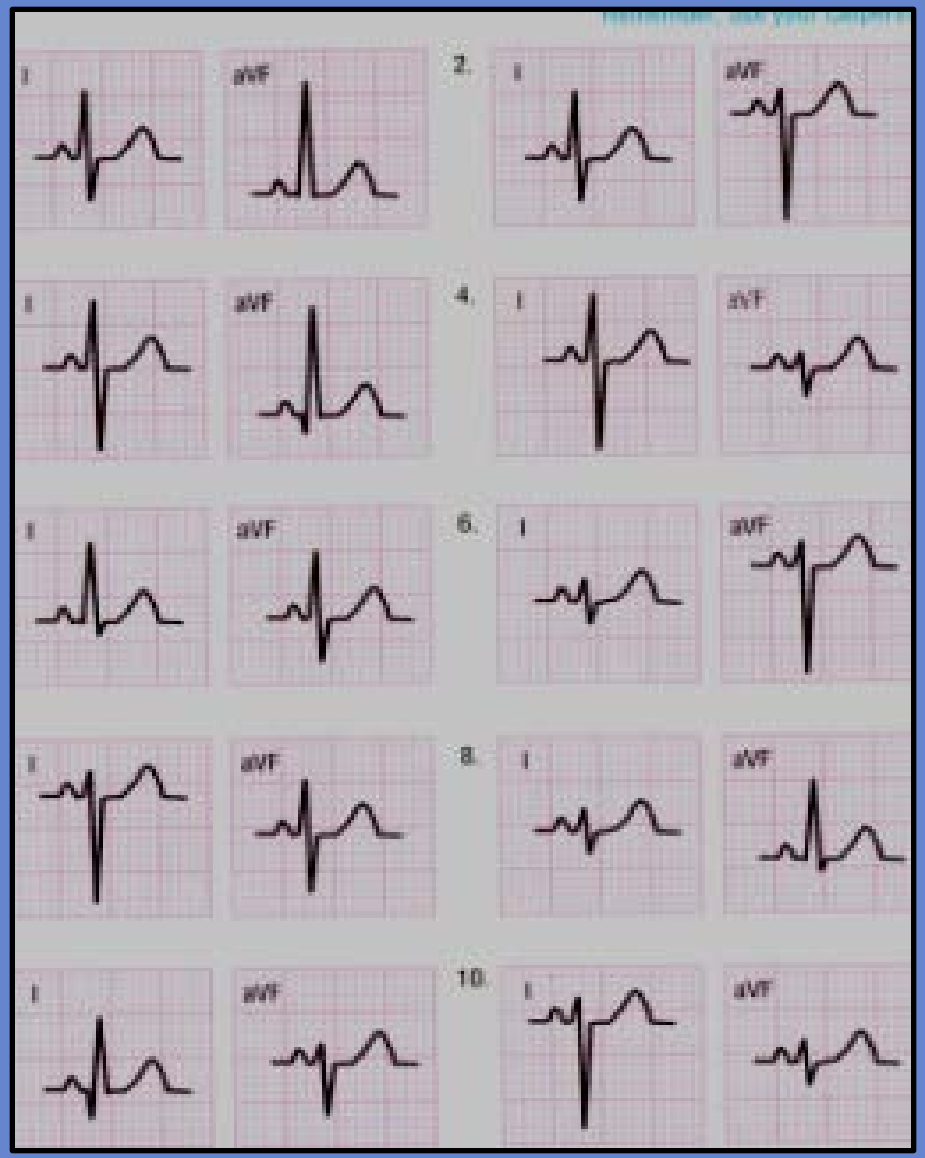
- -RVH
- -Left posterior hemiblock
- -Dextrocardia
- -Ectopic ventricular beats and rhythms

