



12-LEAD ECG



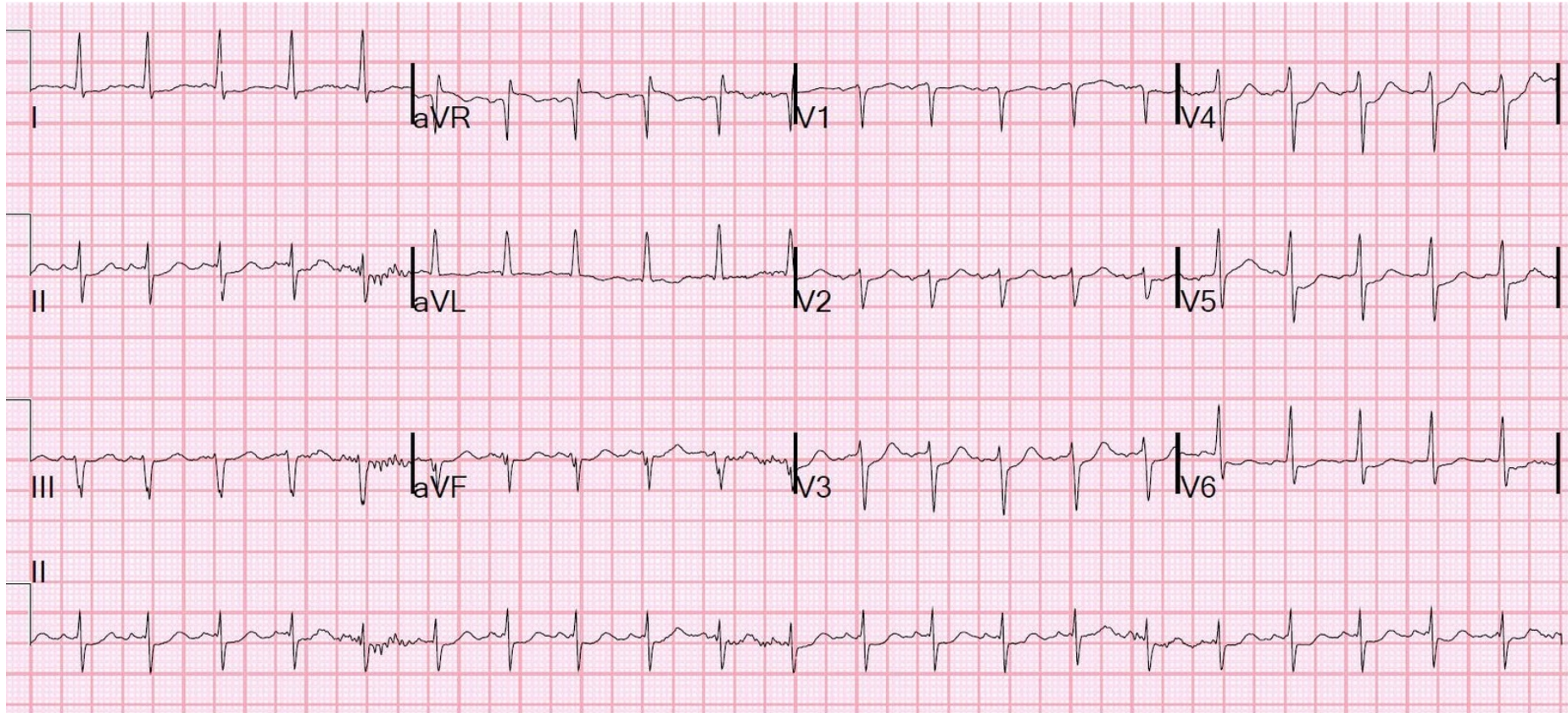
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A QUICK GUIDE TO INTERPRETATIONS OF MI PATTERNS ON THE 12 LEAD ECG

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MAY 2019

Session Purpose

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



Learning Objectives

By the end of this session, you will be able to:



Describe normal cardiac anatomy and physiology



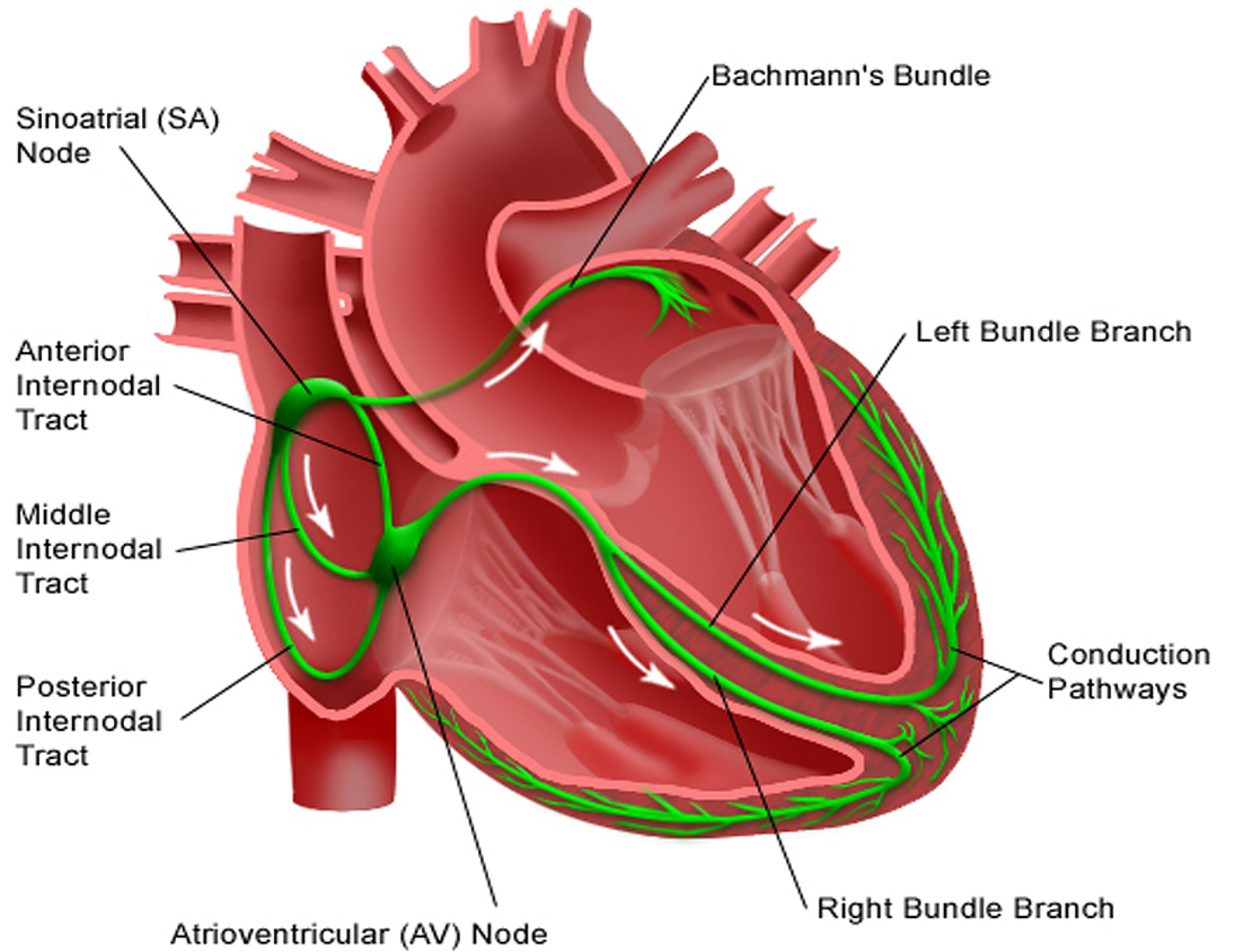
Describe a systematic approach to 12-lead analysis



