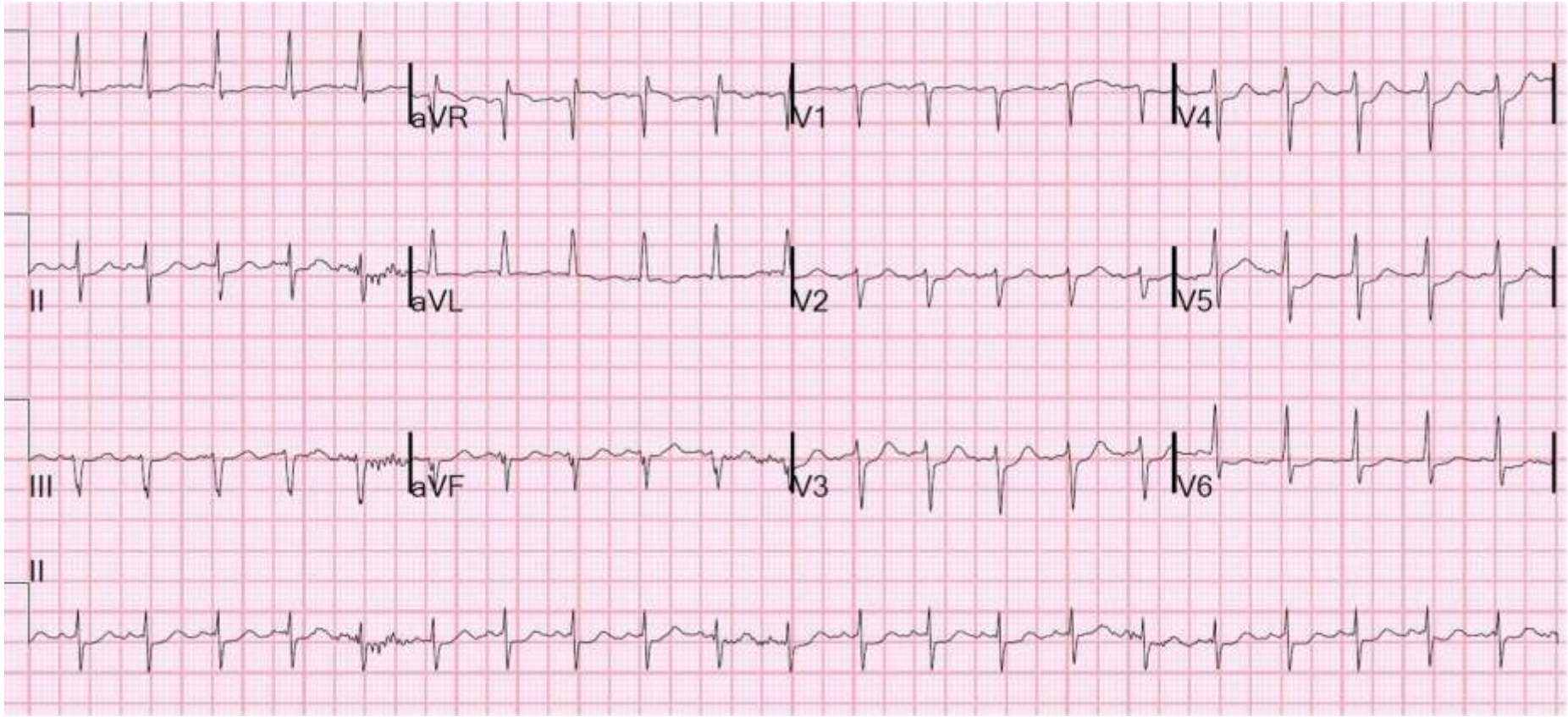
A QUICK GUIDE TO INTERPRETATIONS OF MI PATTERNS ON THE 12 LEAD ECG

Session Purpose

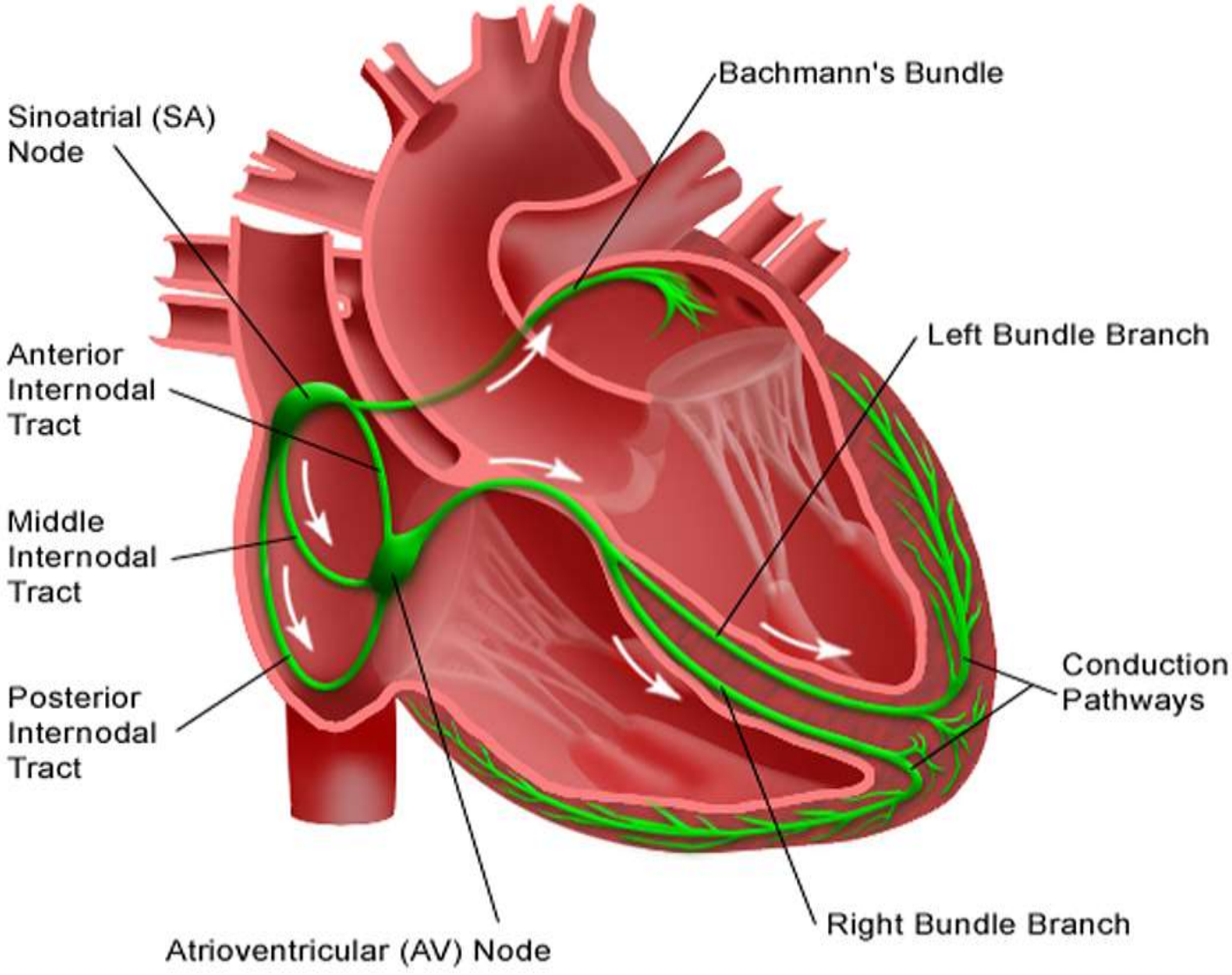
To introduce a method for reviewing the 12-Lead ECG for myocardial infarction.



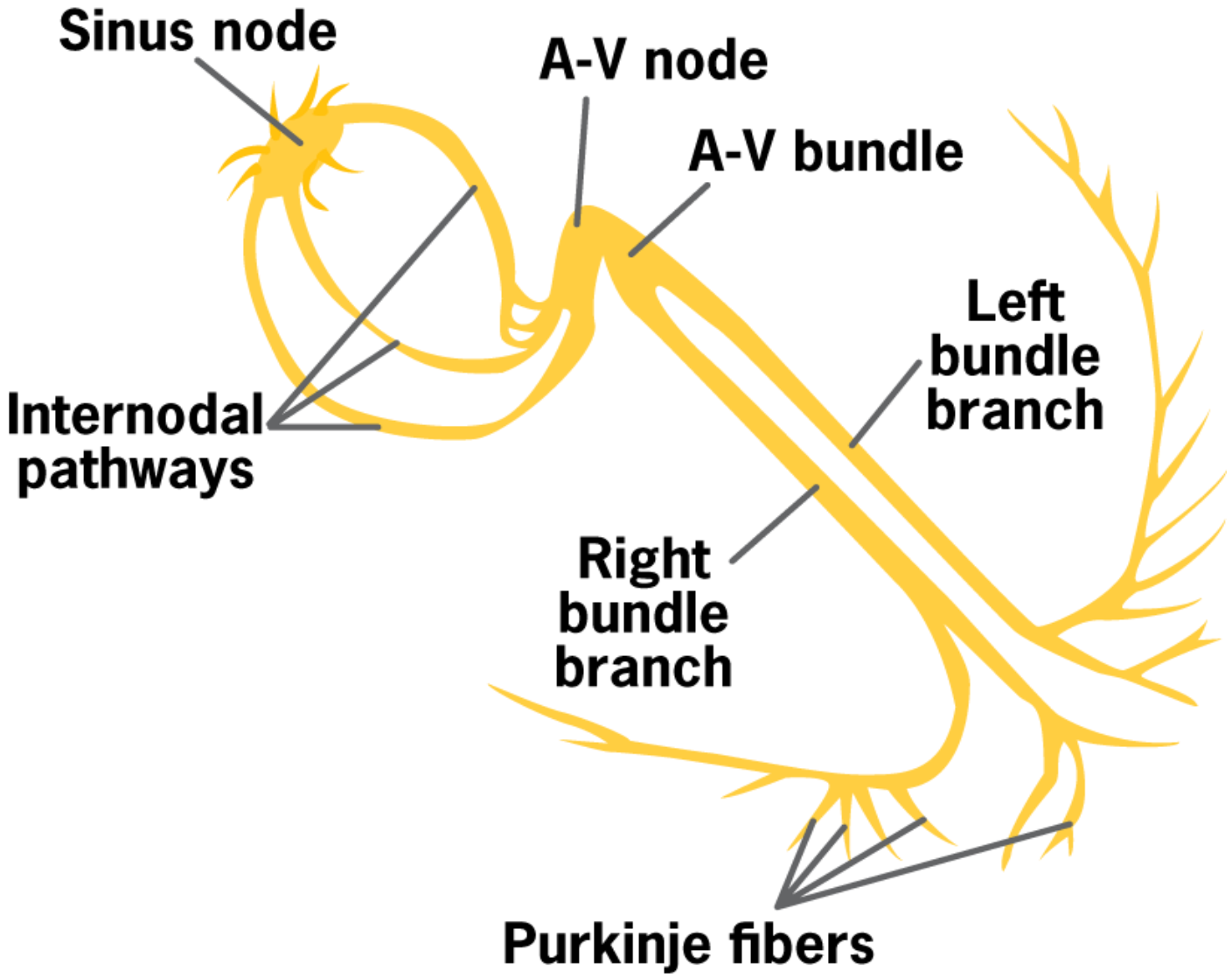
Learning Objectives

- Describe normal cardiac anatomy and physiology
- Describe a systematic approach to 12-lead analysis
- Describe proper electrode placement