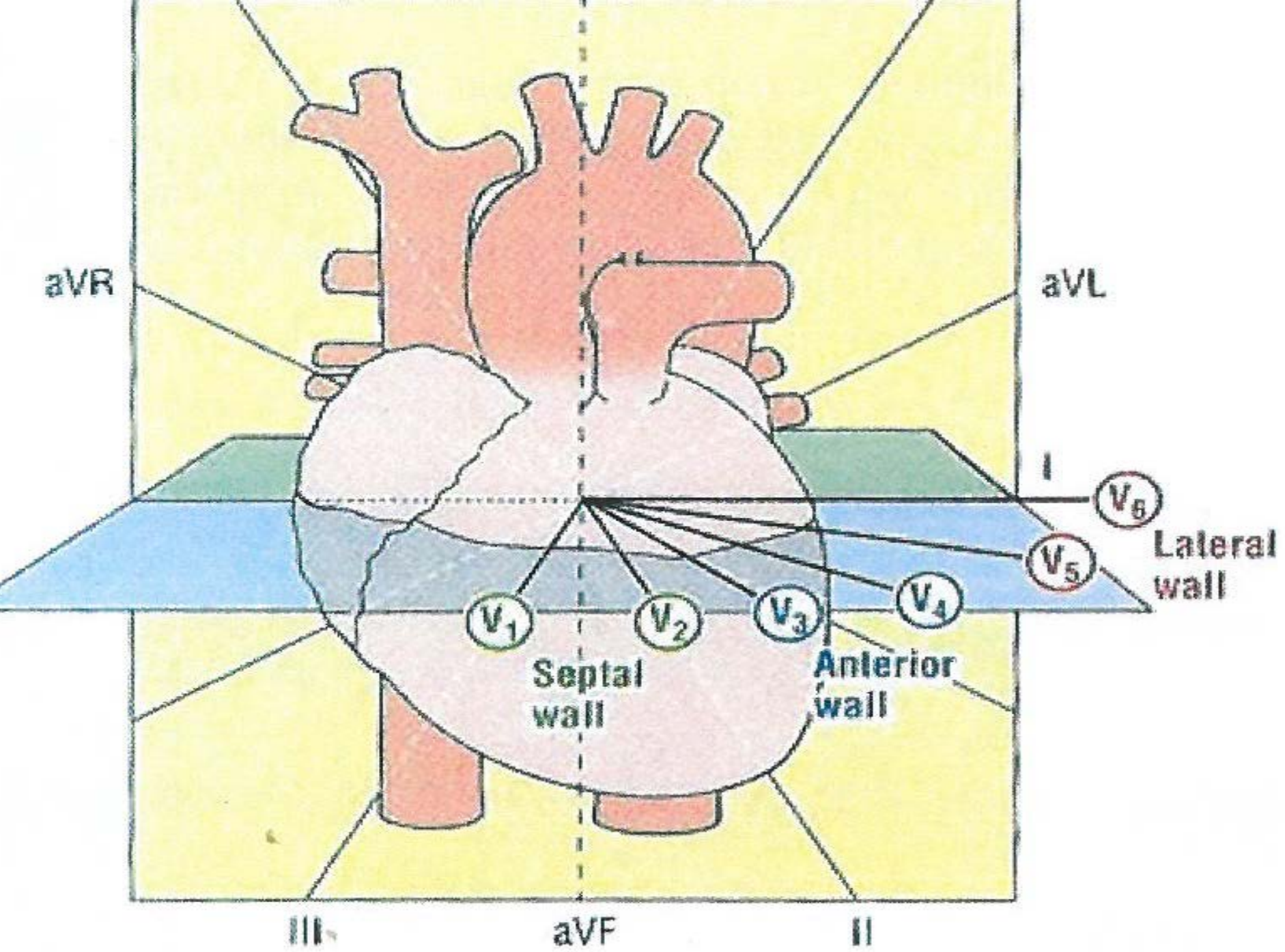
Left axis deviation

- -Left Anterior hemiblock
- -Ectopic ventricular beats and rhythms

Extreme Right

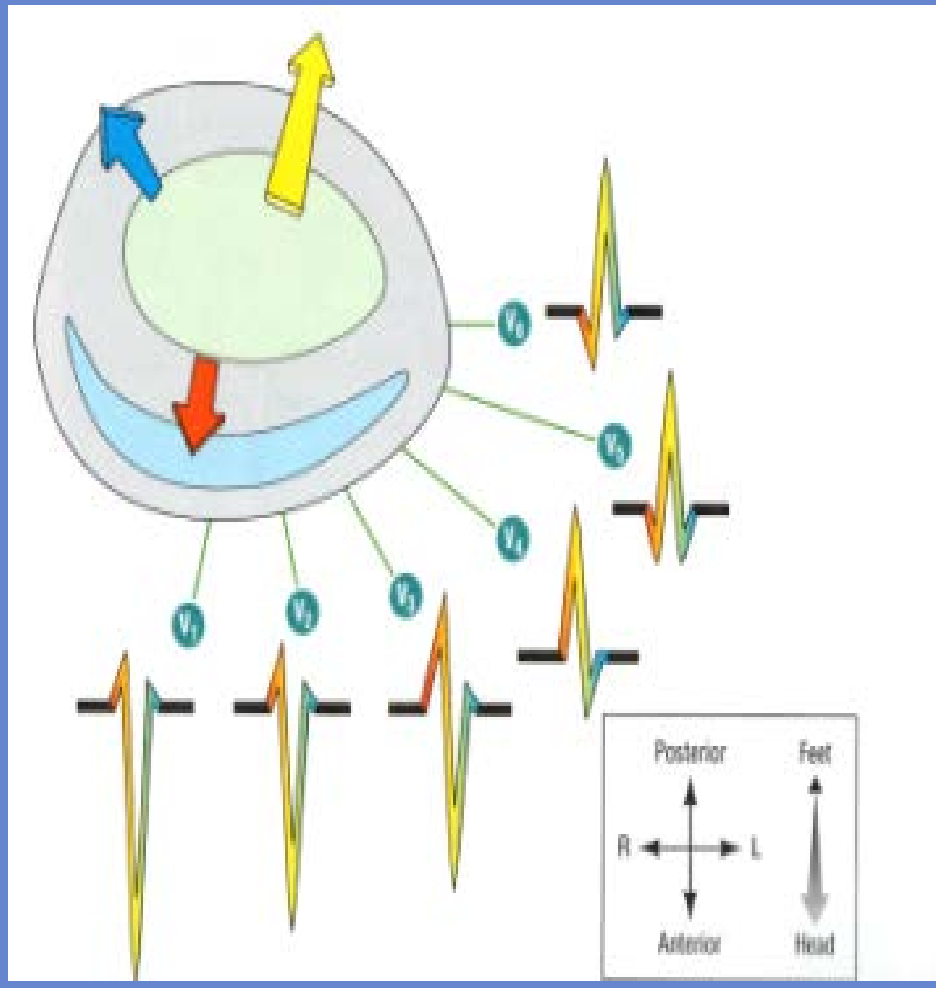
Determine the axis



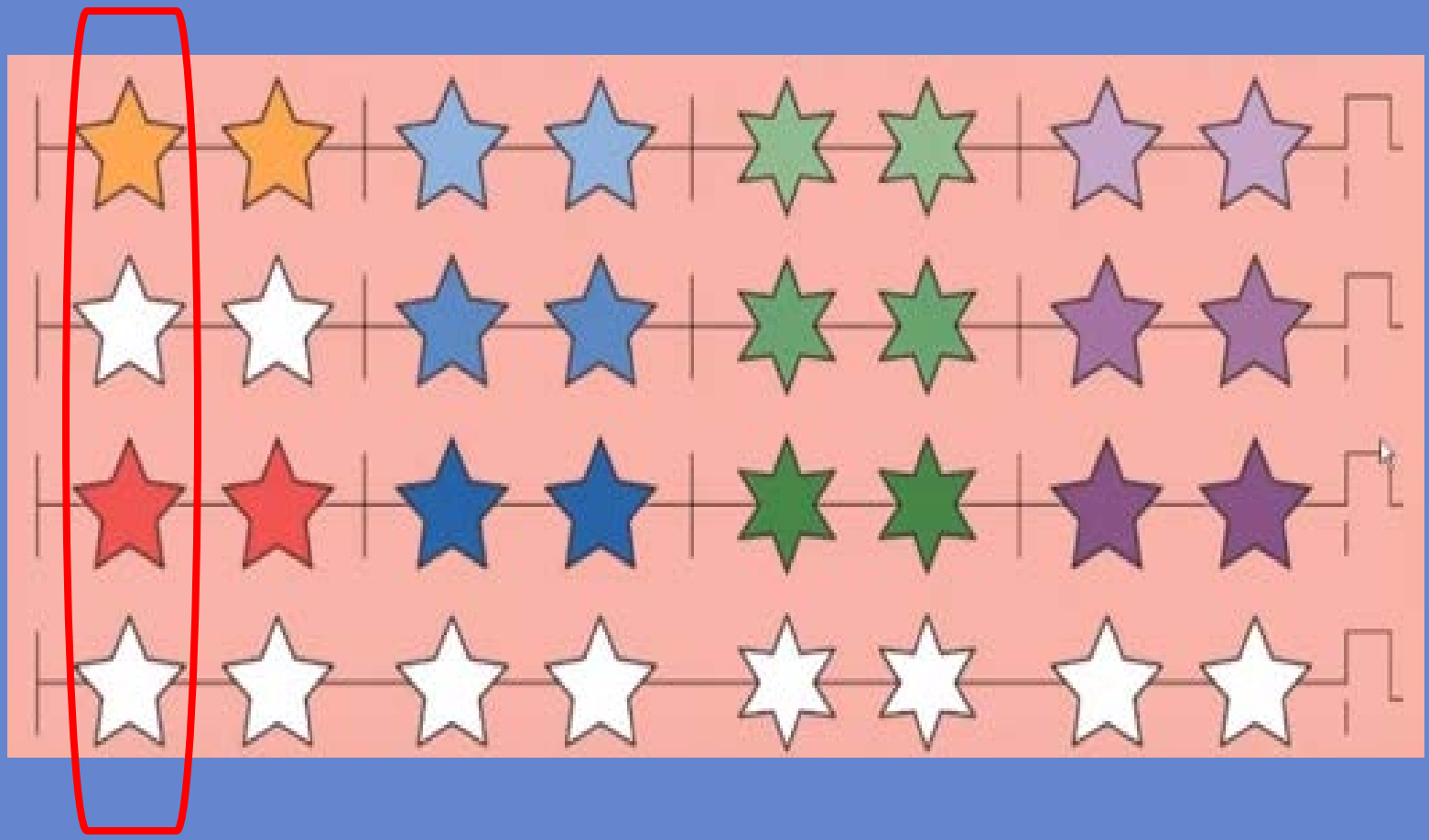

aVR
aVL
I
V_6
V_5
V_4
V_3
V_2
V_1
Lateral wall
Septal wall
Anterior wall
III
aVF
II

R Wave Progression

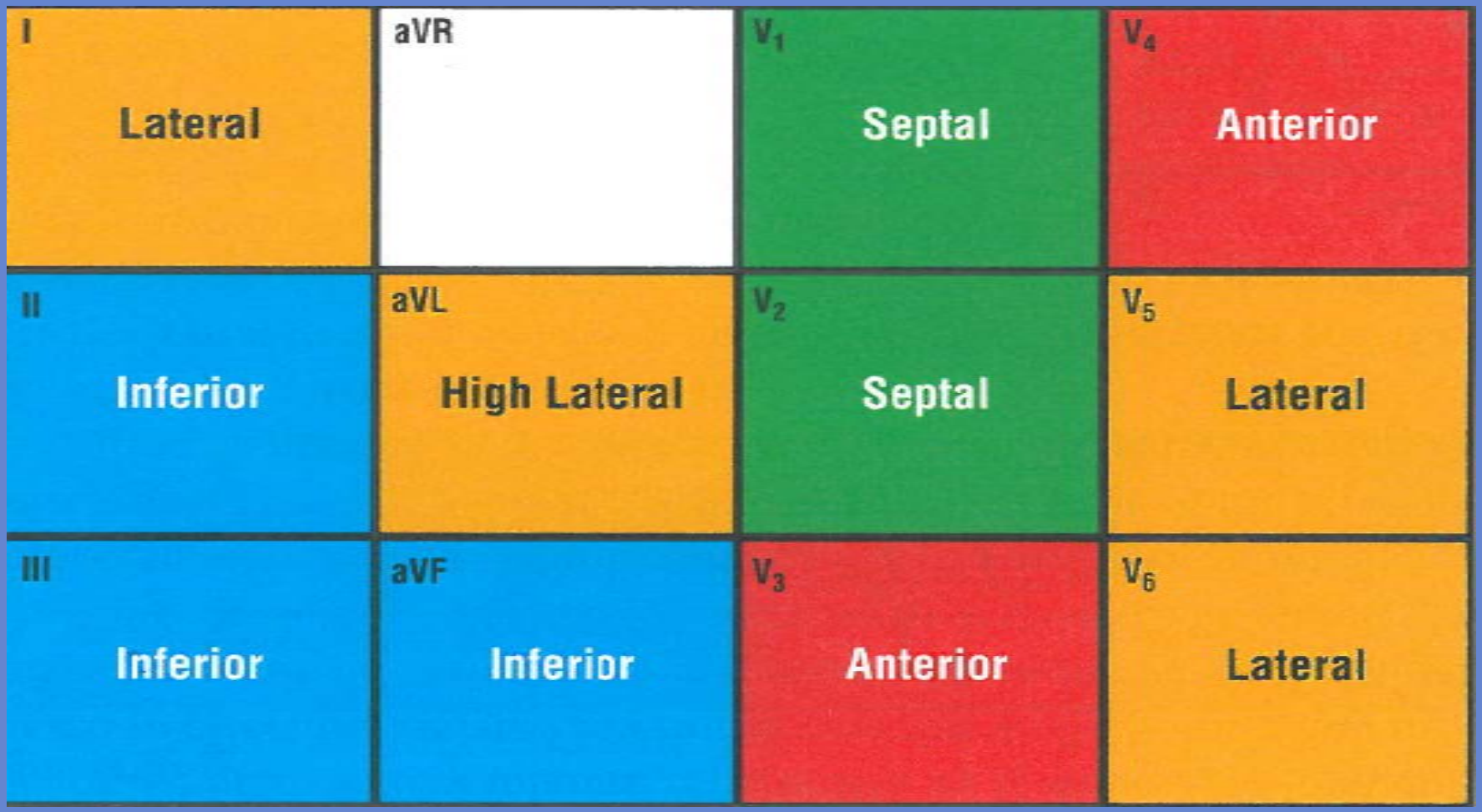
- V1 overlays right ventricle deep s wave
- V5 & V6 overlay left ventricle tall positive R waves. V5 usually the tallest R wave
- Transition zone between V3 & V4