Describe proper electrode placement

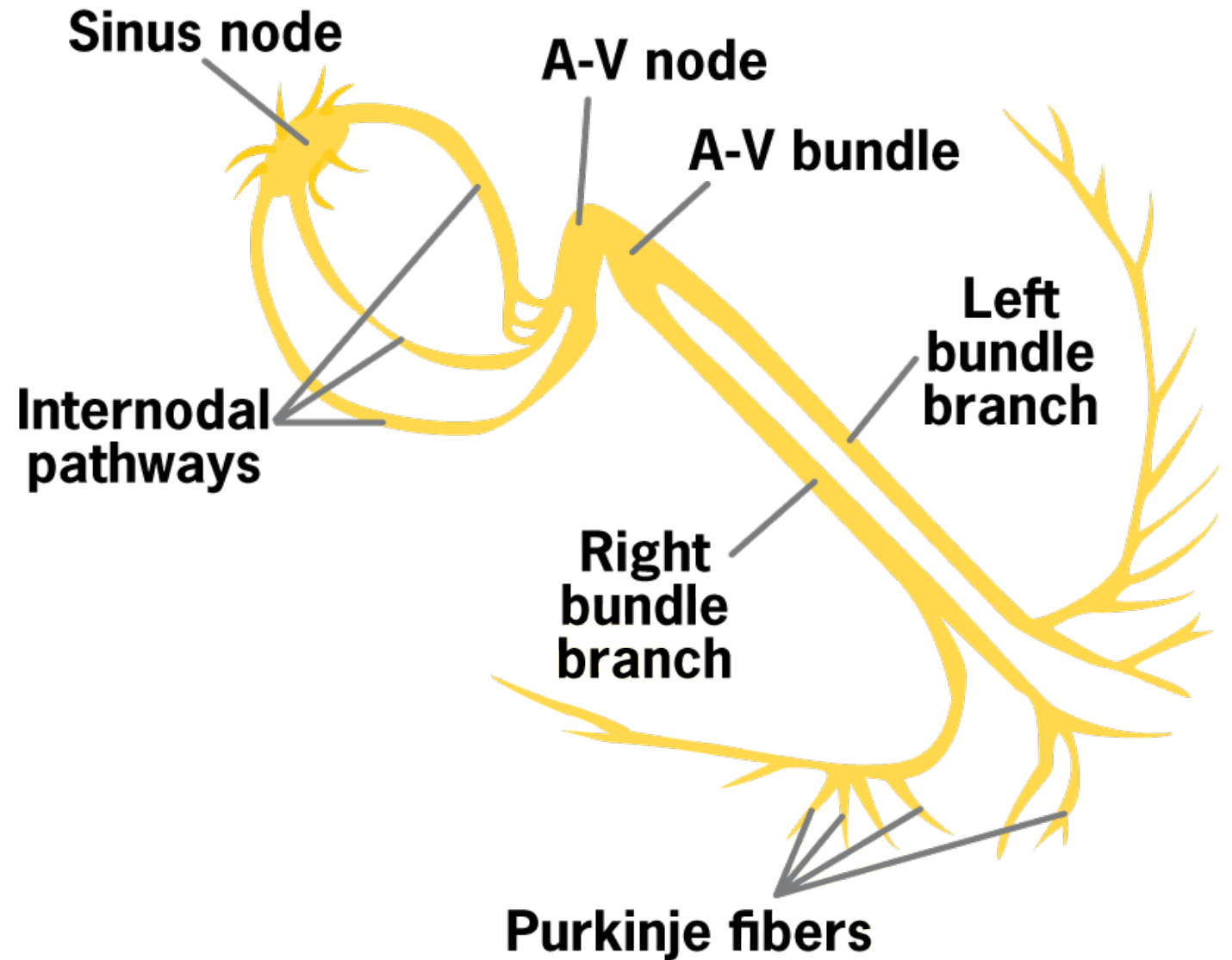


Electrical System of the Heart

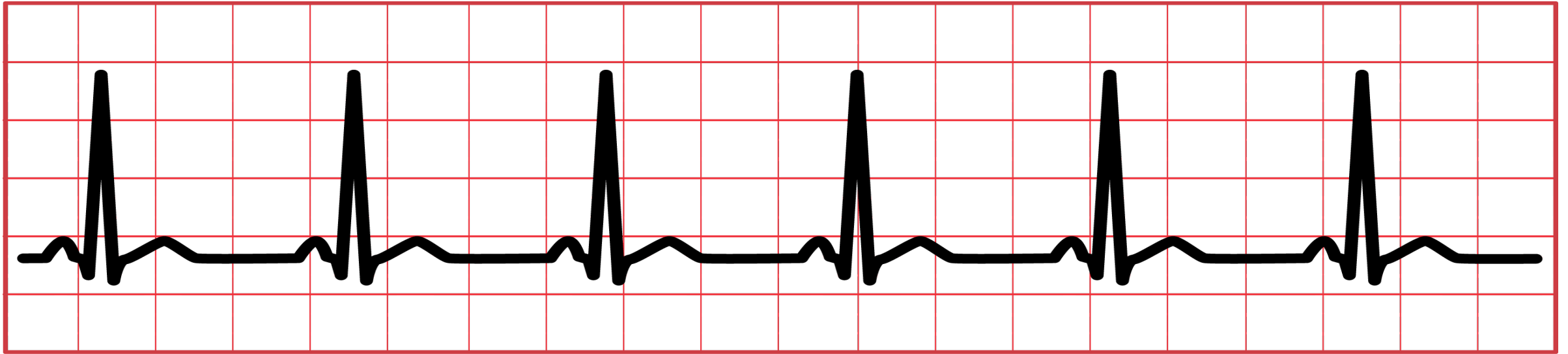