Electrical System of the Heart

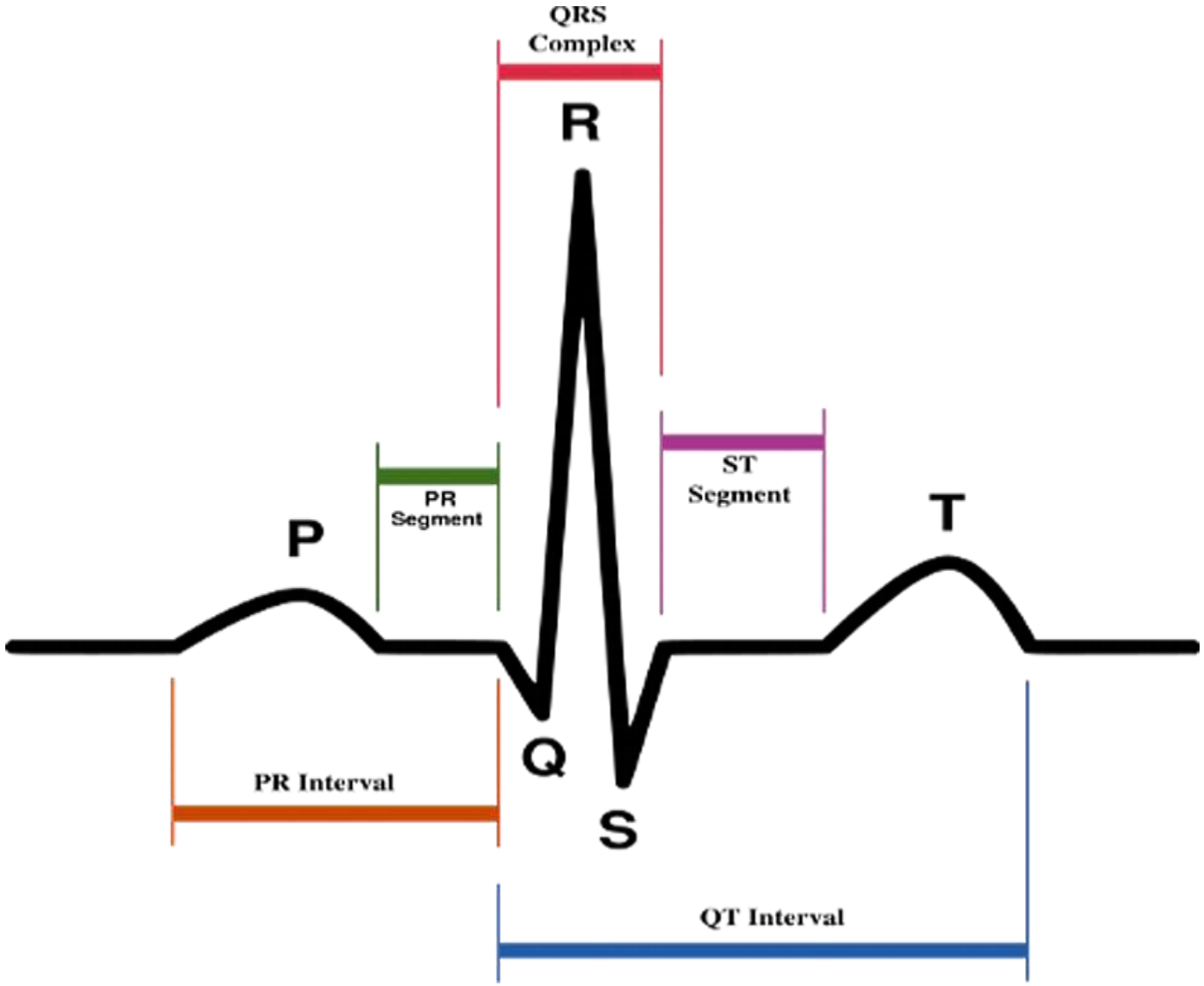


Electrical System of the Heart



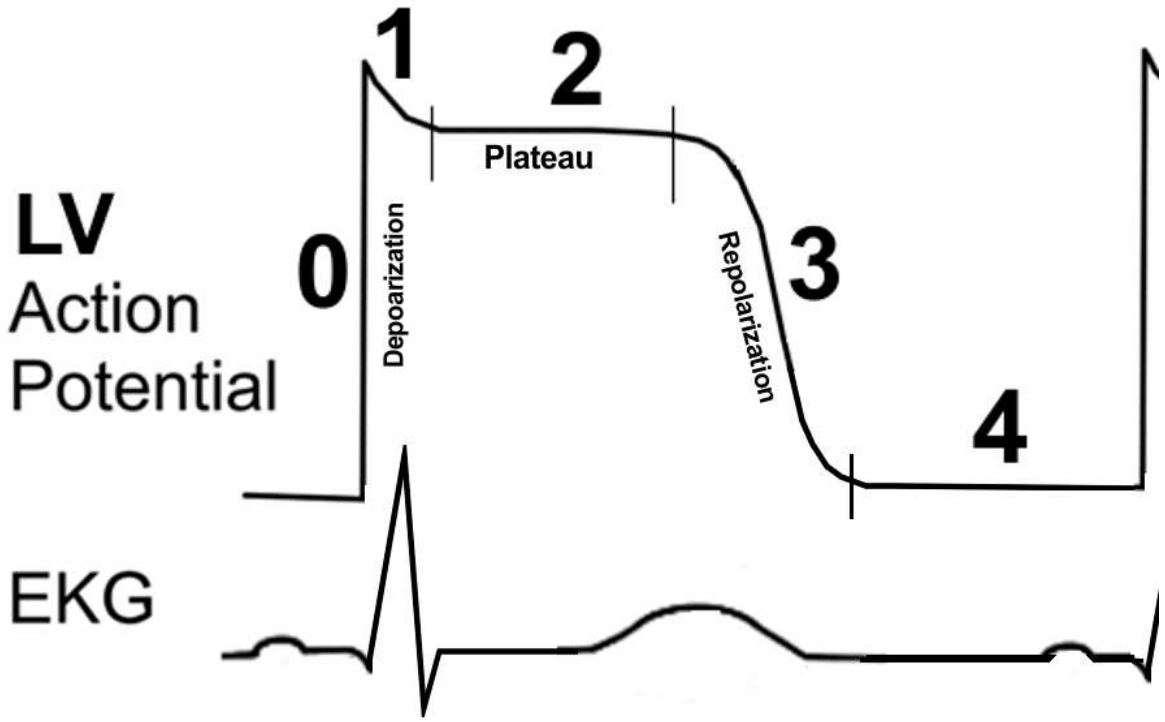
Normal Sinus Rhythm

Electrical System of the Heart



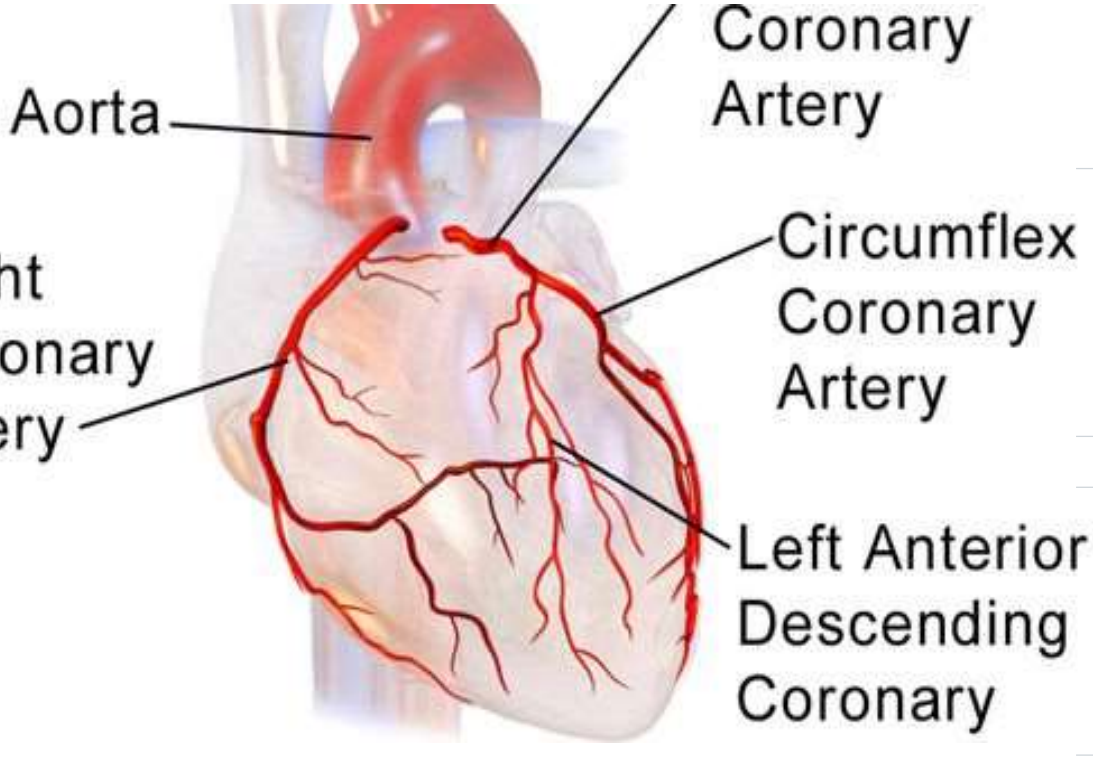
Cardiac Action Potential

Phase 0	Depolarization Na+ rapidly flows into cell via sodium channels
Phase 1	Sodium channels close blocking the inward flow of Na+ and initiating repolarization.
Phase 2	Plateau; Absolute refractory, influx of Ca+ ions and slow efflux of K+
Phase 3	Repolarization; Relative refractory, Calcium channels close, K+ continues to leave cell
Phase 4	Resting membrane potential



Coronary Arteries

RCA – Inferior LV
ECG Leads:
II, III, aVF



L Cx-Lateral LV
ECG Leads:
I, aVL, V5, V6

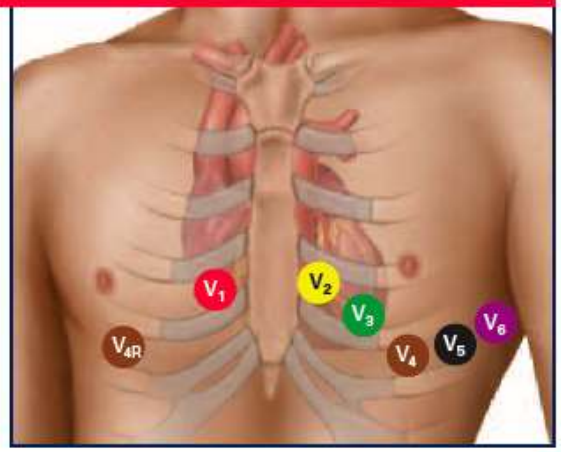
LAD – Anterior LV
ECG Leads:
V1 – V4

The coronary arteries deliver oxygen-rich blood to the muscle tissues of the heart. If the arteries become blocked, heart muscle will die resulting in a heart attack.