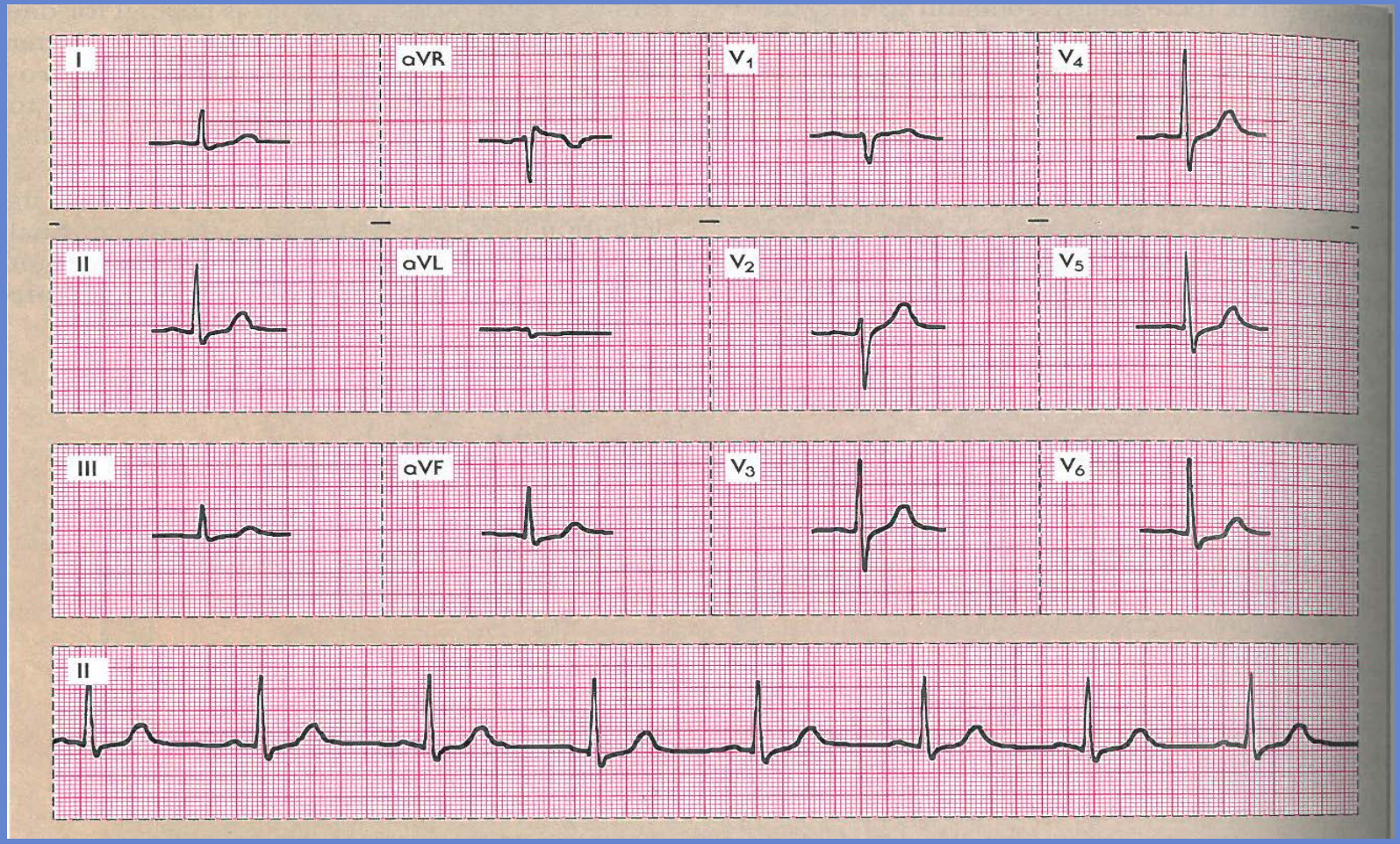
Temporal relationship

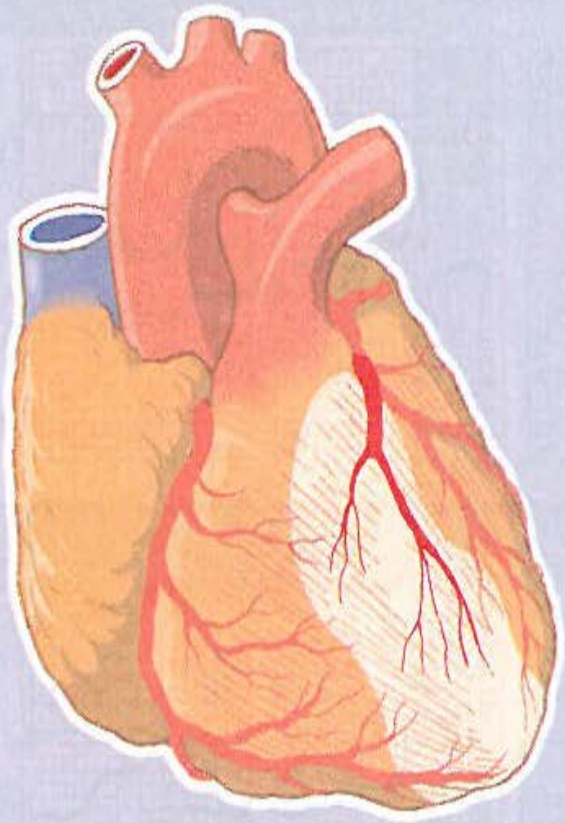


Normal 12 Lead

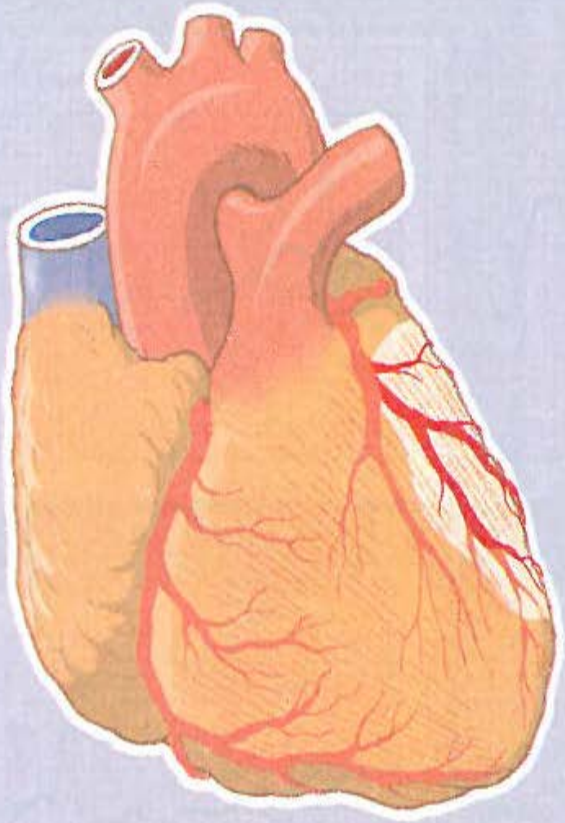


Normal 12 Lead

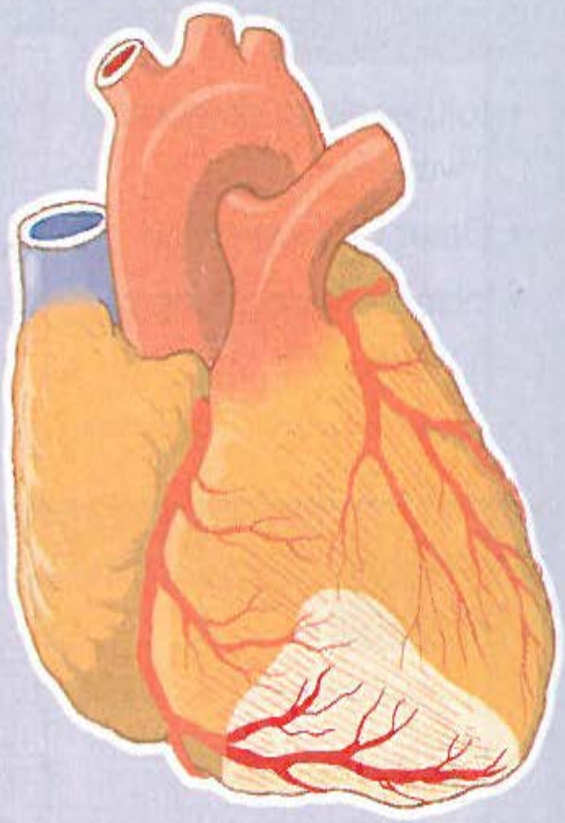




ANTERIOR WALL
occlusion of
Left Anterior Descending
Coronary Artery
causes changes in leads
V_1, V_2, V_3, V_4