Electrical System of the Heart

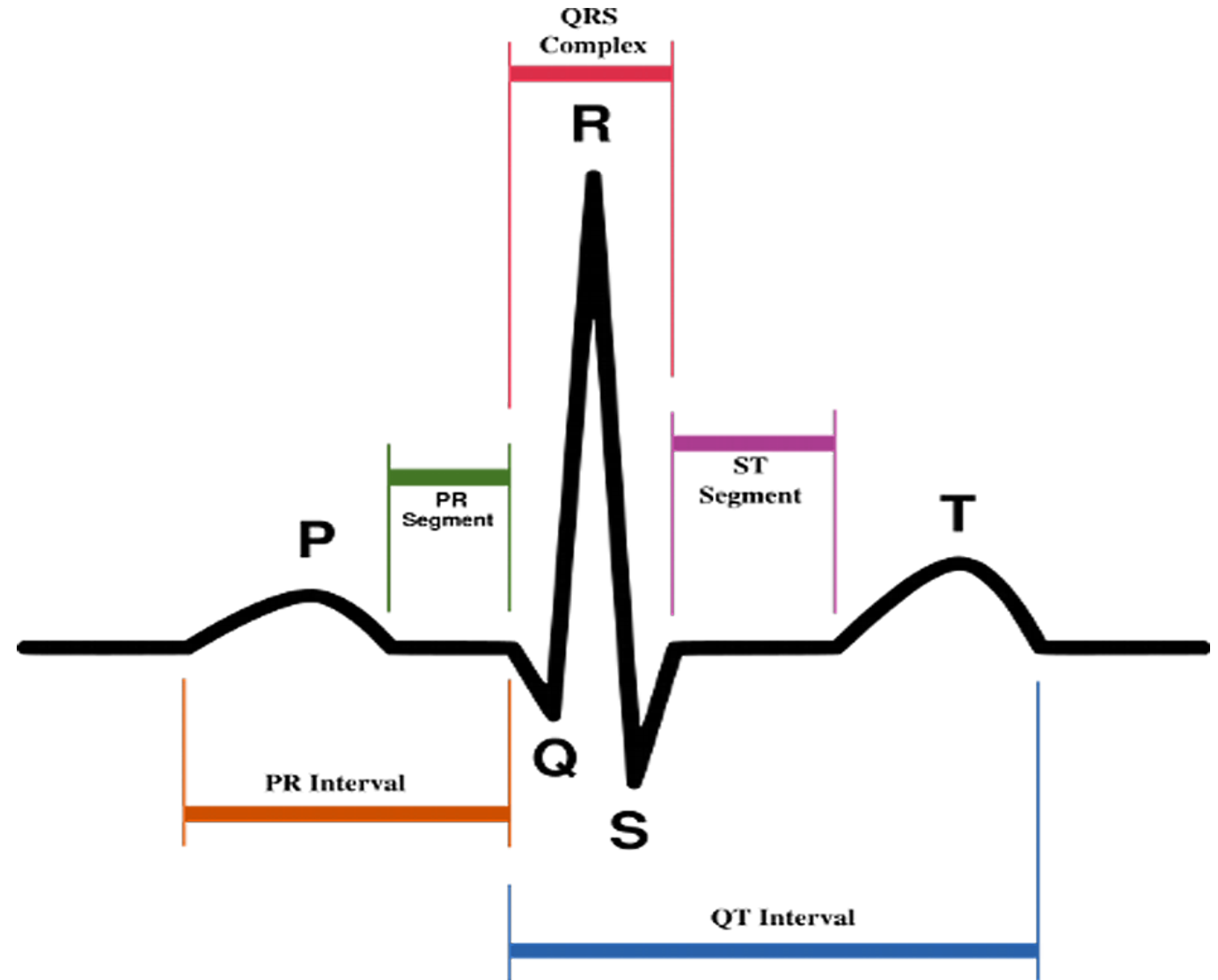


Normal Sinus Rhythm

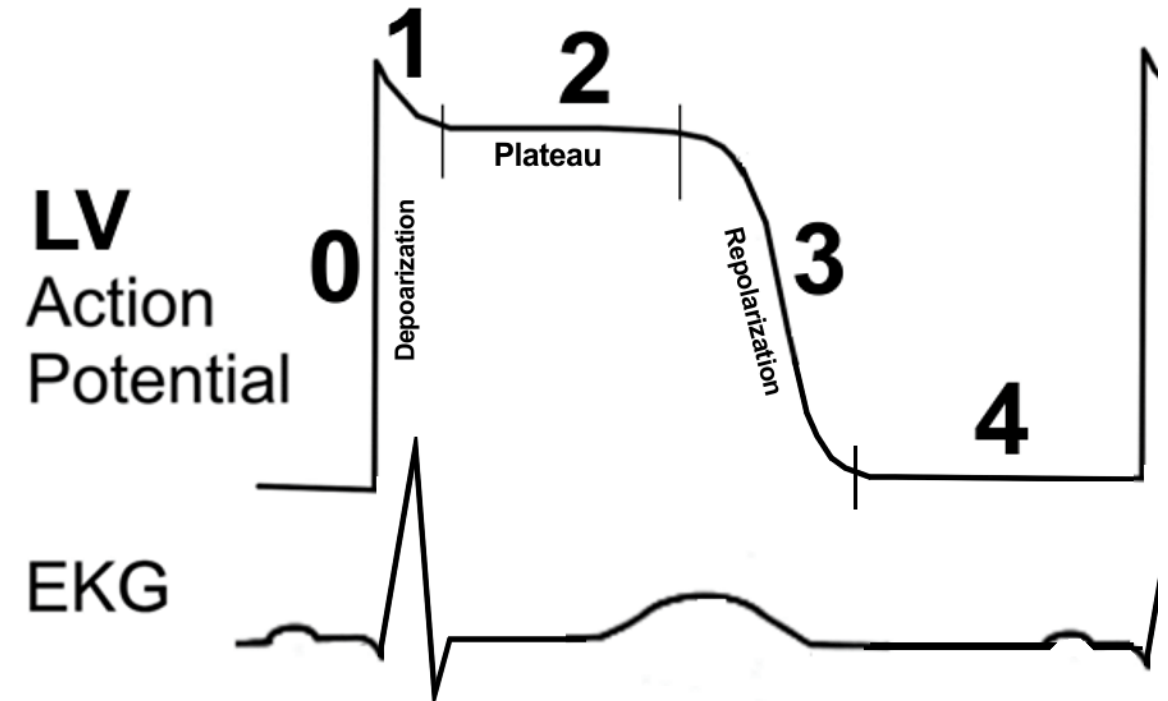
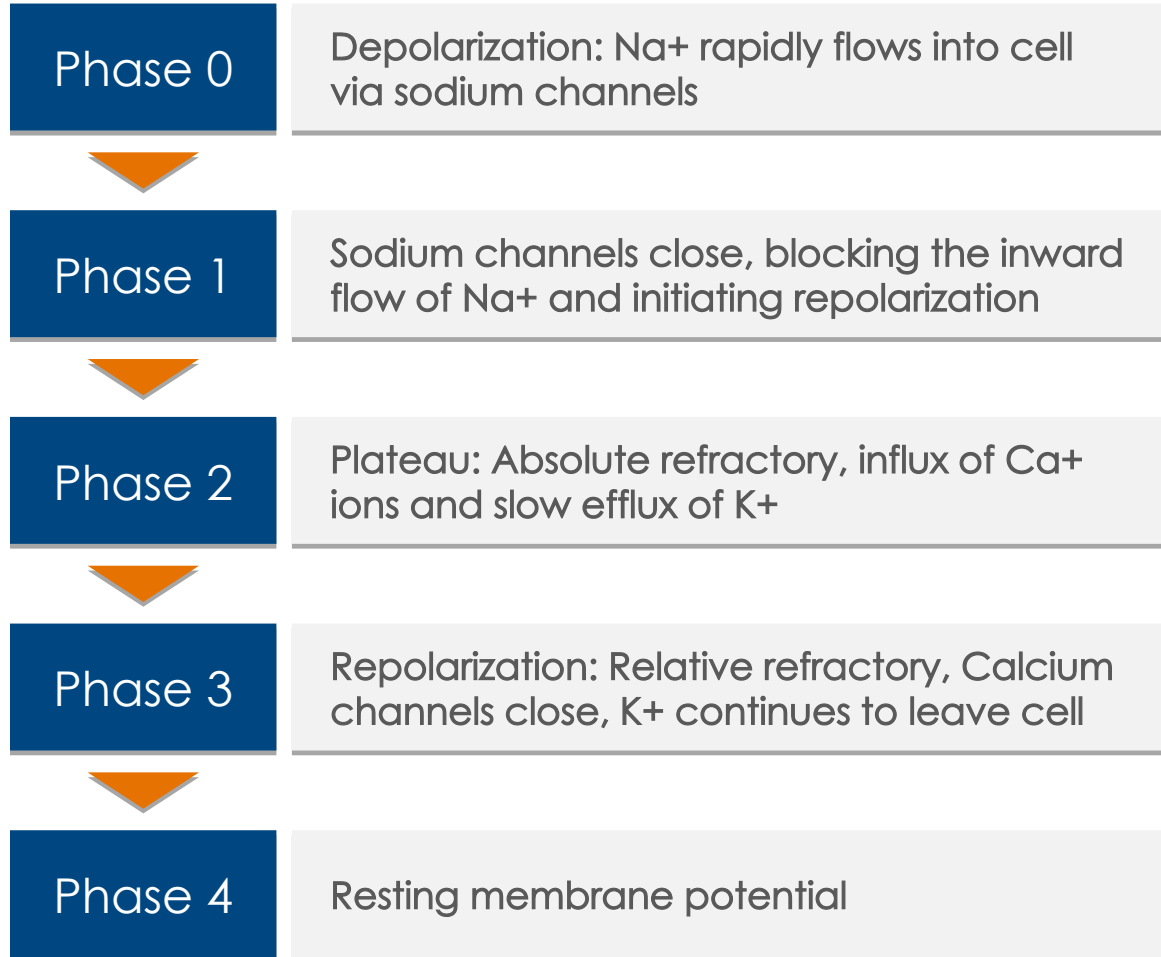