ECG Electrode Placement

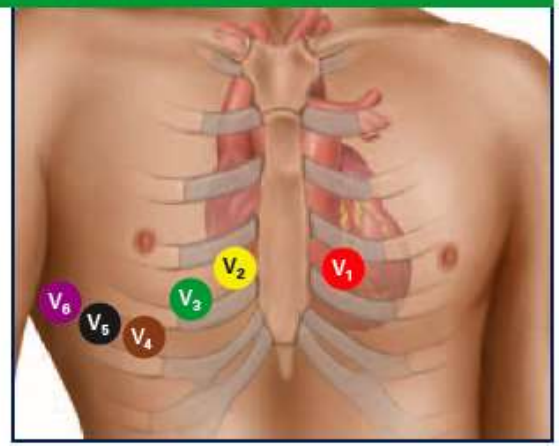
Proper 12-Lead Placement for Left Side of Chest

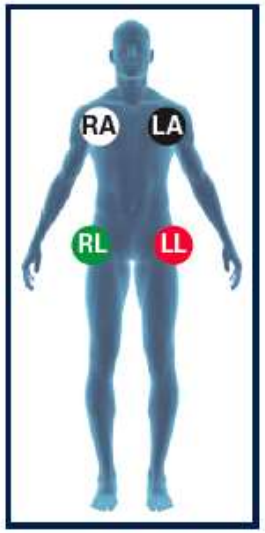
- V_1 4th intercostal space to the right of the sternum
- V_2 4th intercostal space to the left of the sternum
- V_3 directly between the leads V_2 & V_4
- V_4 5th intercostal space at midclavicular line
- V_5 level with V_4 at left anterior axillary line
- V_6 level with V_5 at left midaxillary line *(directly under the midpoint of the armpit)*
- V_{4R} 5th intercostal space, right midclavicular line



Proper 12-Lead Placement for Right Side of Chest

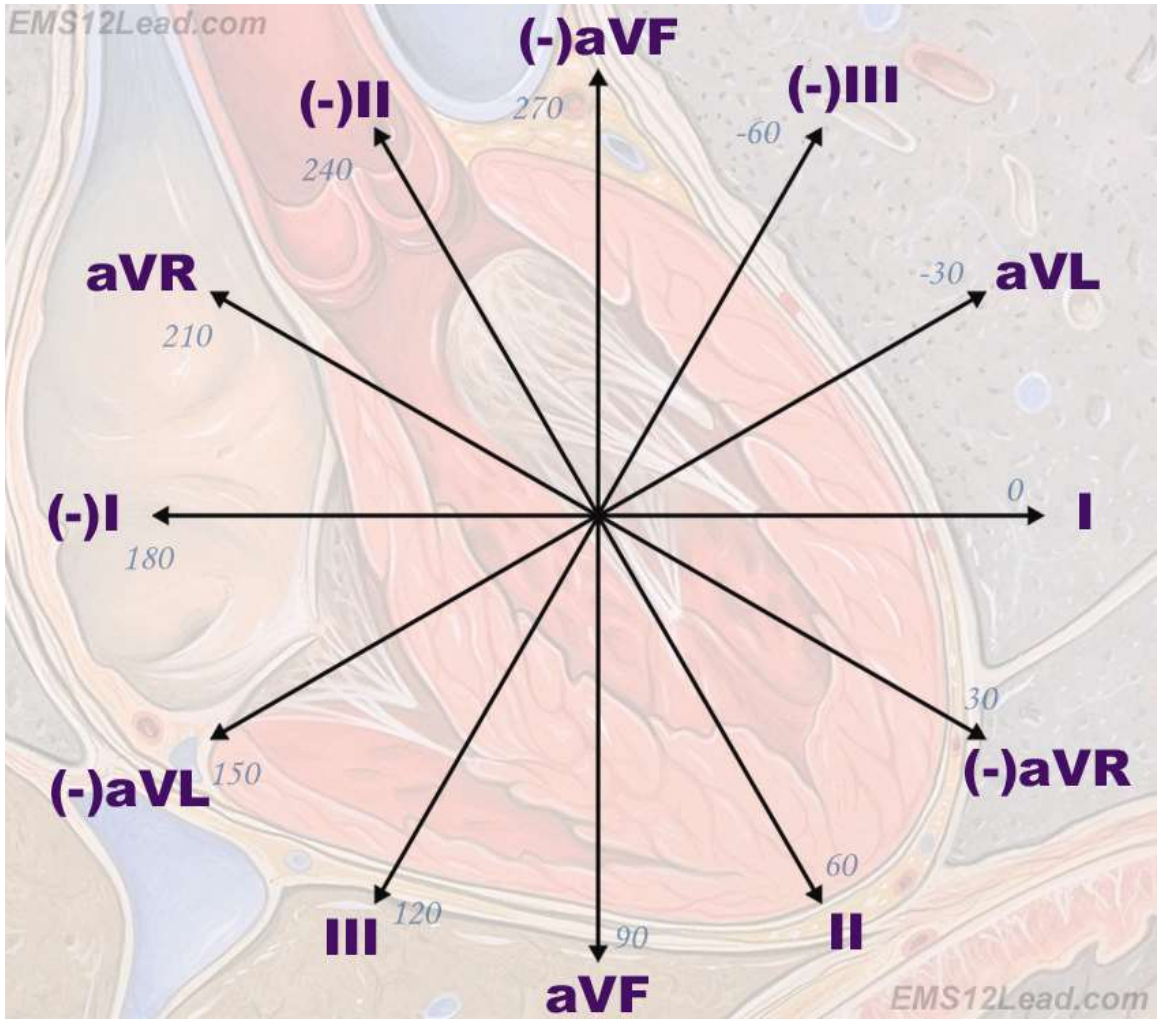
- V_1 4th intercostal space to the left of the sternum
- V_2 4th intercostal space to the right of the sternum
- V_3 directly between the leads V_2 & V_4
- V_4 5th intercostal space at right midclavicular line
- V_5 level with V_4 at right anterior axillary line
- V_6 level with V_5 at right midaxillary line *(directly under the midpoint of the armpit)*





- RA Right Arm
- LA Left Arm
- LL Left Leg
- RL Right Leg

Frontal Plane (limb) Leads

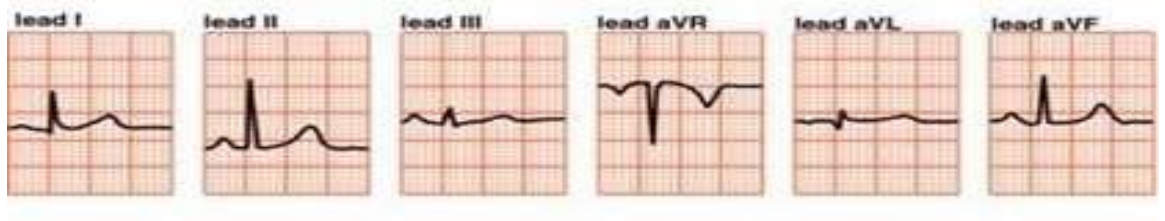


+ Electrode

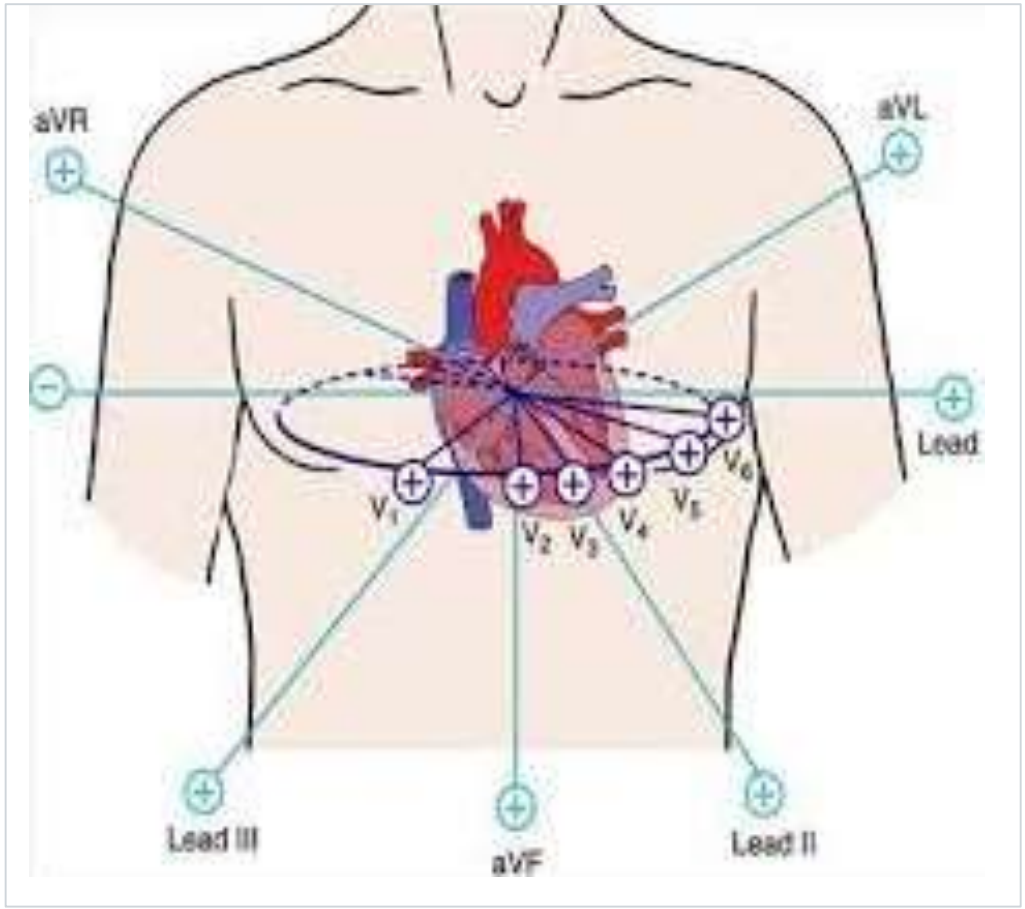
Activity coming toward the camera
= upright complexes

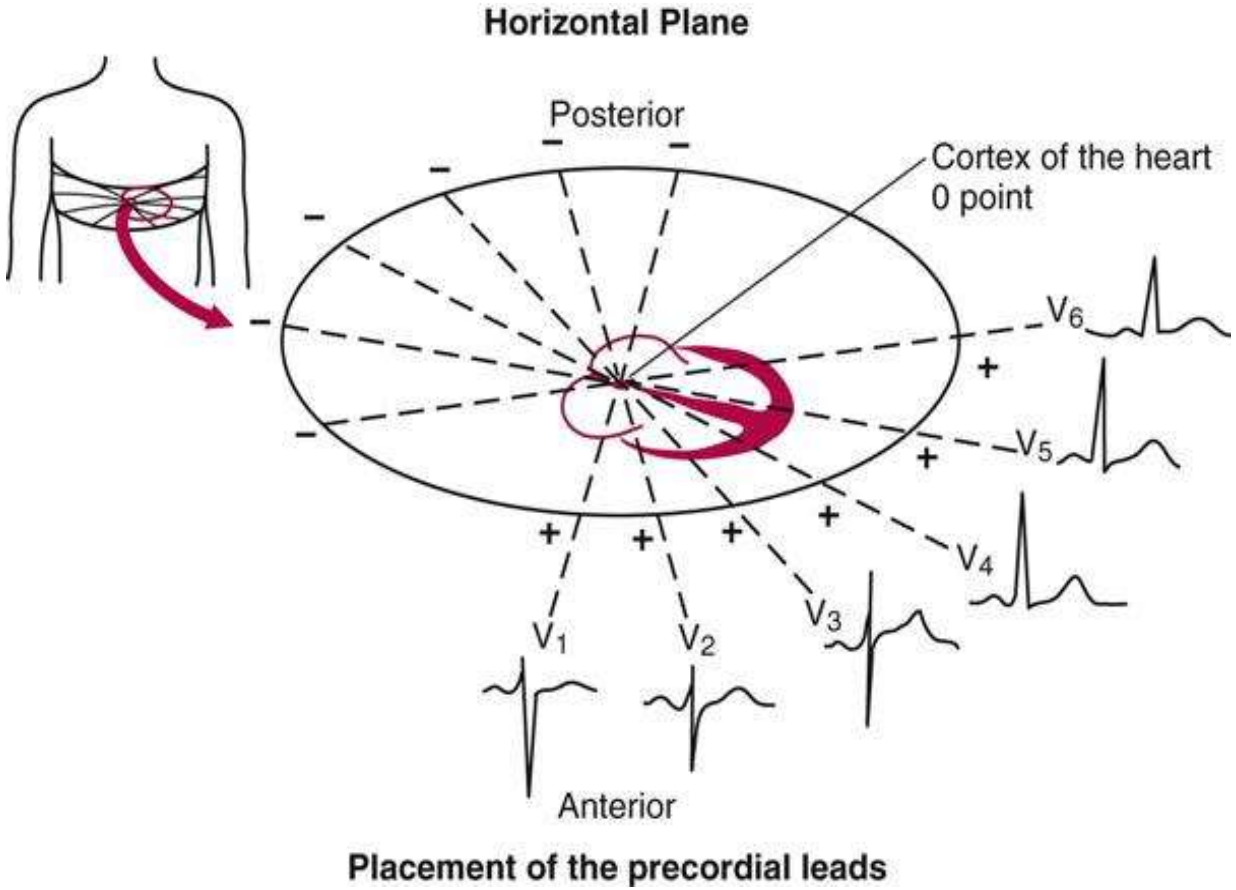
Activity going away from the camera
= downward complexes