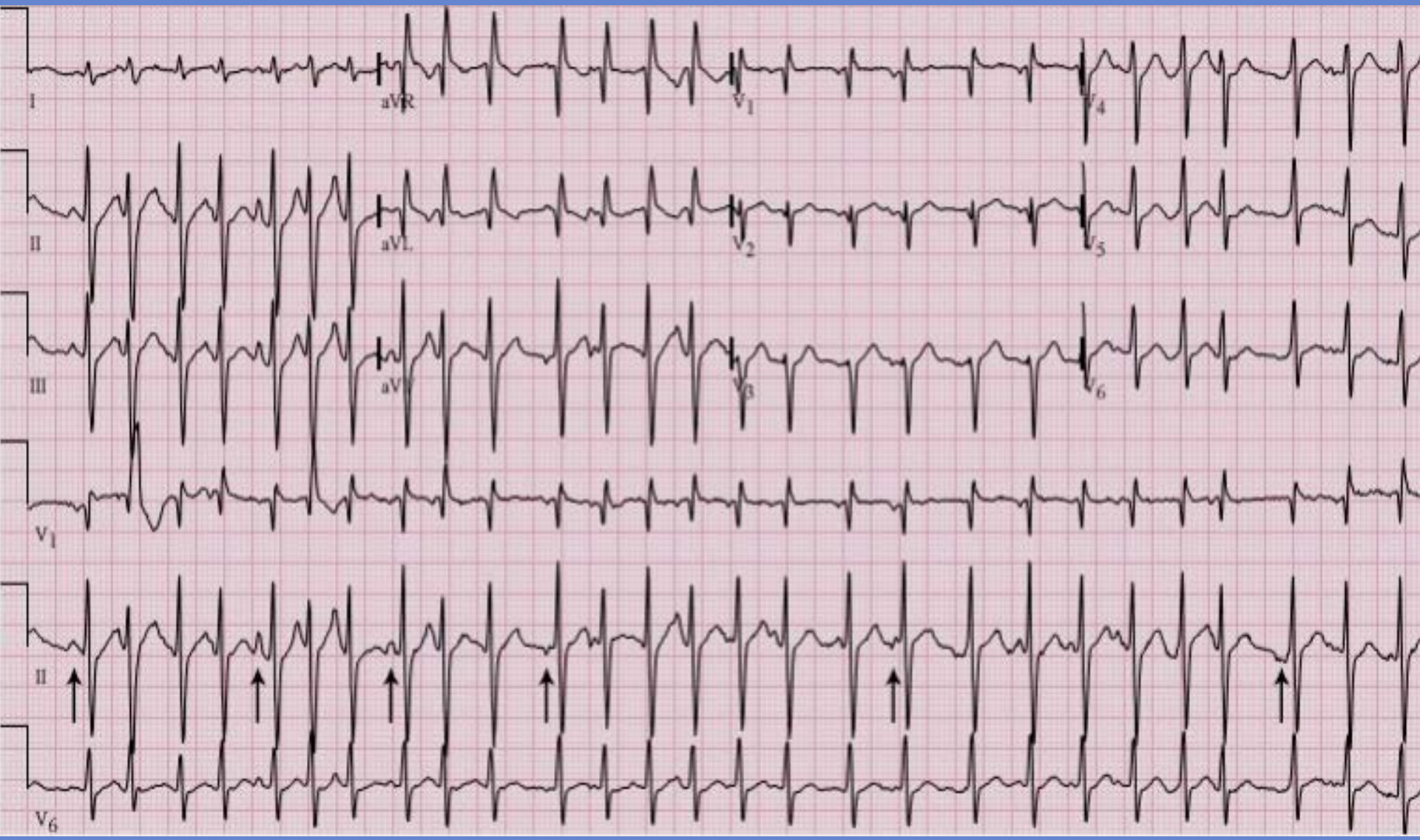
LATERAL WALL
occlusion of
Left Anterior Descending
or **Circumflex** Coronary Artery
causes changes in leads
I, aVL, V_5, V_6

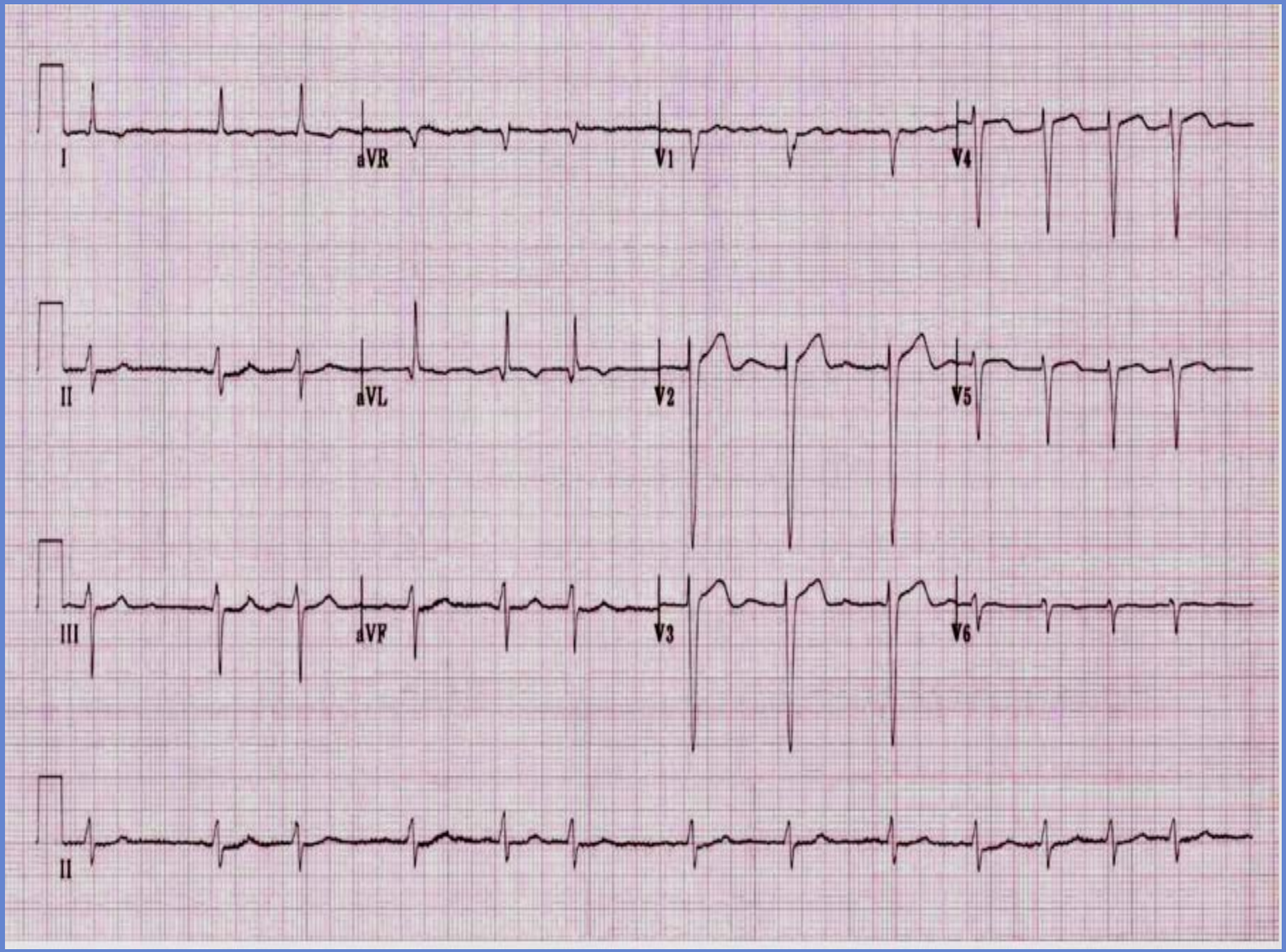


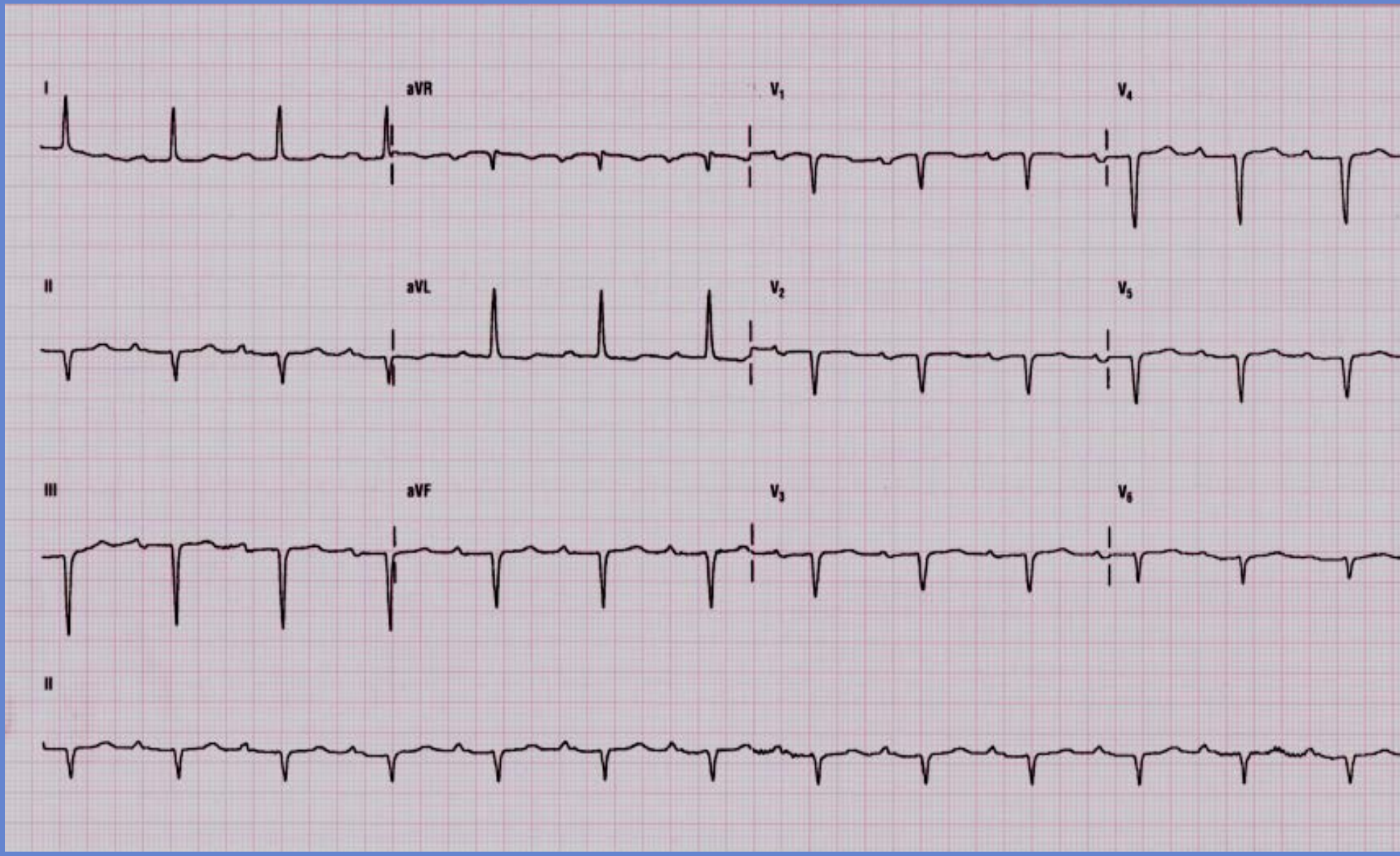
INFERIOR WALL
occlusion of
Right
Coronary Artery
causes changes in leads
II, III, aVF