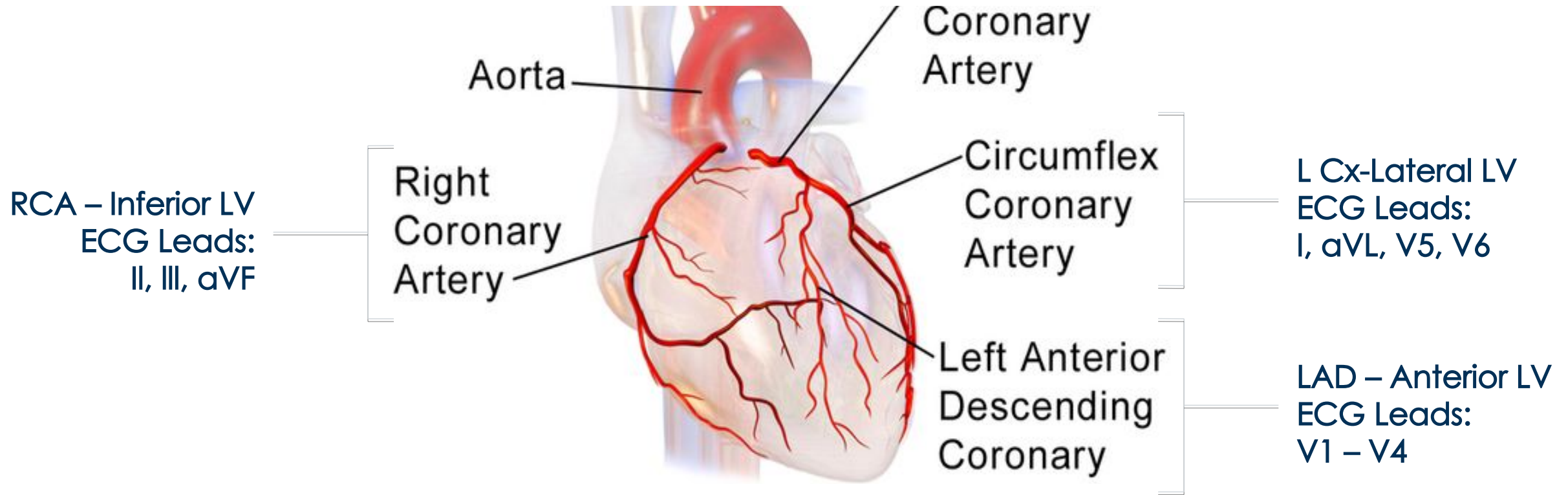
Electrical System of the Heart



Cardiac Action Potential

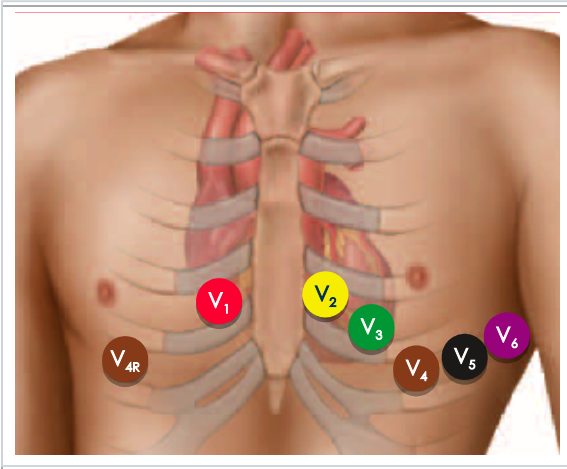


Coronary Arteries



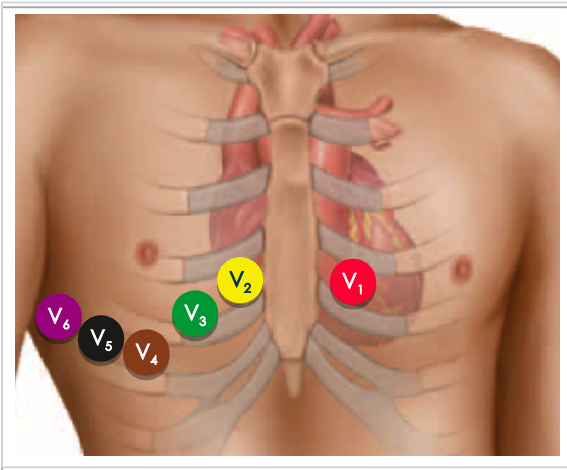
The coronary arteries deliver oxygen-rich blood to the muscle tissues of the heart. If the arteries become blocked, heart muscle will die, resulting in a heart attack.

ECG Electrode Placement



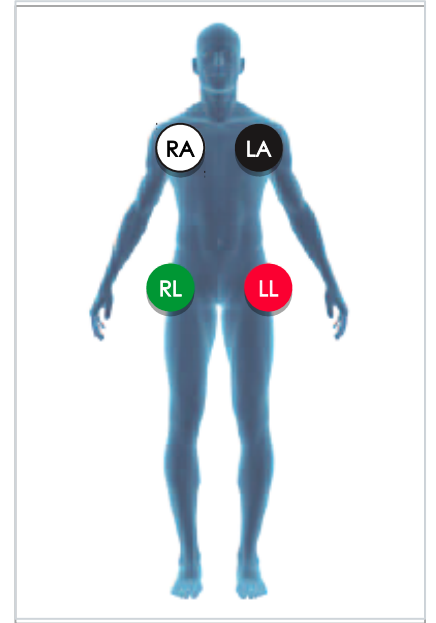
Proper 12-Lead Placement for Left Side of Chest

- | | |
|--|---|
| V₁ 4 th intercostal space to the right of the sternum | V₅ Level with V ₄ at left anterior axillary line |
| V₂ 4 th intercostal space to the left of the sternum | V₆ Level with V ₅ at left midaxillary line (directly under the midpoint of the armpit) |
| V₃ Directly between the leads V ₂ & V ₄ | V_{4R} 5 th intercostal space, right midclavicular line |
| V₄ 5 th intercostal space at midclavicular line | |