MEAN QRS AXIS IN THE FRONTAL PLANE EXAMPLES 1



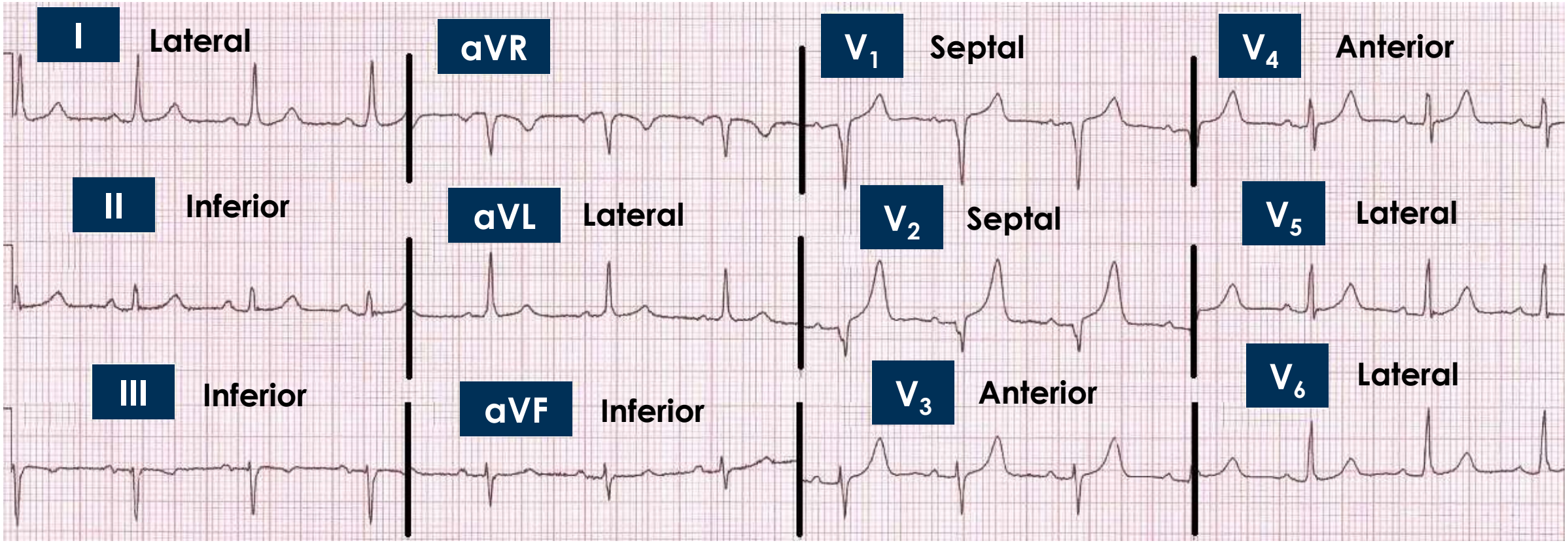
Horizontal Plane (chest) Leads



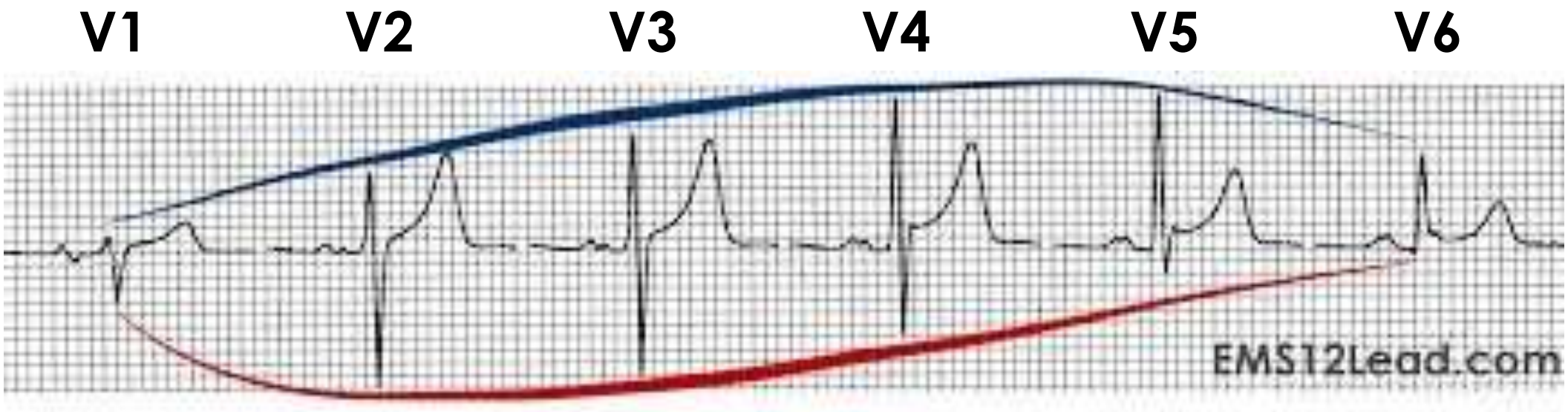


Placement of the precordial leads

12-Lead ECG Walls of the Heart

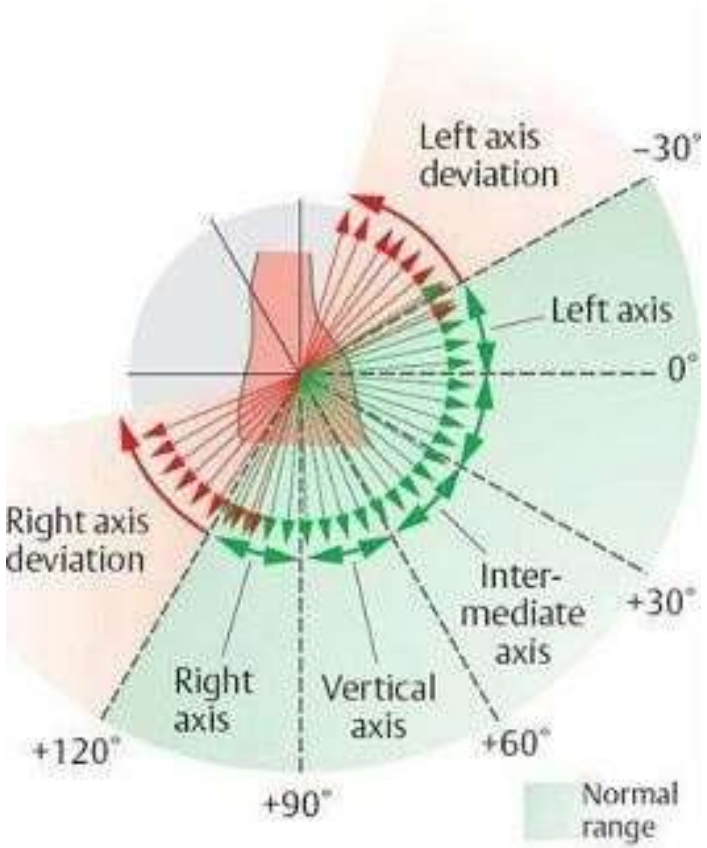


R Wave Progression



In a normal R wave progression the R wave in Lead 2 should be slightly larger. R wave progression in the V leads demonstrates that the septum is healthy, absence of an R wave in V2 should make us suspicious of a septal infarct. Poor R Wave progression can indicate LBBB, Lt Ventricular hypertrophy and emphysema.

Axis Deviation



QRS deflection		Axis
Lead 1	**aVF**	
Positive	**Positive**	**Normal**
Positive	**Negative**	**LAD**
Negative	**Positive**	**RAD**
Negative	**Negative**	**Extreme RAD or Extreme LAD**