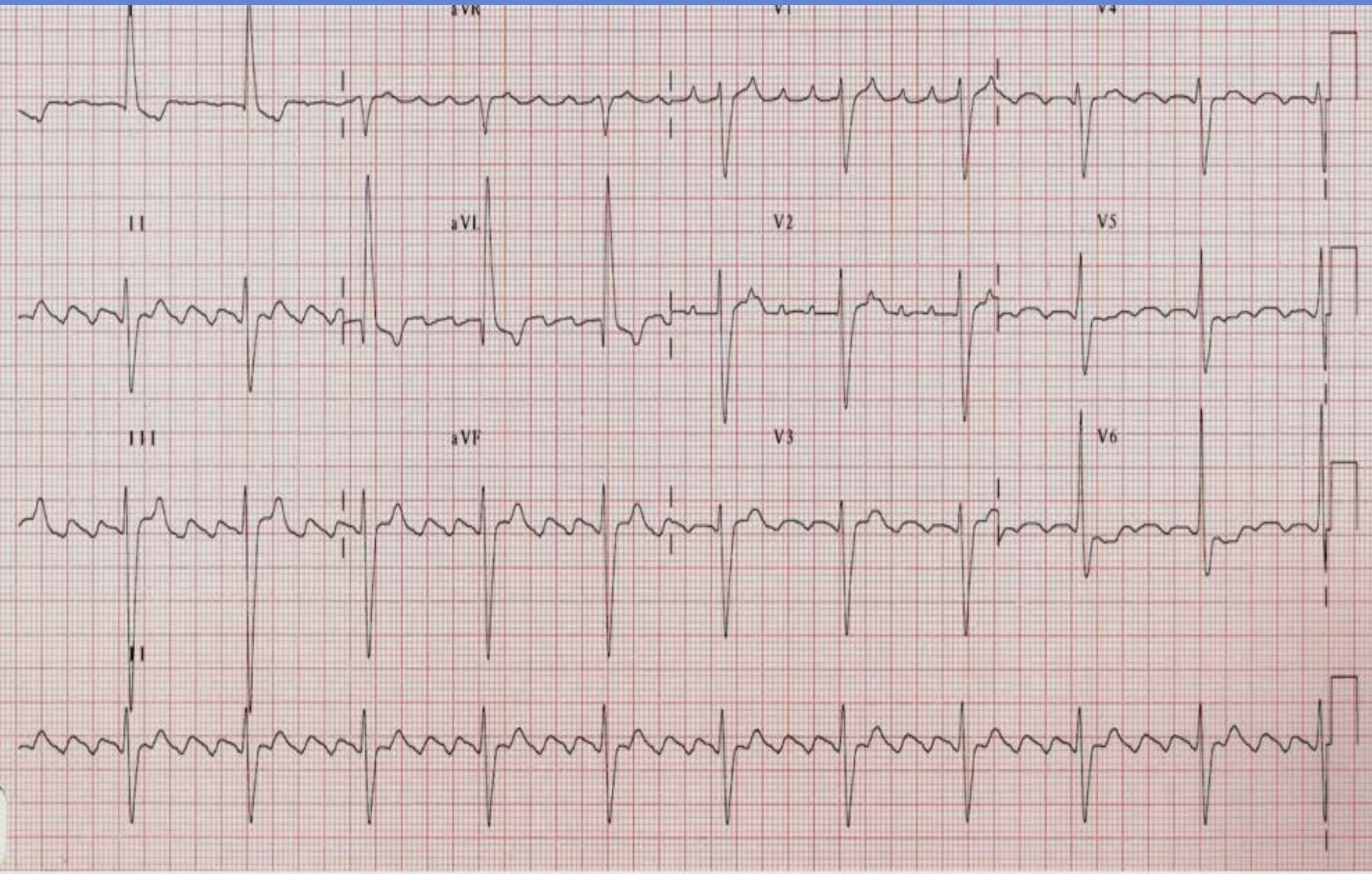
Systematic Approach to Interpretation

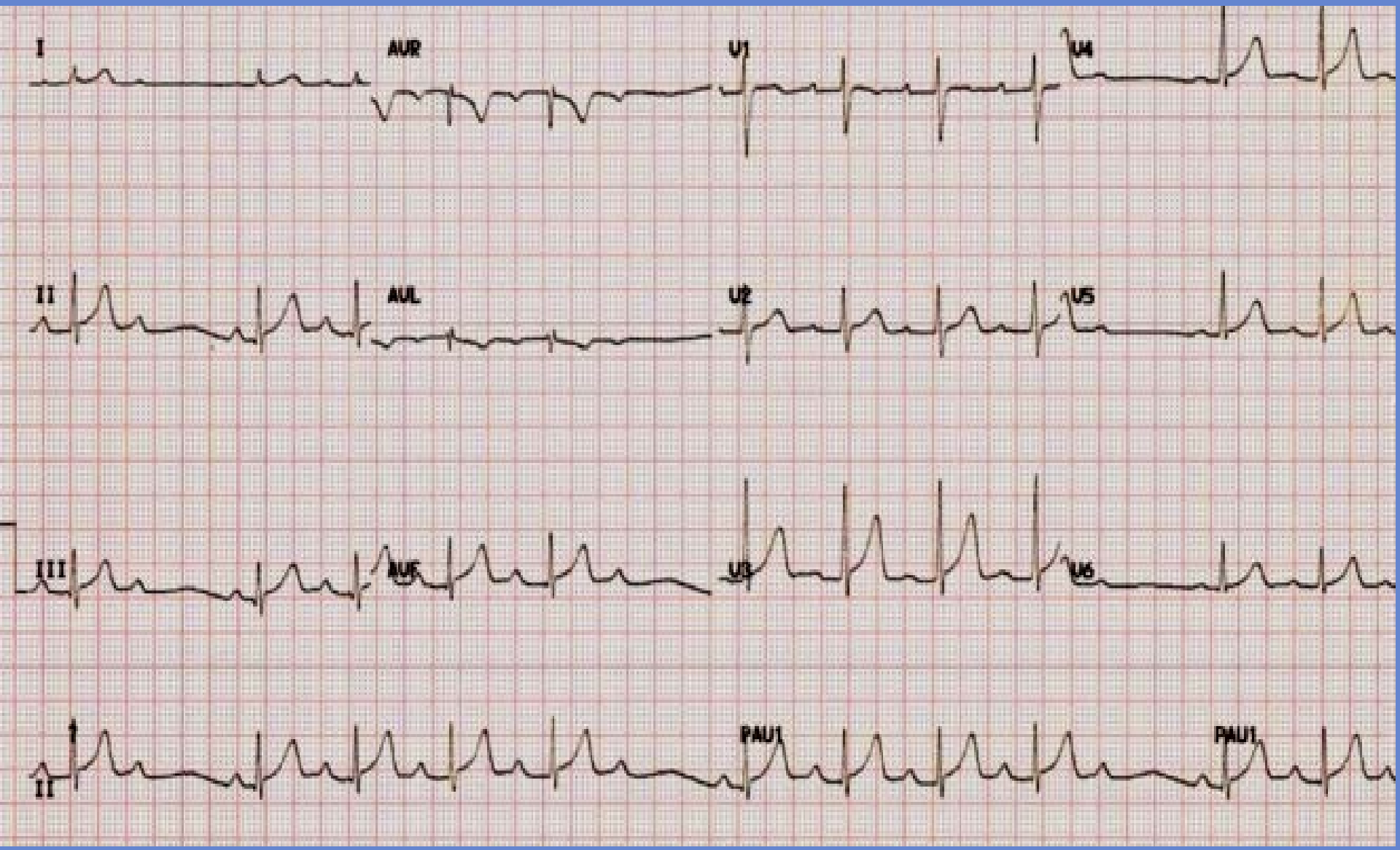
- General Impression/Anything that sticks out?
- Rate, intervals & rhythm
- Axis
- Is there hypertrophy
- Ischemia or infarction
- Any other unusual findings
- Putting it all together for the patient