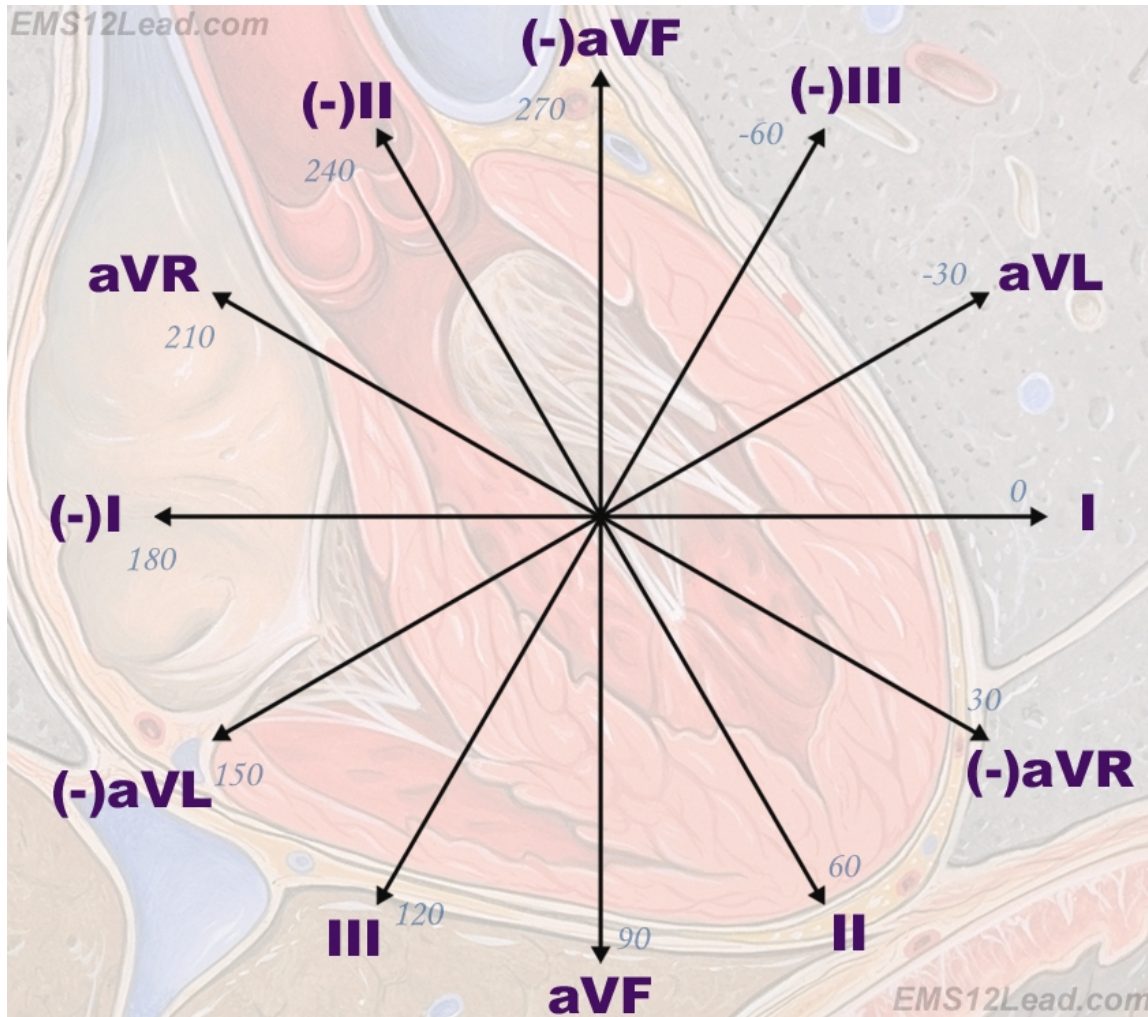
Proper 12-Lead Placement for Right Side of Chest

- | | |
|--|--|
| V₁ 4 th intercostal space to the left of the sternum | V₄ 5 th intercostal space at right midclavicular line |
| V₂ 4 th intercostal space to the right of the sternum | V₅ Level with V ₄ at right anterior axillary line |
| V₃ Directly between the leads V ₂ & V ₄ | V₆ 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