Fast way to calculate Electrical axis of heart

Causes of Axis Deviation

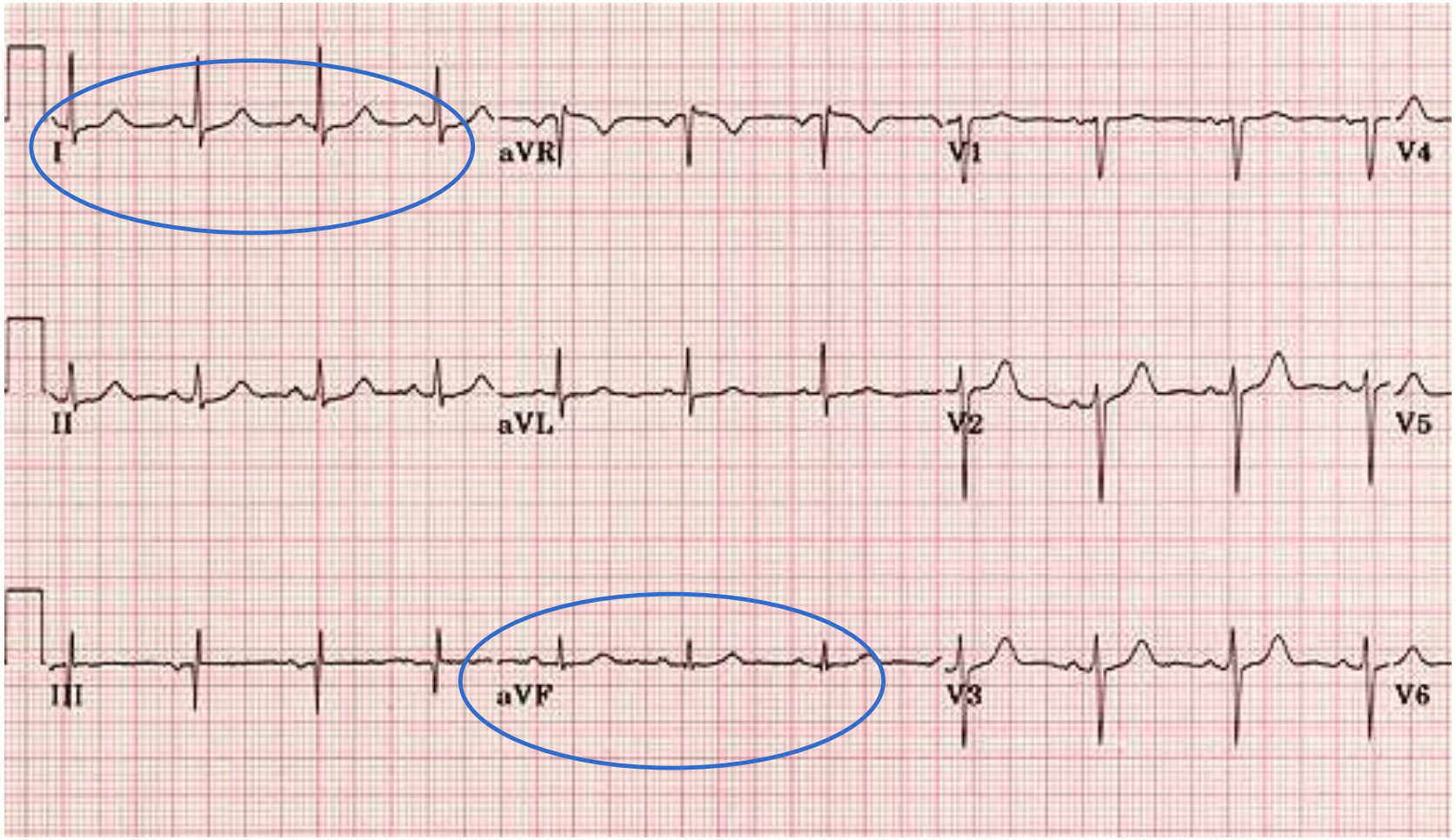
RT Axis Deviation

- Right Ventricular hypertrophy
- Rt Bundle Branch Block
- Dextrocardia
- Ventricular ectopic rhythms
- Lateral Wall MI
- Rt ventricular load; i.e. pulmonary embolism or COPD

LT Axis Deviation

- Normal Variations: (physiologic, often with age)
- Mechanical shifts: (pregnancies, ascites)
- Left ventricular hypertrophy
- LBBB
- Congenital heart disease: (Atrial septal defect)
- Emphysema
- Hyperkalemia
- Ventricular ectopic rhythms
- Inferior MI

Axis



	Lead I	aVF
NL	Positive	Positive
RAD	Negative	Positive
LAD	Positive	Negative
Indet.	Negative	Negative

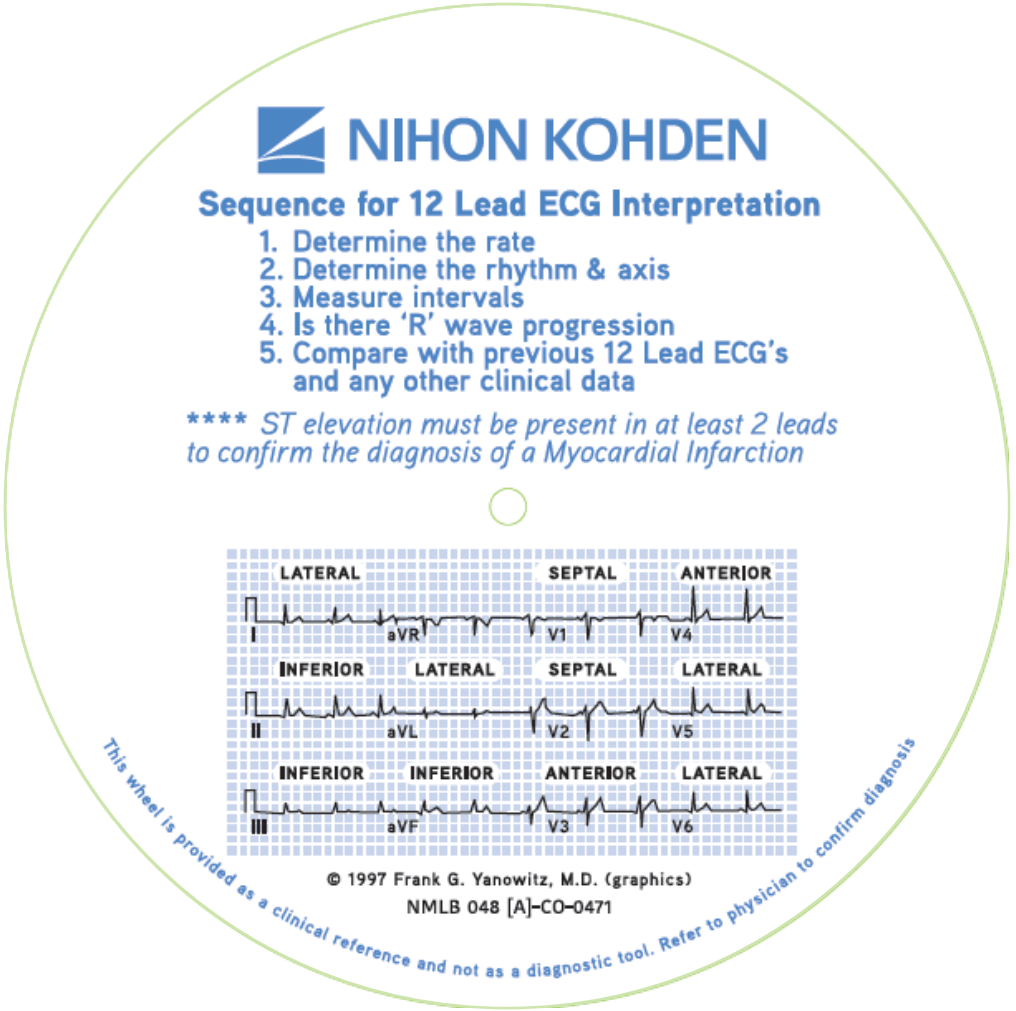
I and aVF both positive
Axis = normal

The 12-Lead ECG

Purpose

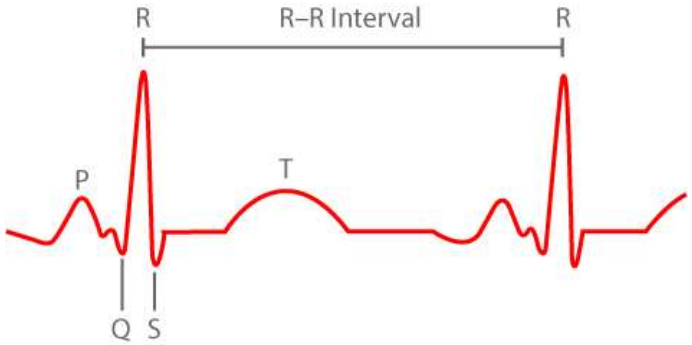
To help identify primary conduction abnormalities, arrhythmias, cardiac hypertrophy, pericarditis, electrolyte imbalance, myocardial infarction (MI), and the site and extent of any MI.