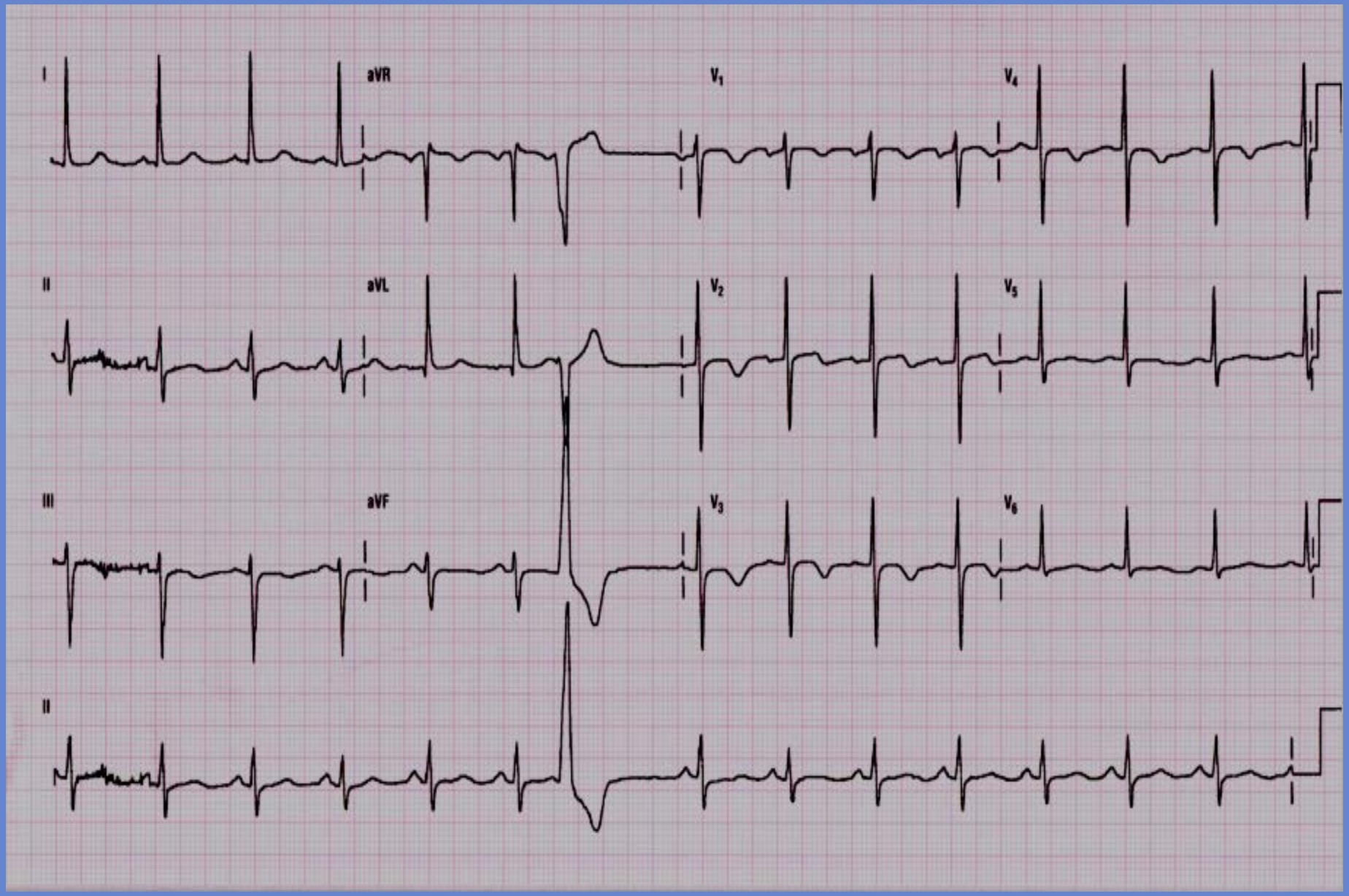

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V6

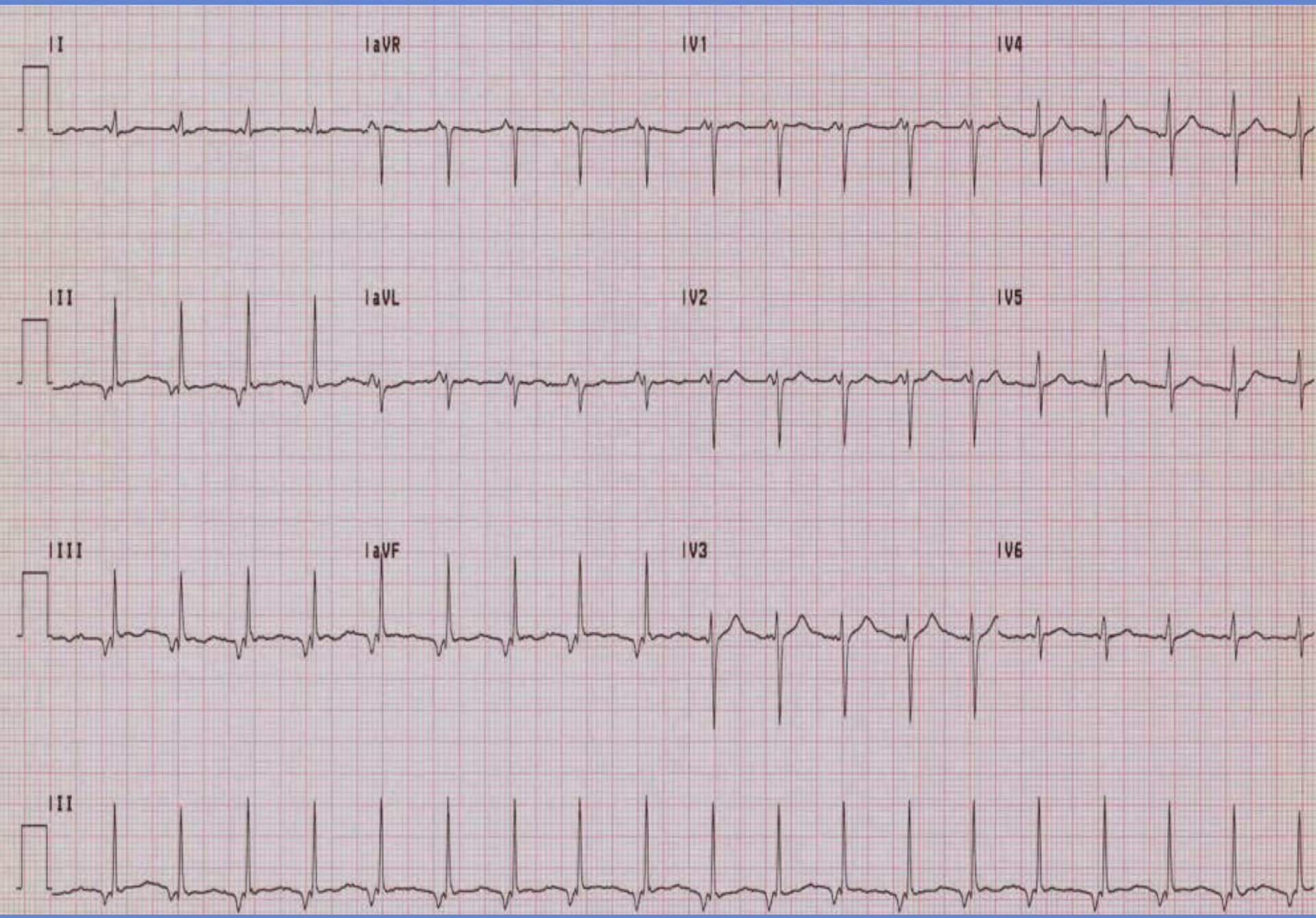

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

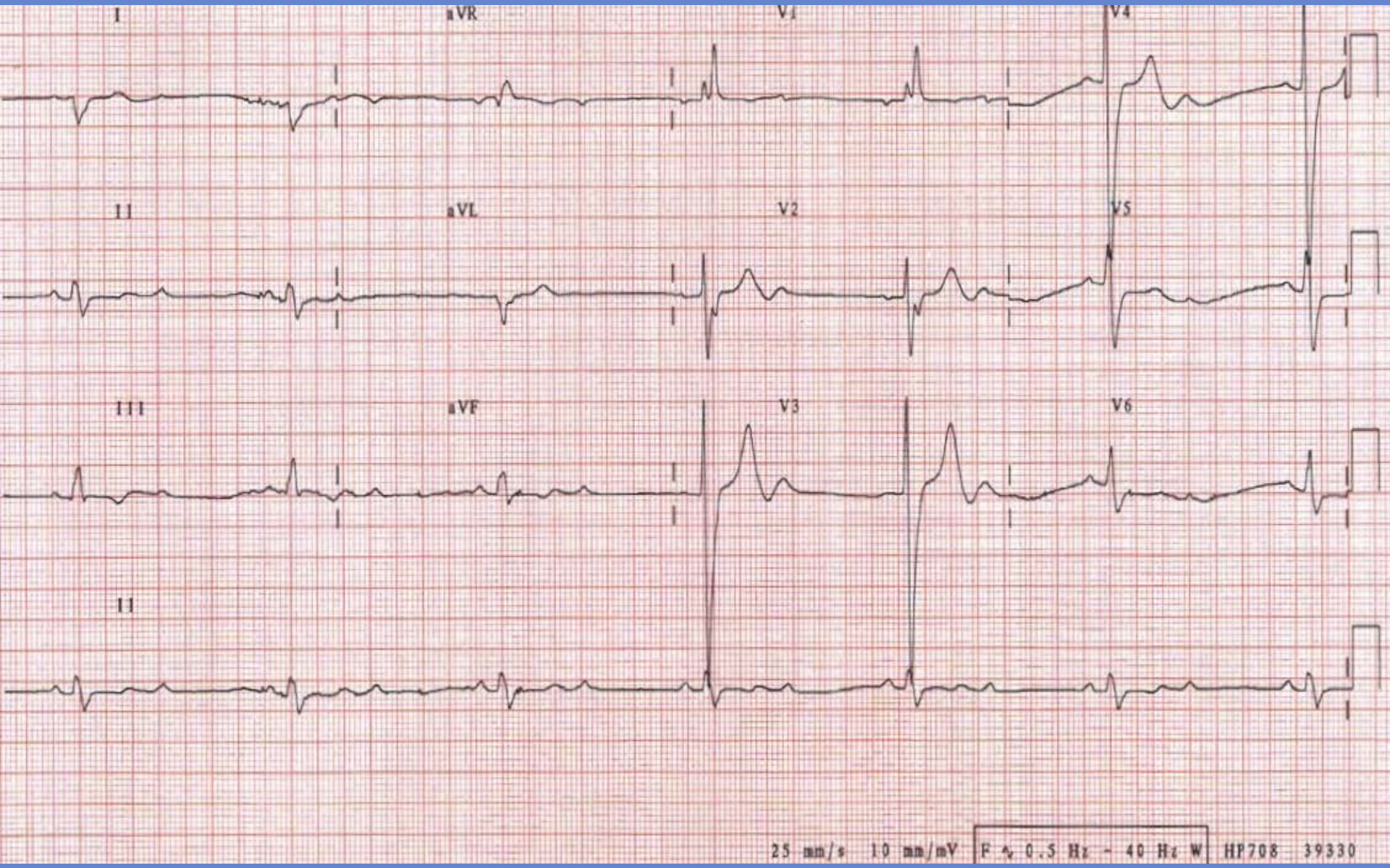

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

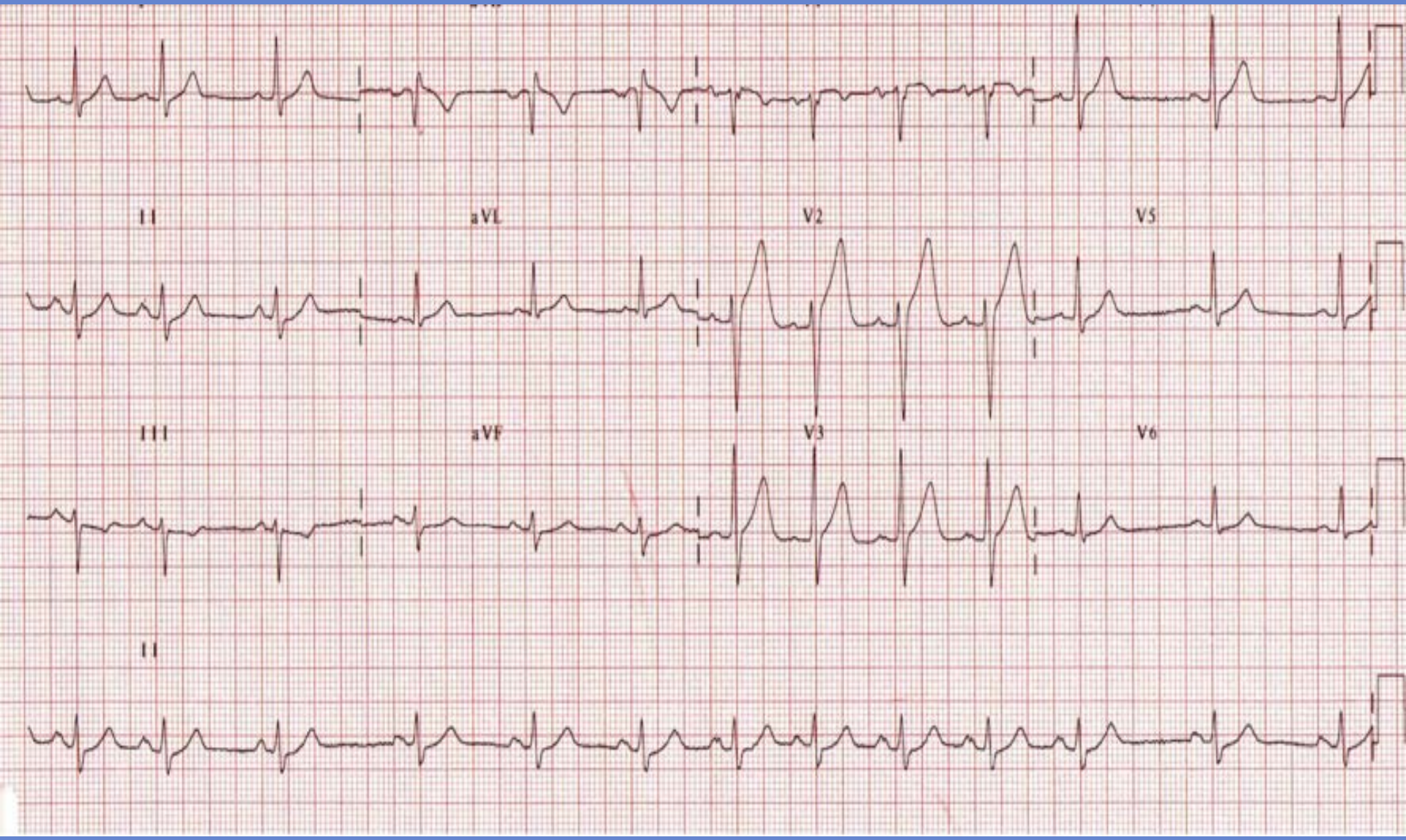

aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

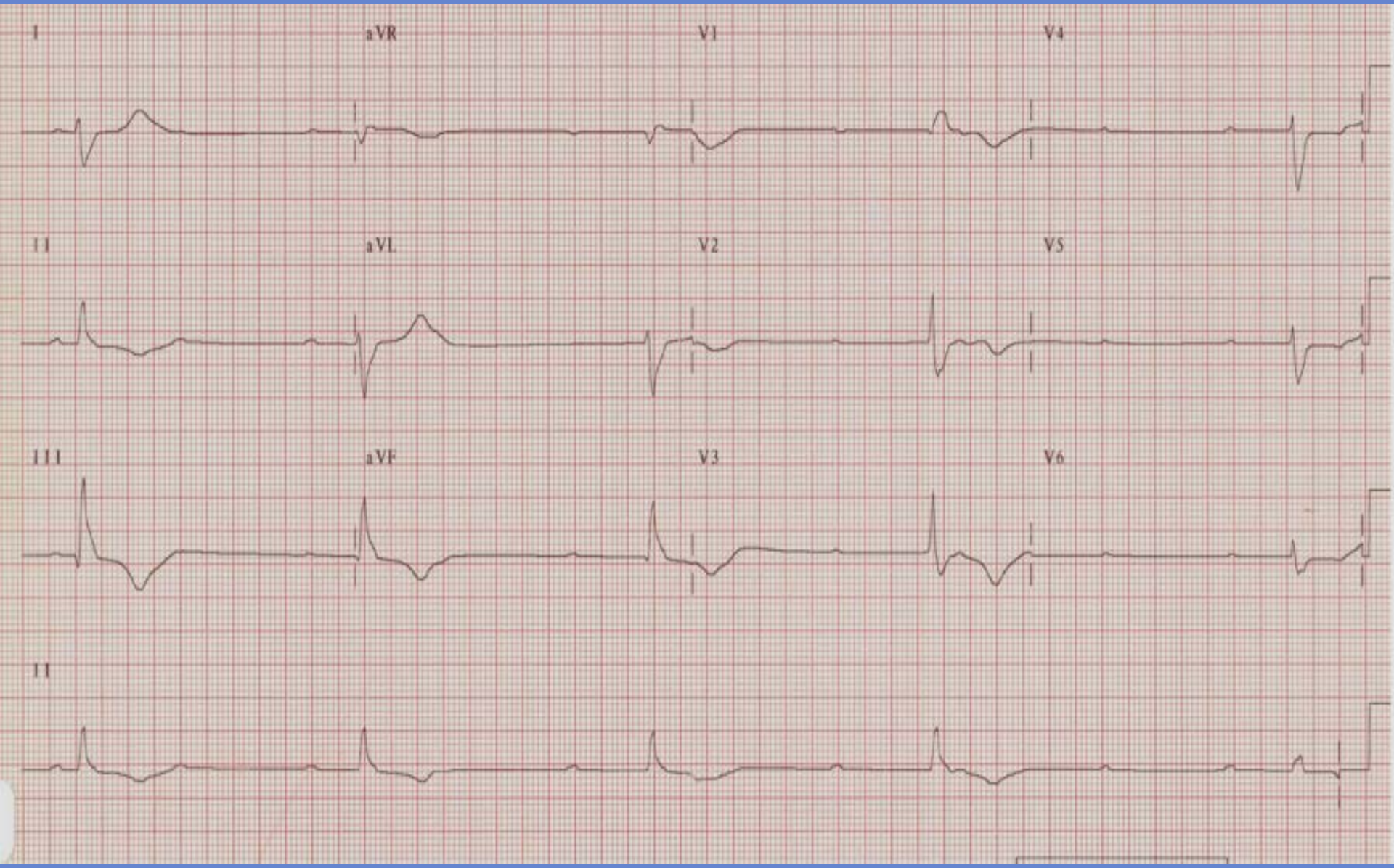

I
AVR
V1
V4
II
AVL
V2
V5
III
AVF
V3
V6
II
PAV1
PAV1

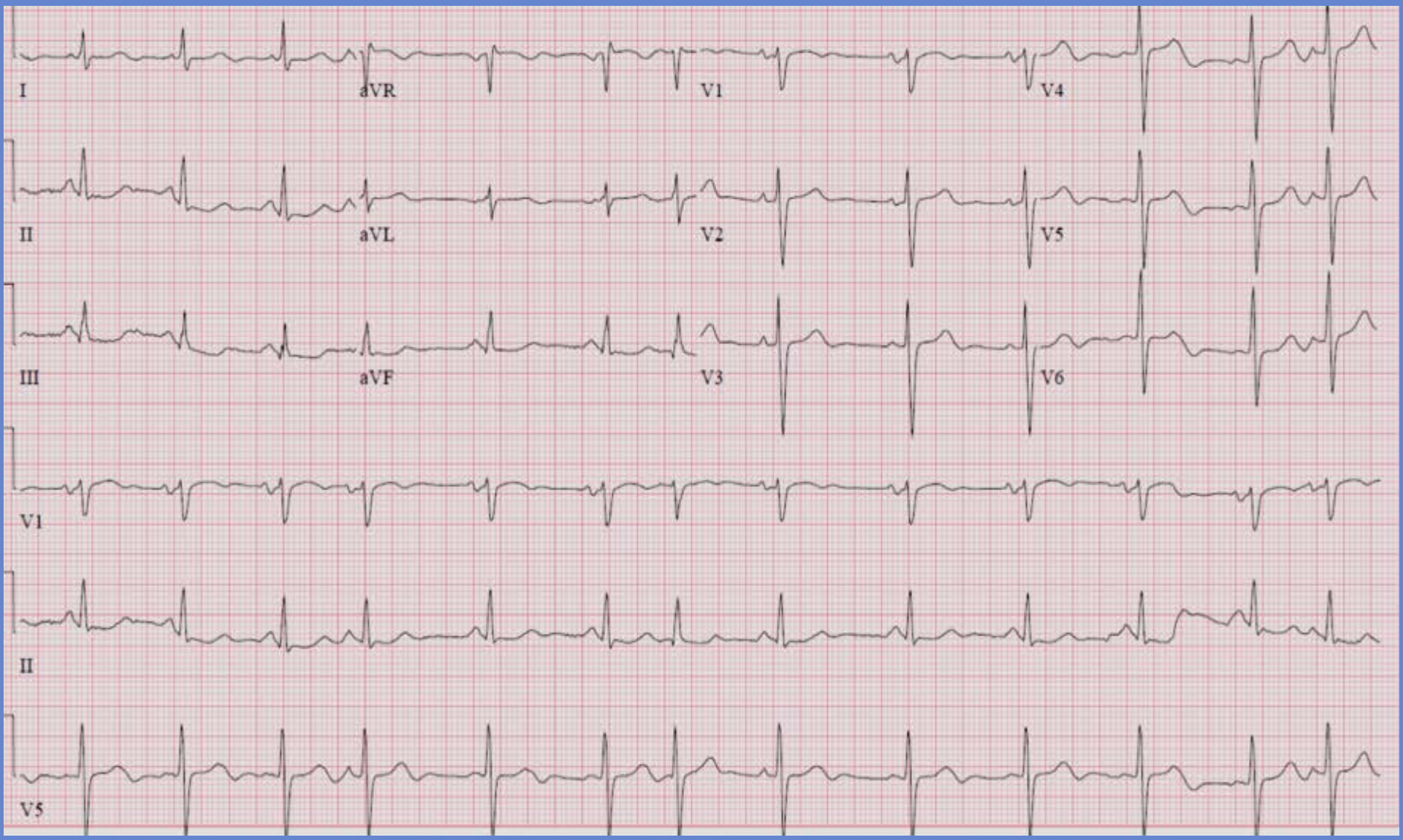

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

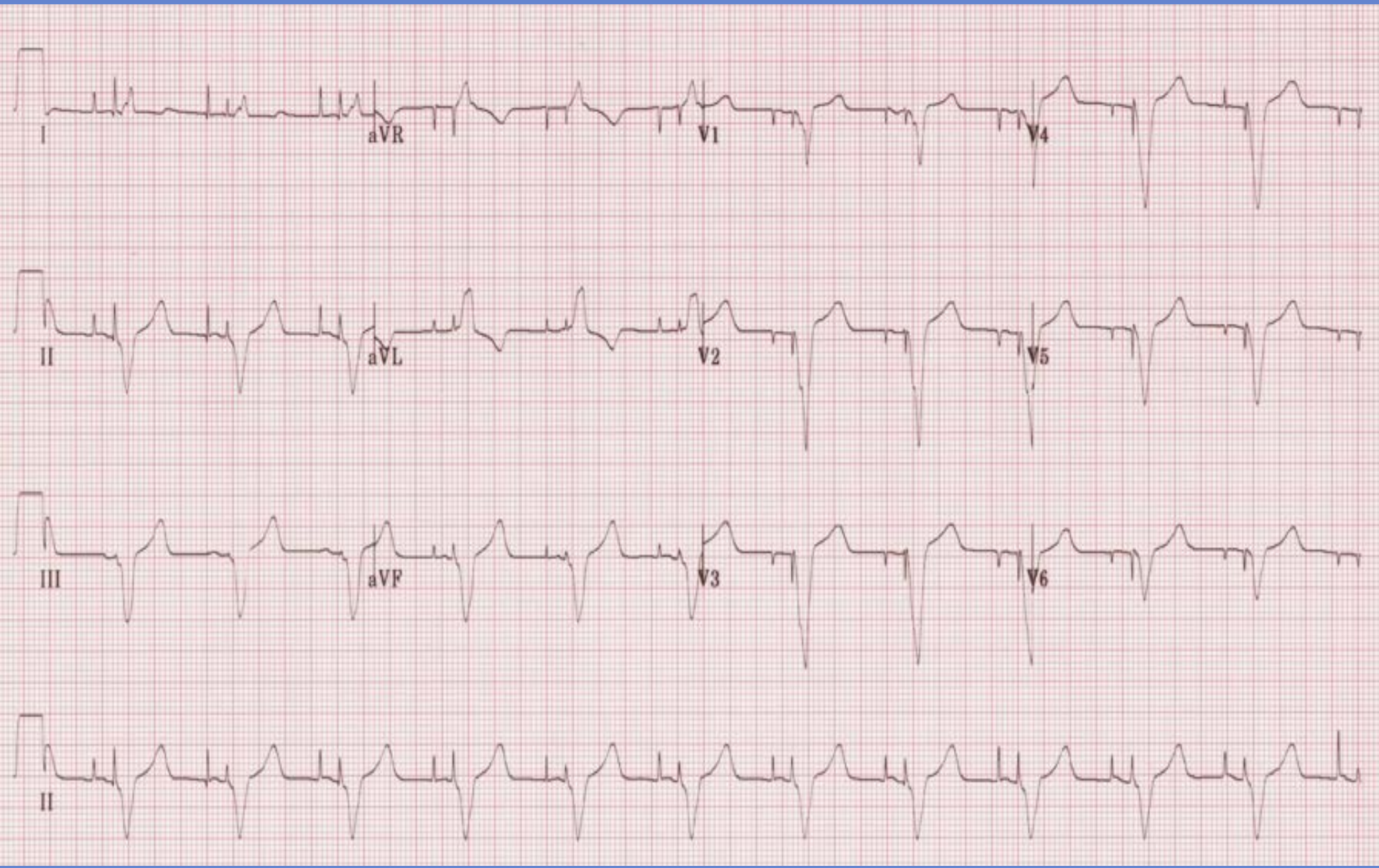

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

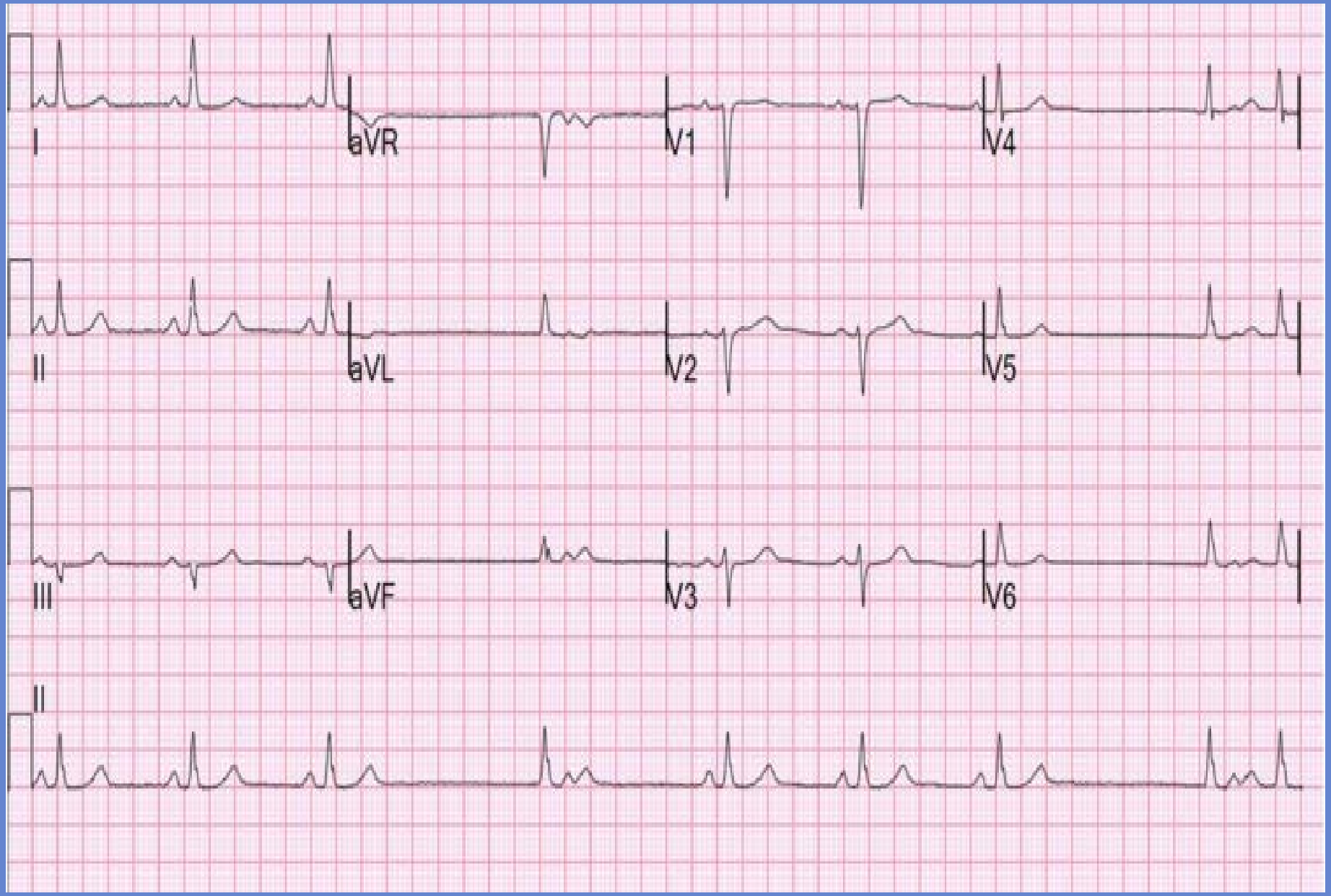

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25 mm/s 10 mm/mV
F ∿ 0.5 Hz - 40 Hz W
HP708 39330


I
aVL
V2
V5
III
aVF
V3
V6
II


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


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
II


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

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