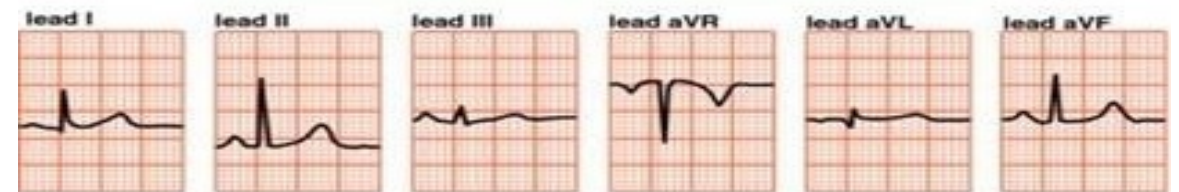


+ Electrode

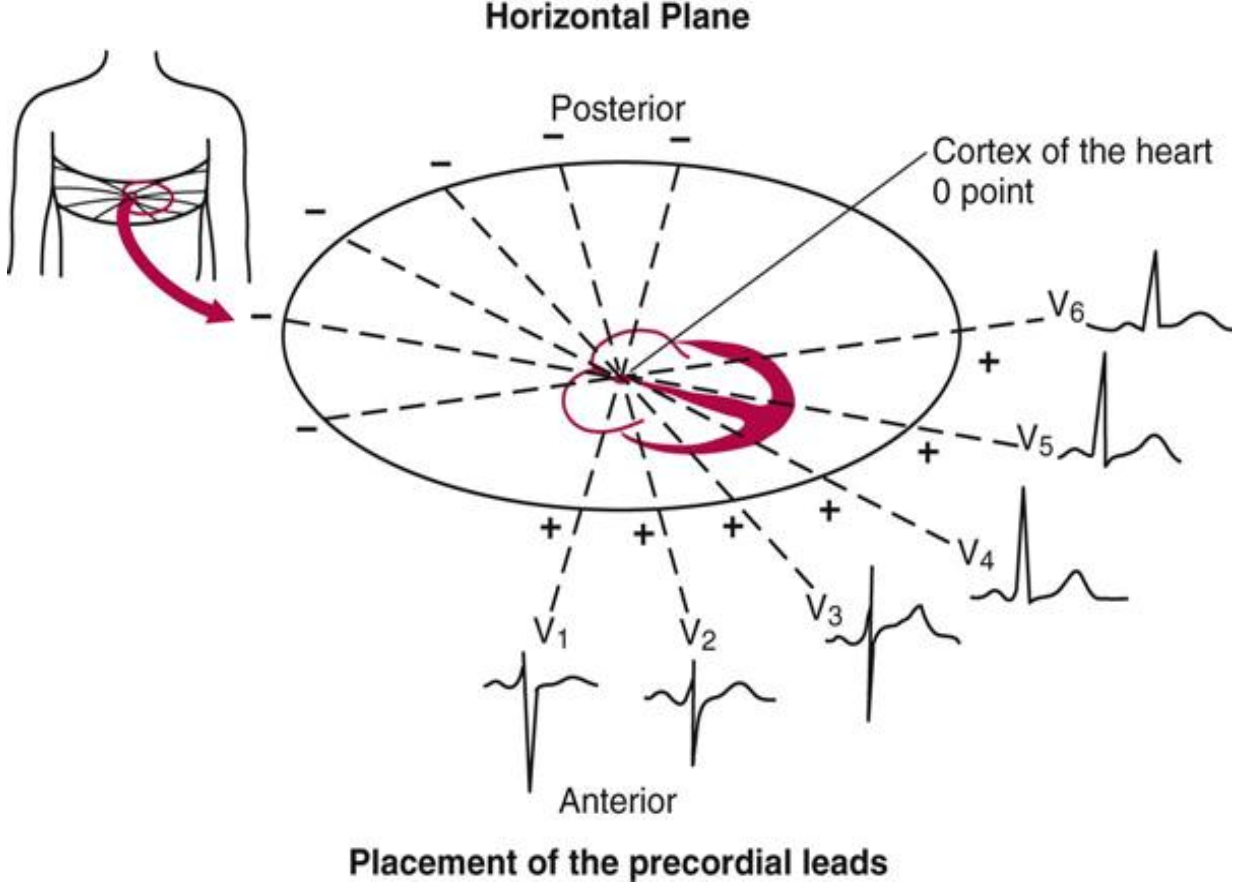
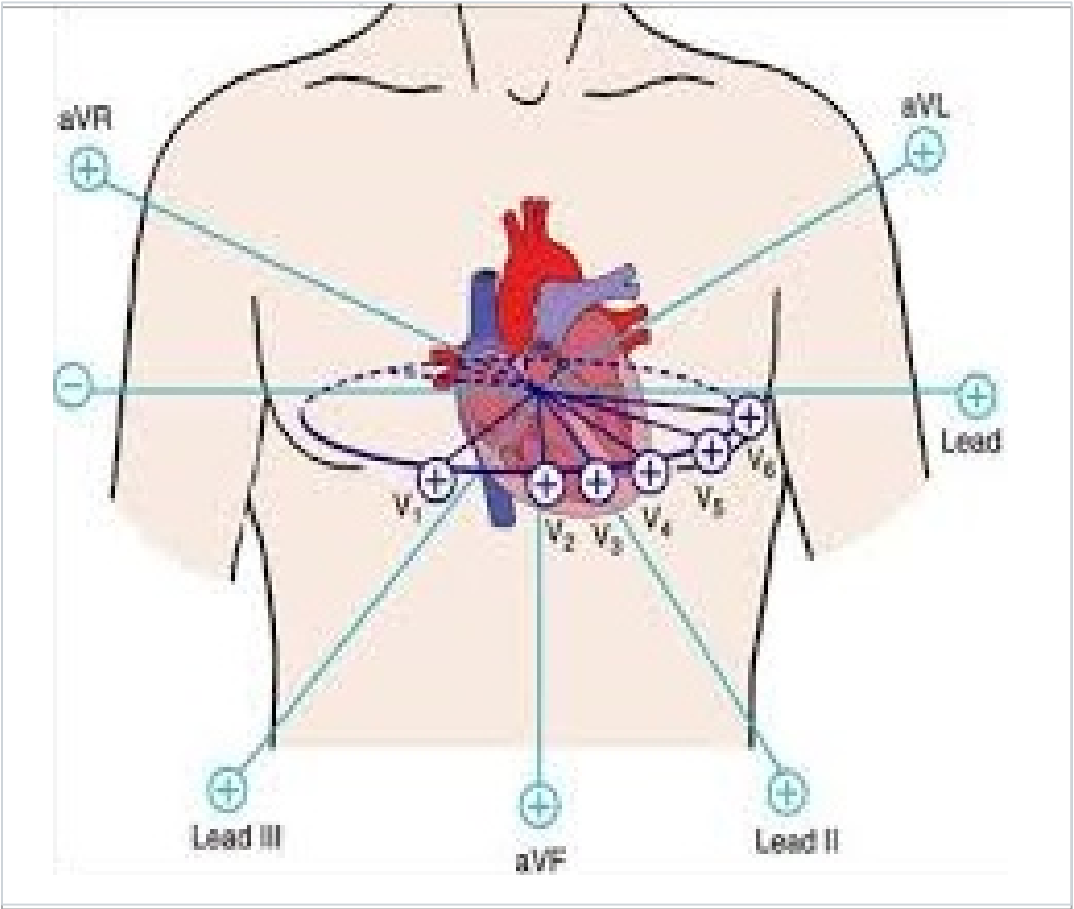
Activity coming toward the camera
= **upright complexes**