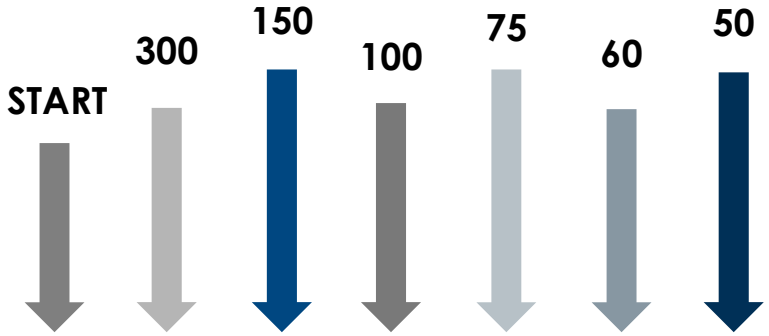
12-Lead ECG Interpretation

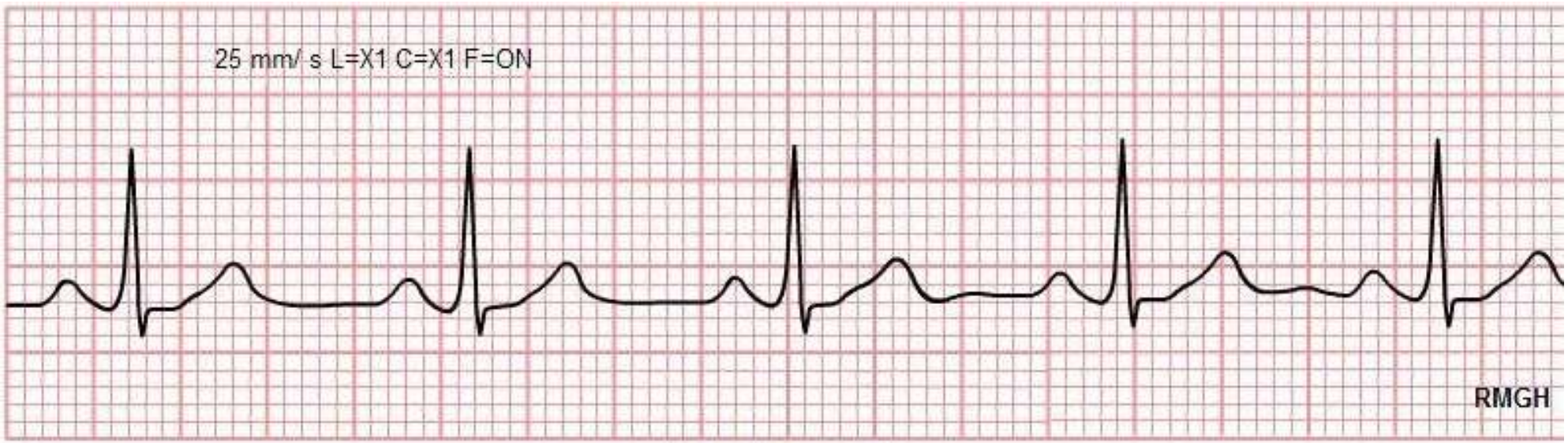


1. Determine Rate

Normal Sinus Rhythm

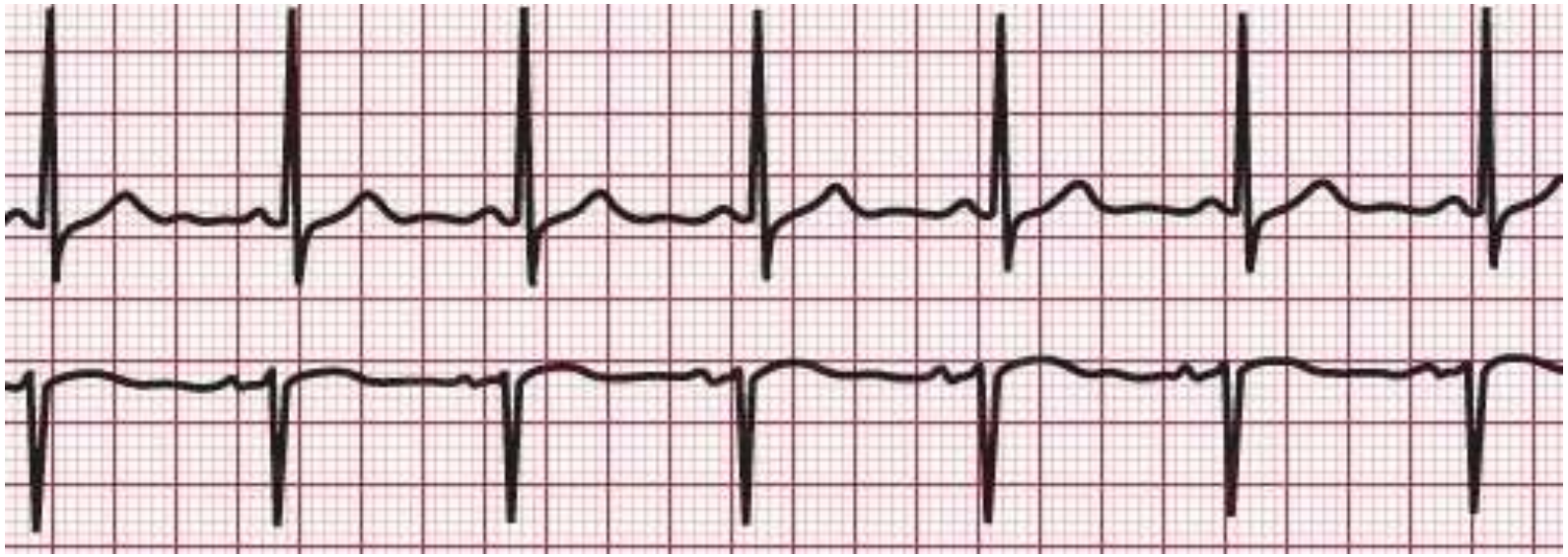






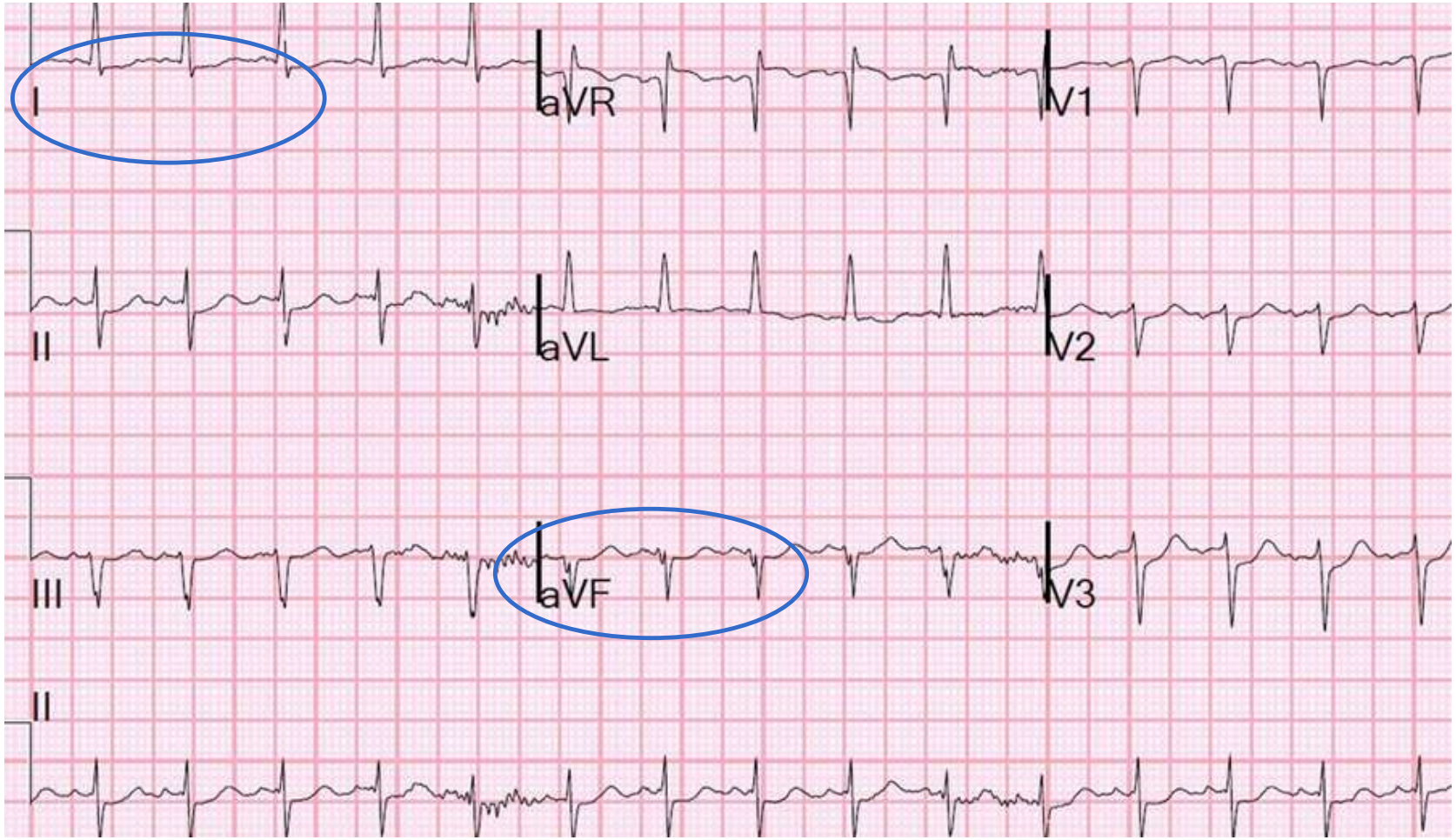
2. Determine Rhythm

Normal Sinus Rhythm



Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
60-100 bpm	Regular	Before each QRS, identical	.12 to .20	<.12

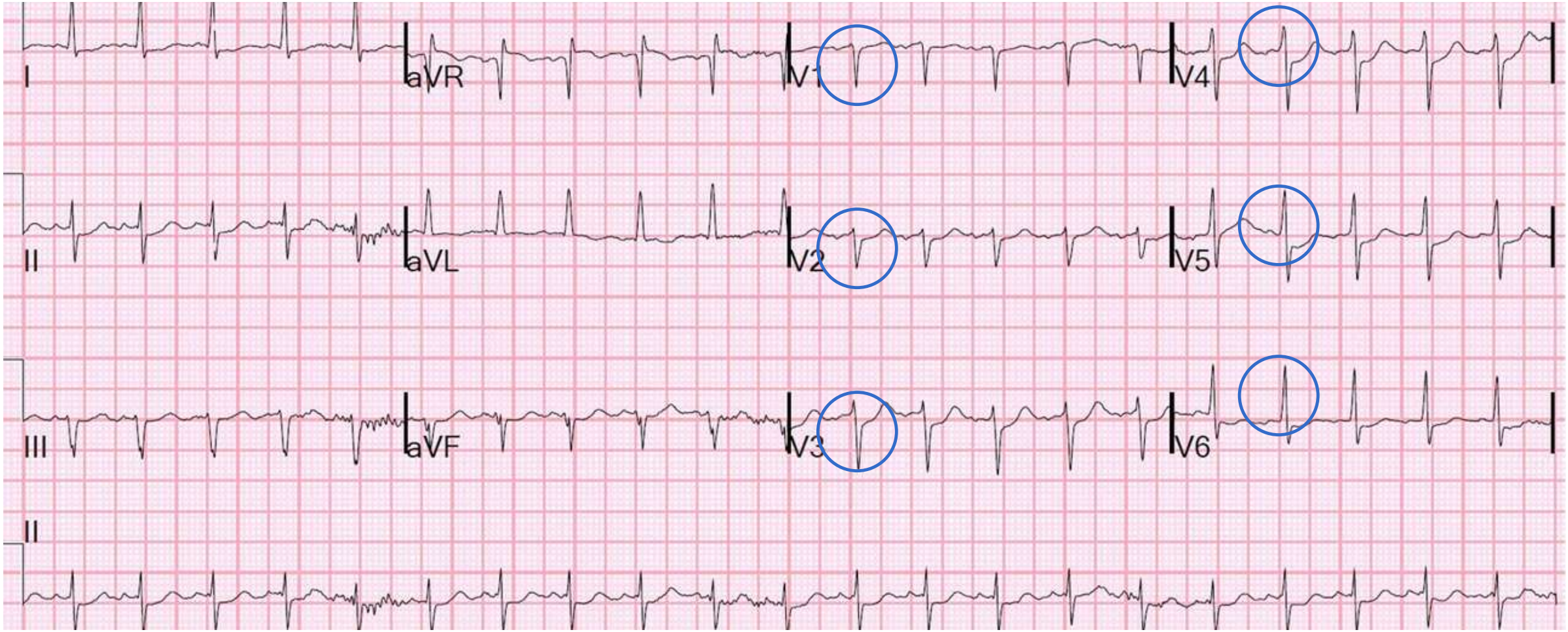
2a. Axis net QRS Deflection



	Lead I	aVF
NL	Positive	Positive
RAD	Negative	Positive
LAD	Positive	Negative
Indet.	Negative	Negative

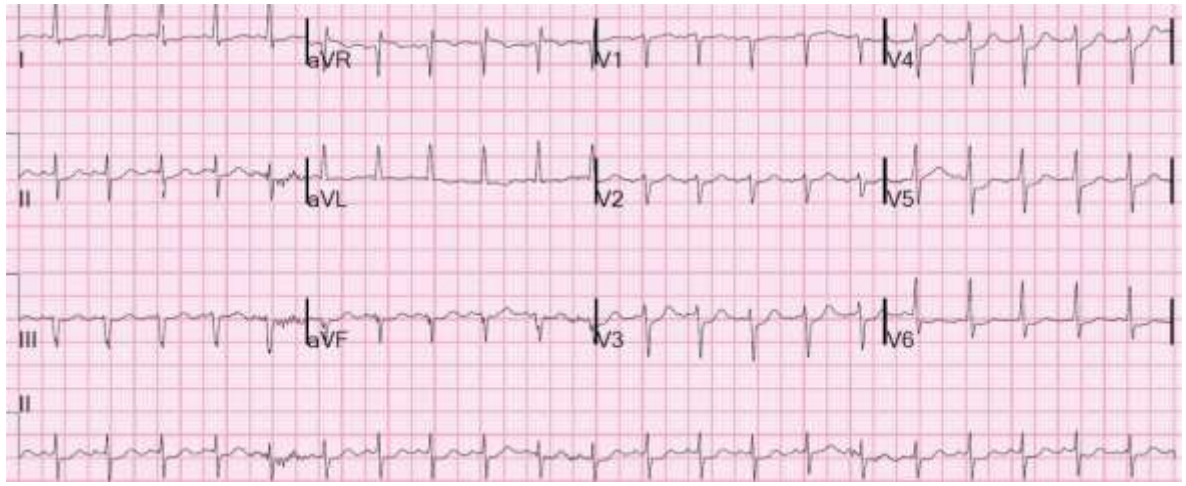
I – positive aVF - negative
Axis = LAD

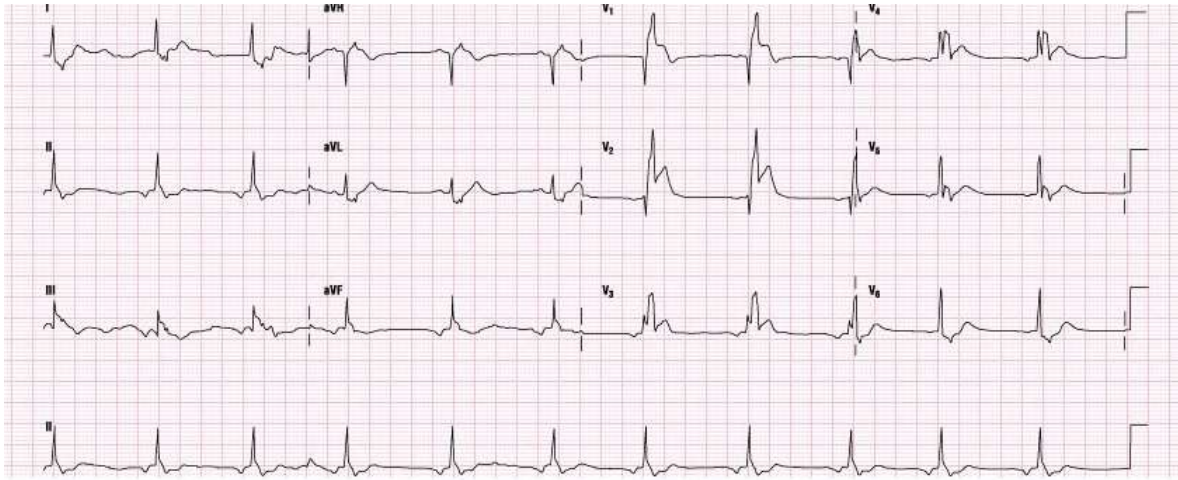
4. Assess R-wave Progression



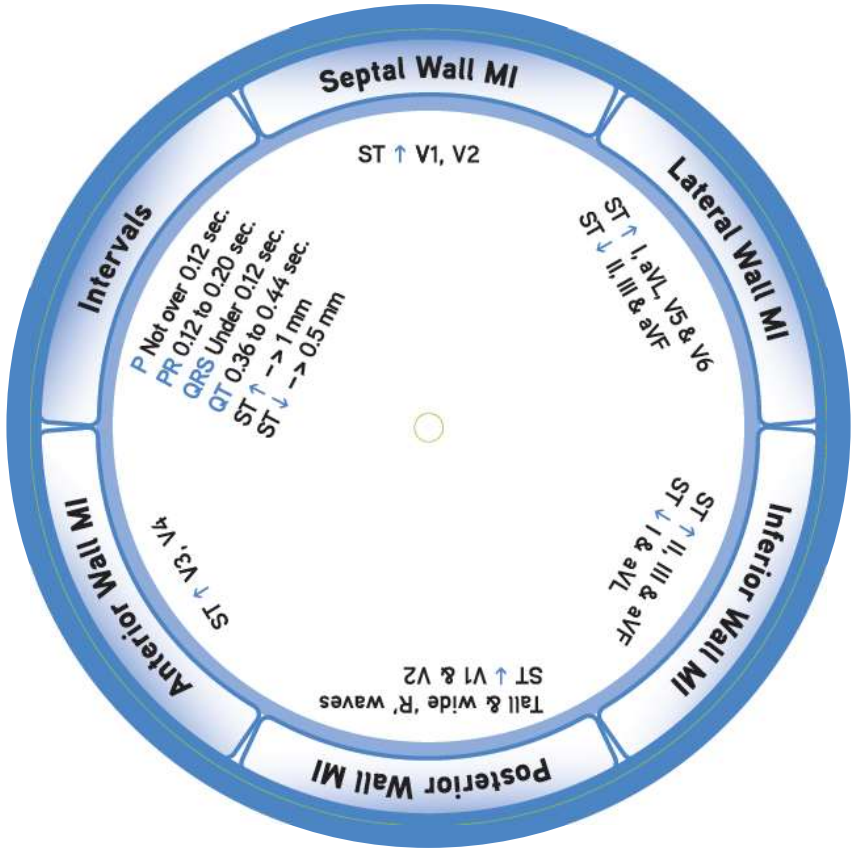
5. Compare and Assess

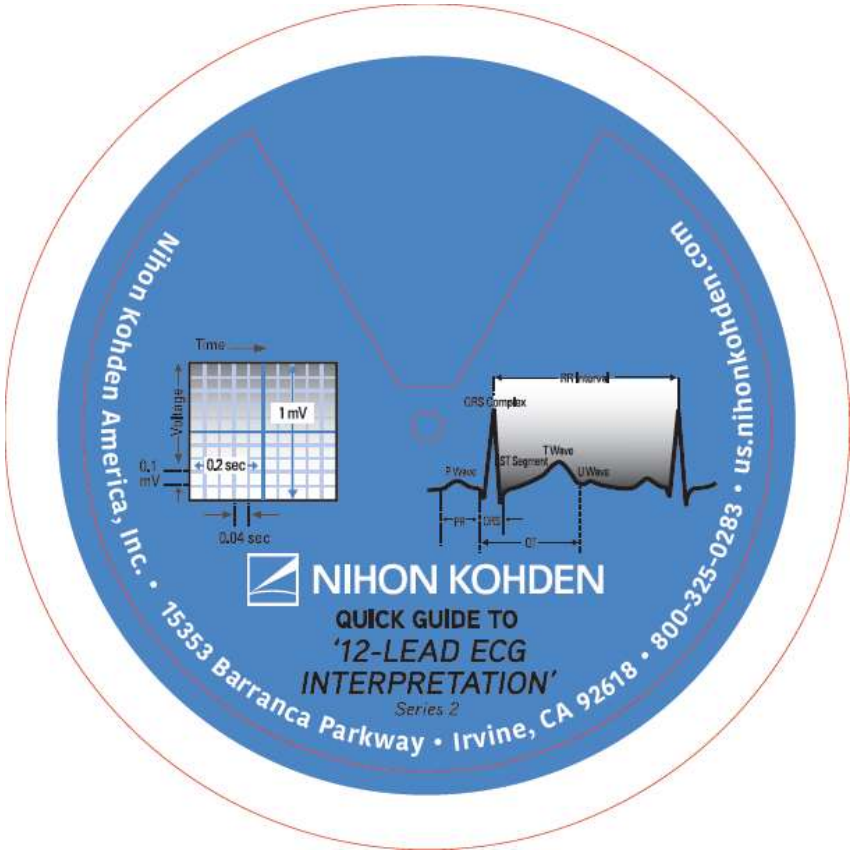
Previous 12 Leads and Presenting Clinical Data





Assess the 12 Lead ECG for MI

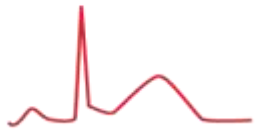




Principal Indicators of Acute Infarction

Compare ST Segments/T-Waves and presence of Q-Waves

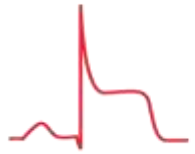
ST Segment Elevation (=injury)



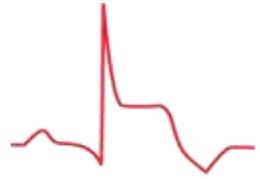
Early ("Hyperacute") Stage

Caved ("Frowny") ST Segment Elevation (=Acute Injury Pattern)

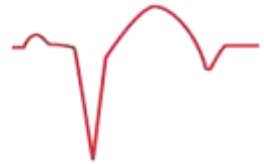
Development of Q Waves



Early Q wave development



Established Q Wave Stage



QS Complex

T Wave Inversion (=ischemia)

Early T wave Inversion

Deeper, Symmetric T Wave Inversion (=ischemia)

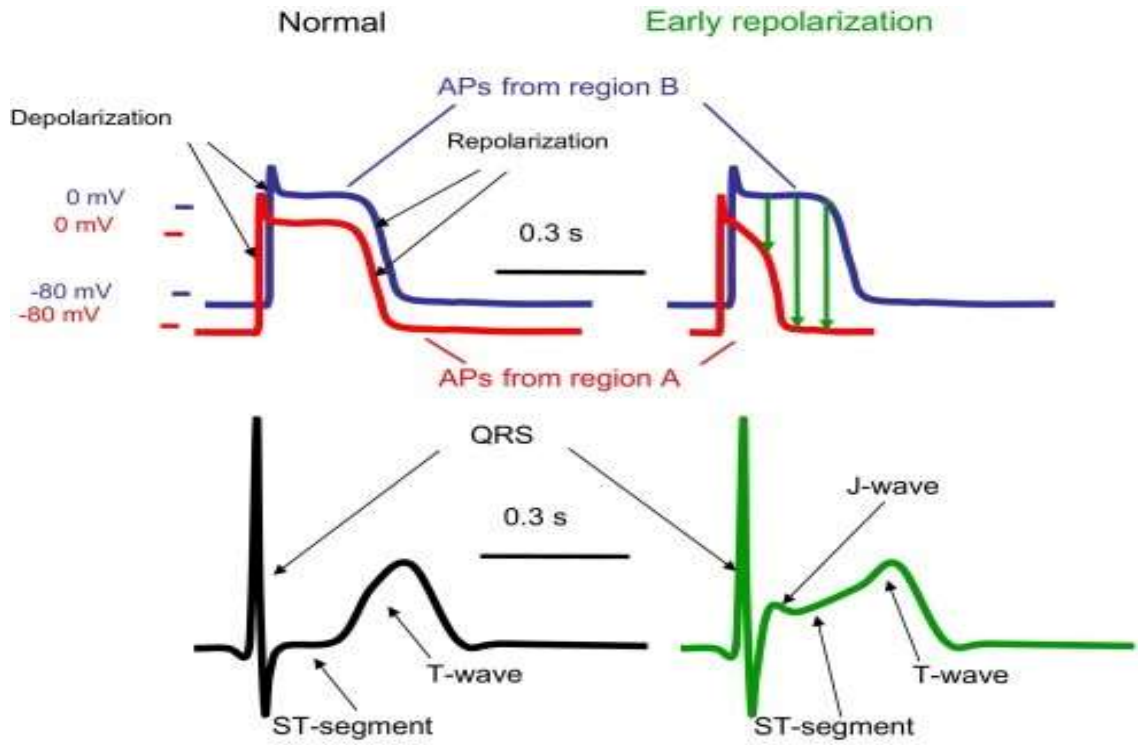
Reciprocal ST Segment Depression

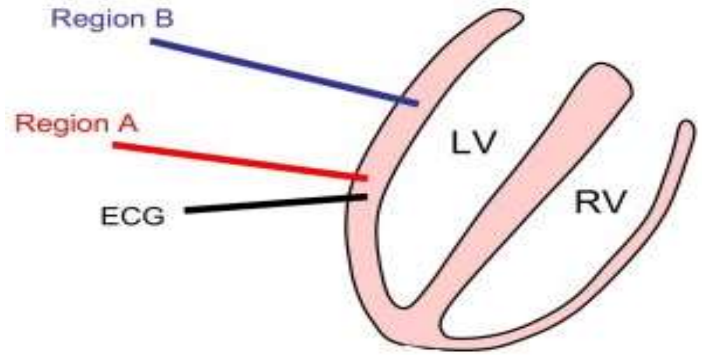
Mirror Image ST Depression

Subtle Reciprocal ST Segment Depression

Grauer, K. (1998). A practical guide to ECG interpretation (2nd edition). Mosby, St. Louis

Why does the ST elevate?