Activity going away from the camera
= **downward complexes**

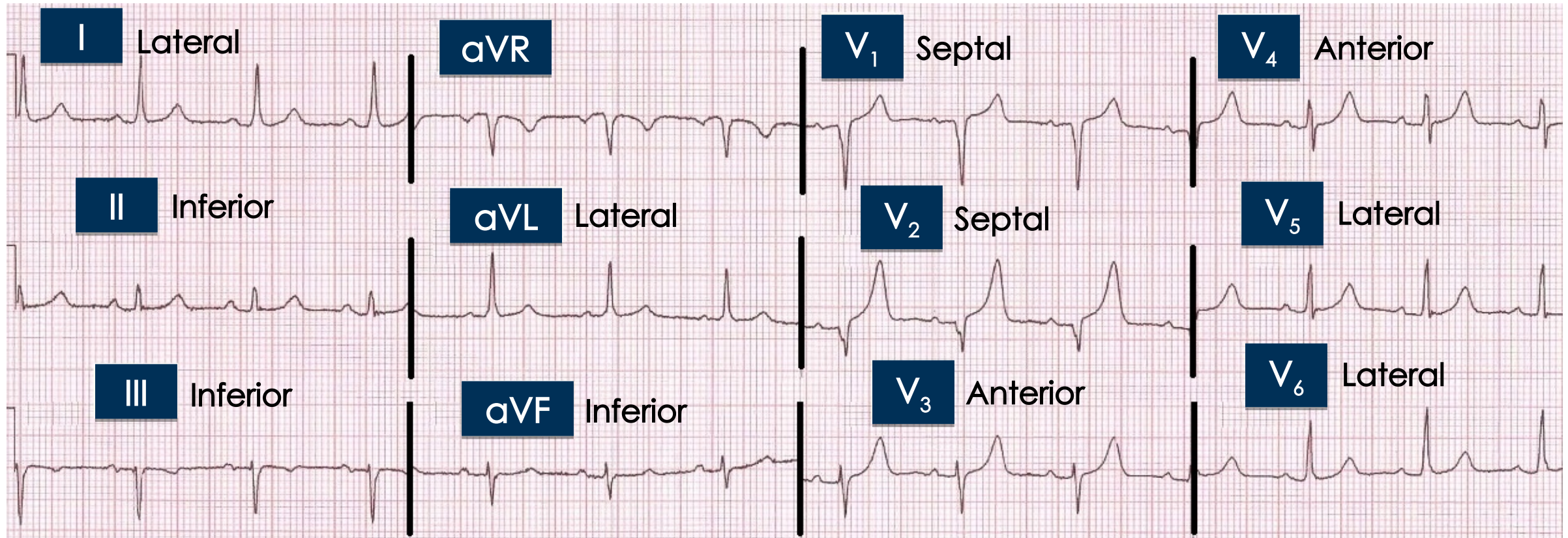
MEAN QRS AXIS IN THE FRONTAL PLANE EXAMPLES 1



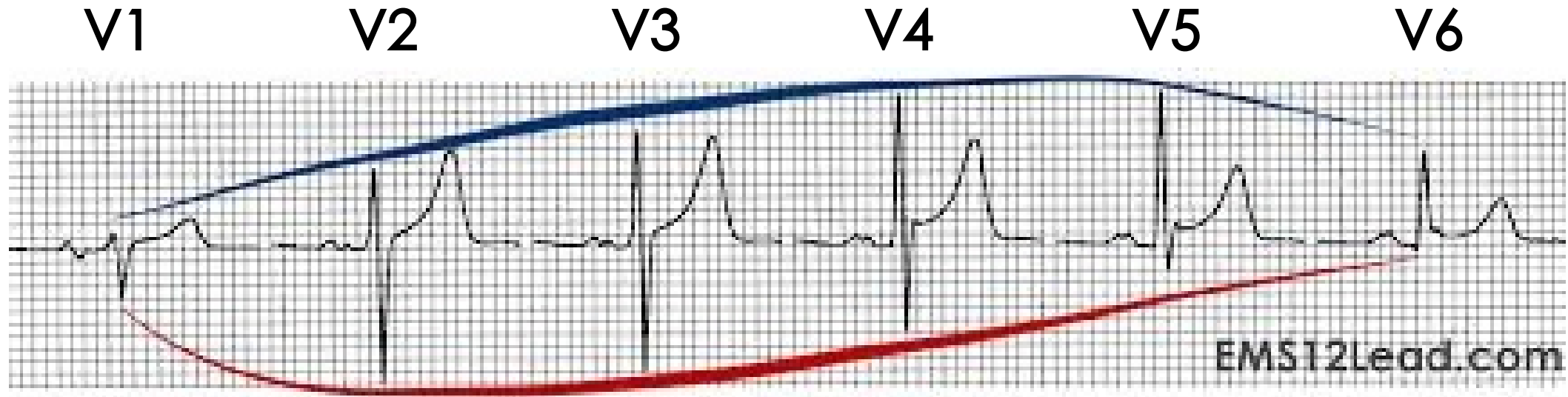
Horizontal Plane (Chest) Leads



12-Lead ECG Walls of the Heart

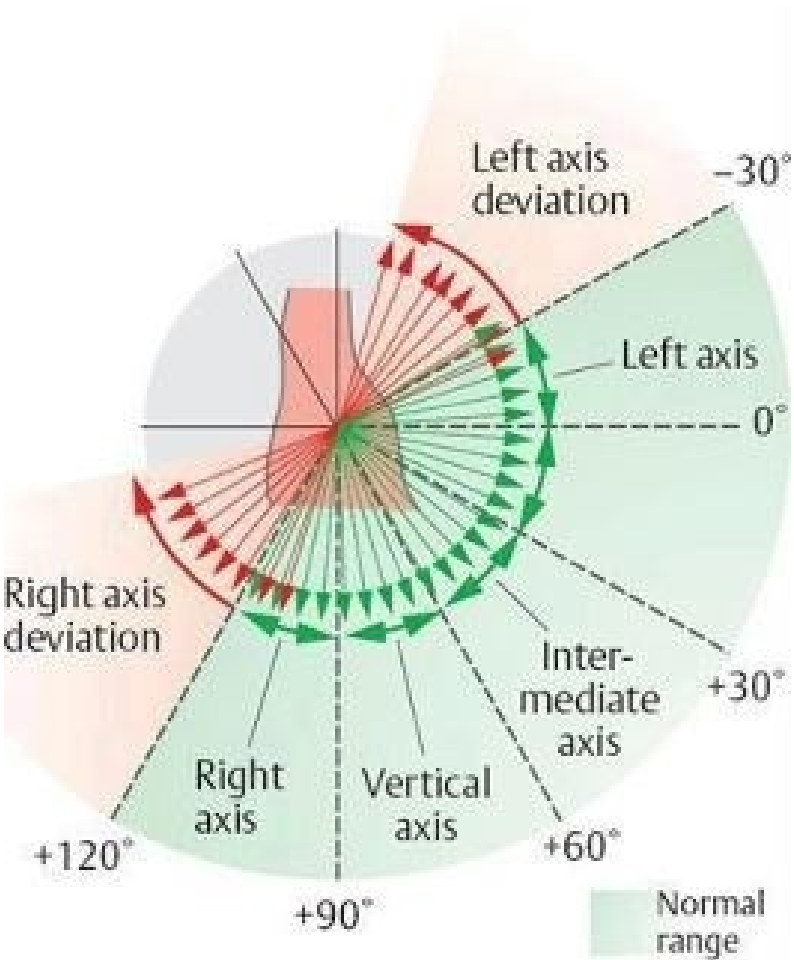


R-Wave Progression



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, while 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

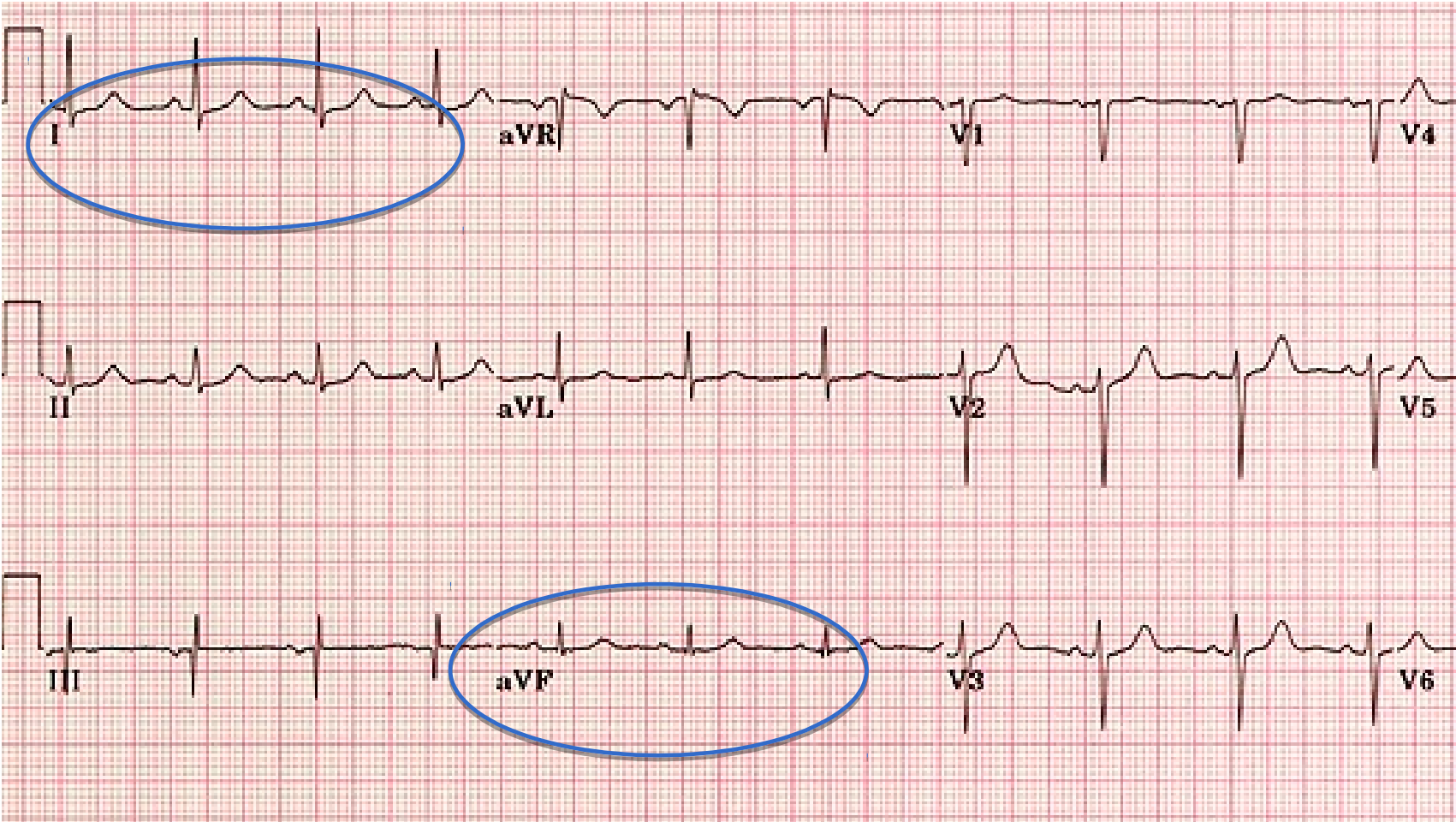
RT Axis Deviation

- 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.