Evolution of an Infarct

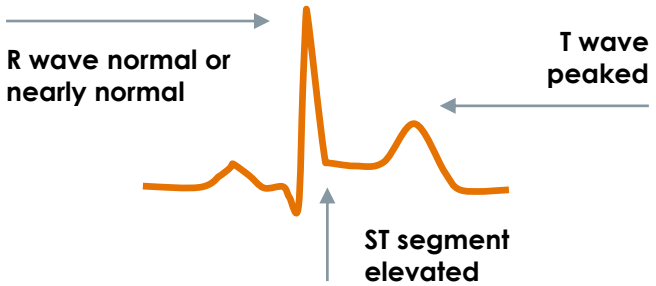
Transmural Infarction

Before Coronary Occlusion

Heart muscle normal

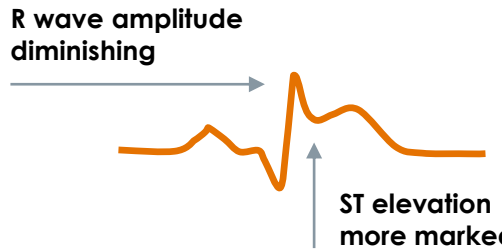
Onset and First Several Hours

Subendocardial injury and myocardial ischemia. No cell death (infarction) yet

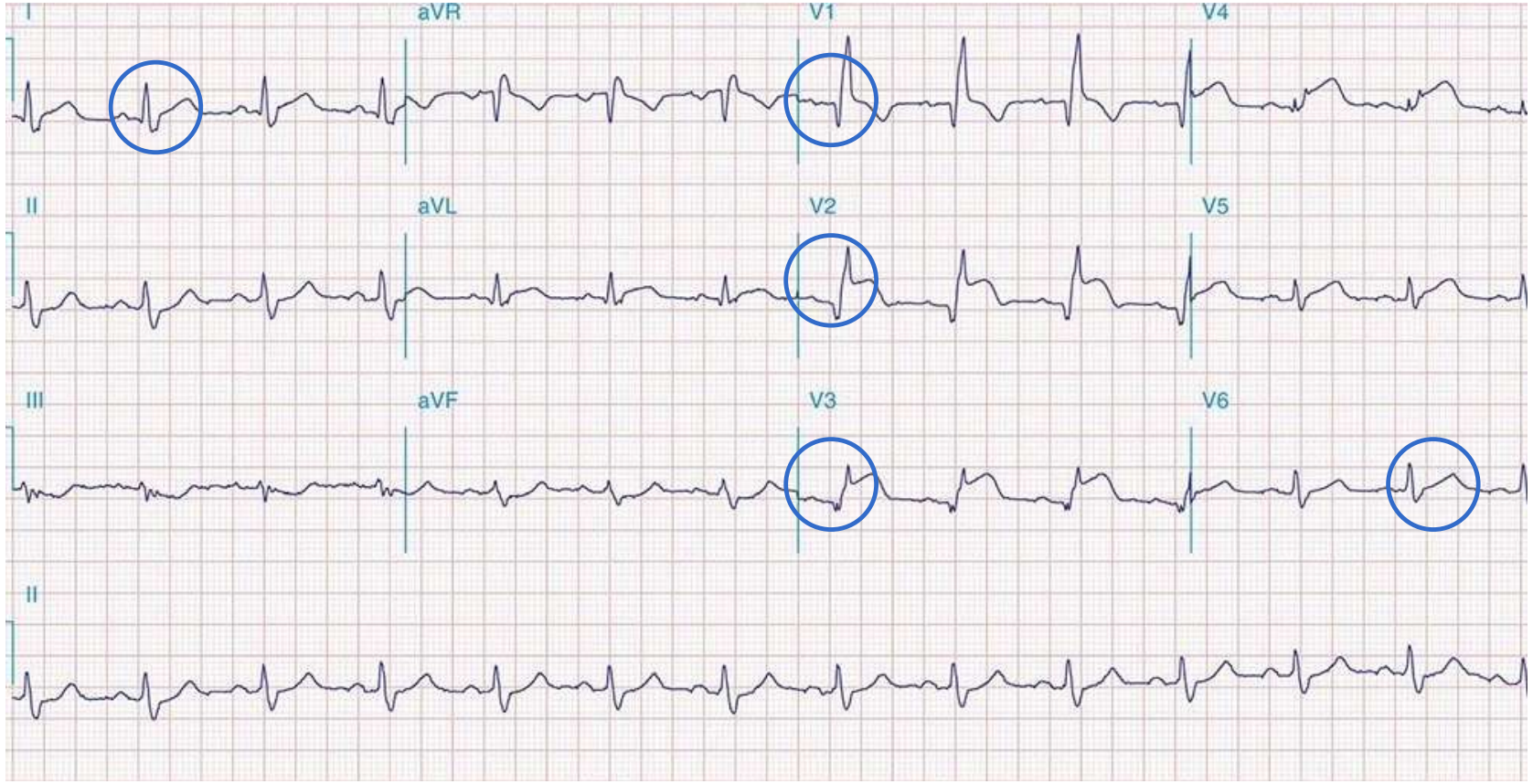


First Day

Ischemia and injury extend to epicardial surface. Subendocardial muscle dying in area of most severe injury



Acute Antero-septal MI



ST elevations

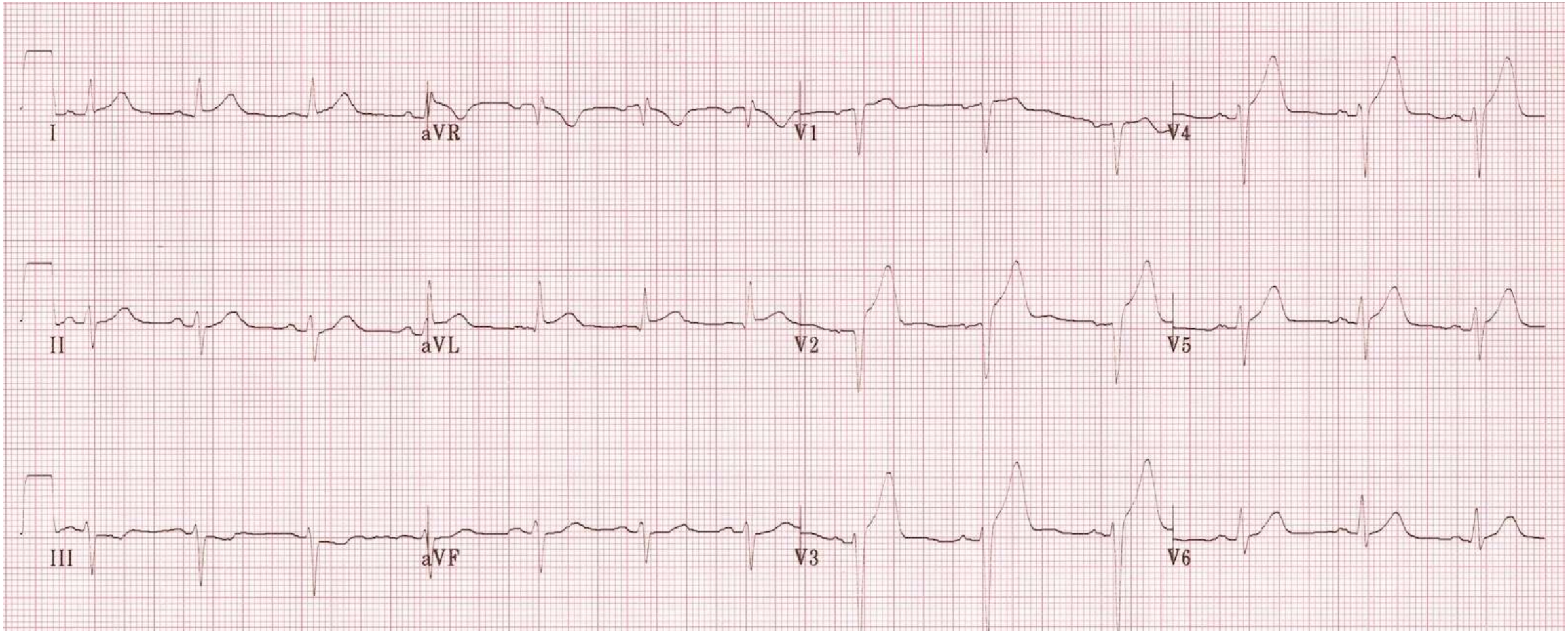
V1-V4

Q waves

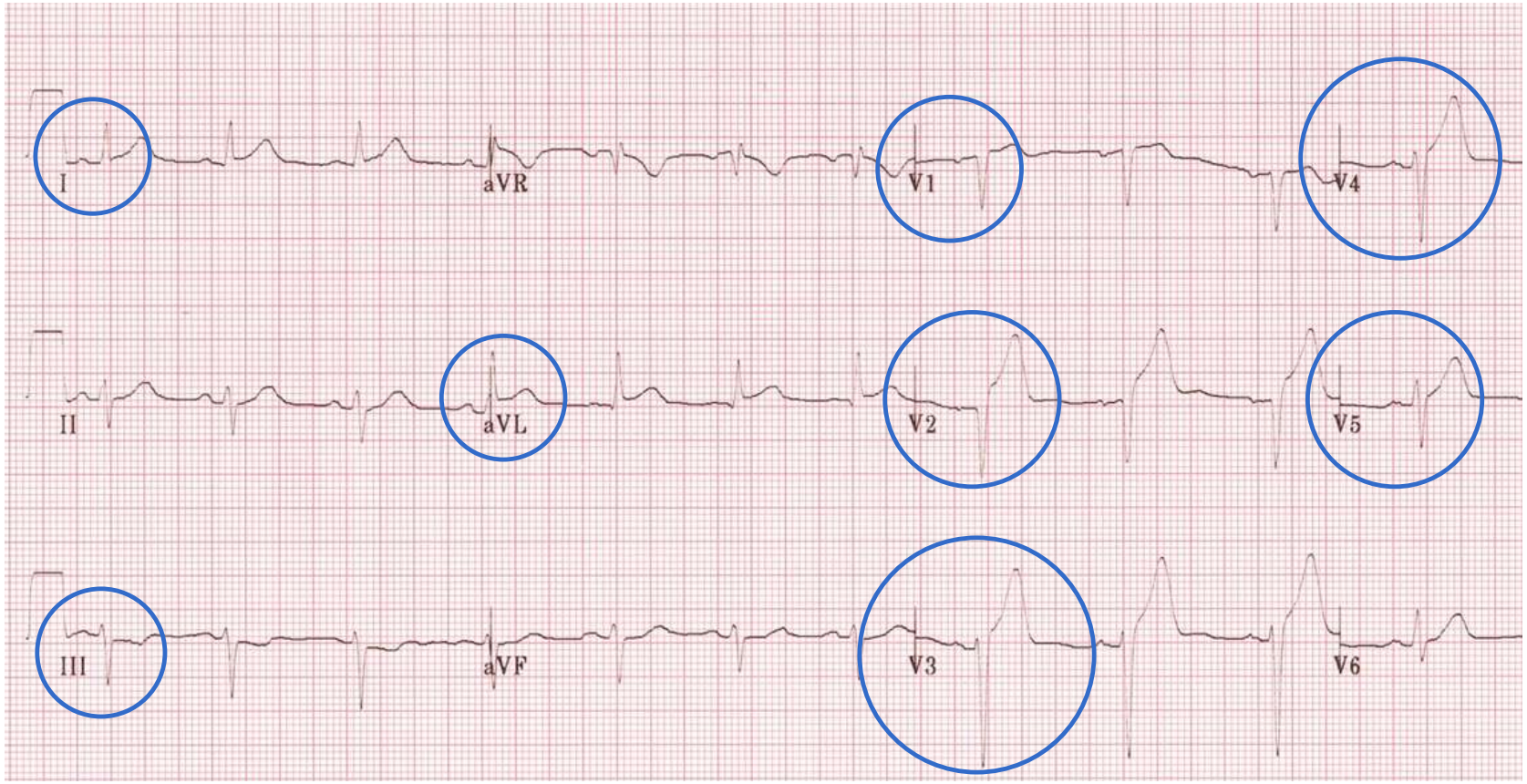
Terminal R wave

RBBB

Let’s interpret this EKG



Anterolateral STEMI



1. ST elevation leads V1-V4
2. Q waves in V1-V2
3. Subtle ST elevation In I, aVL, & V5 with Reciprocal Depression in lead III
4. Hyperacute (peaked T waves in V2-V4

12-Lead ECG

Any Questions?

References

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