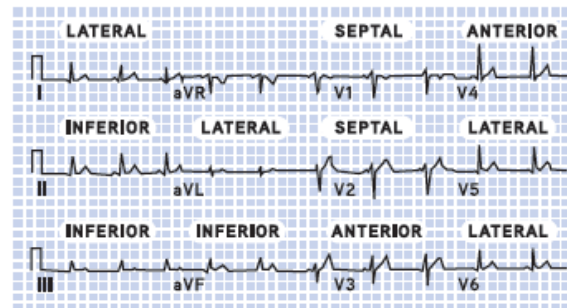
12-Lead ECG Interpretation



Sequence for 12 Lead ECG Interpretation

1. Determine the rate
2. Determine the rhythm & axis
3. Measure intervals
4. Is there 'R' wave progression
5. Compare with previous 12 Lead ECG's and any other clinical data

**** ST elevation must be present in at least 2 leads to confirm the diagnosis of a Myocardial Infarction

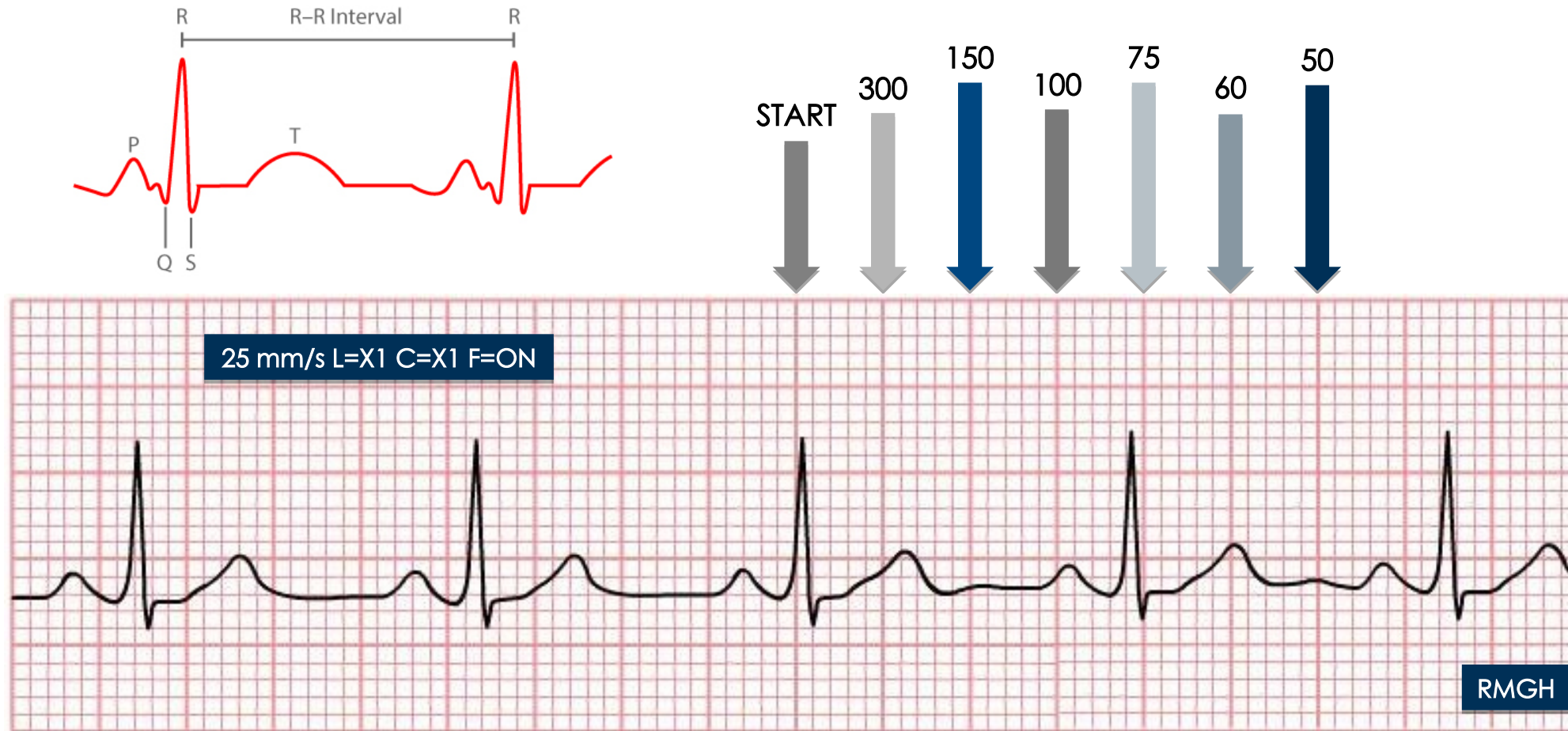


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NMLB 048 [A]-CO-0471

This wheel is provided as a clinical reference and not as a diagnostic tool. Refer to physician to confirm diagnosis

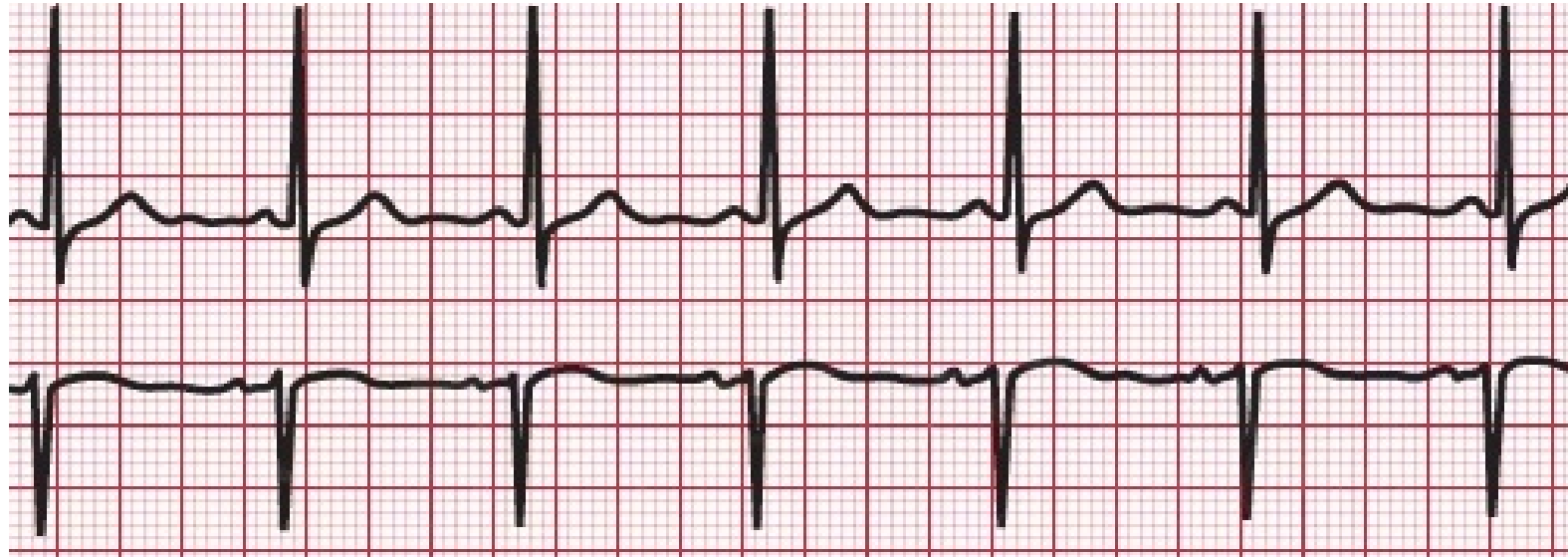
1. Determine Rate

Normal Sinus Rhythm



2. Determine Rhythm

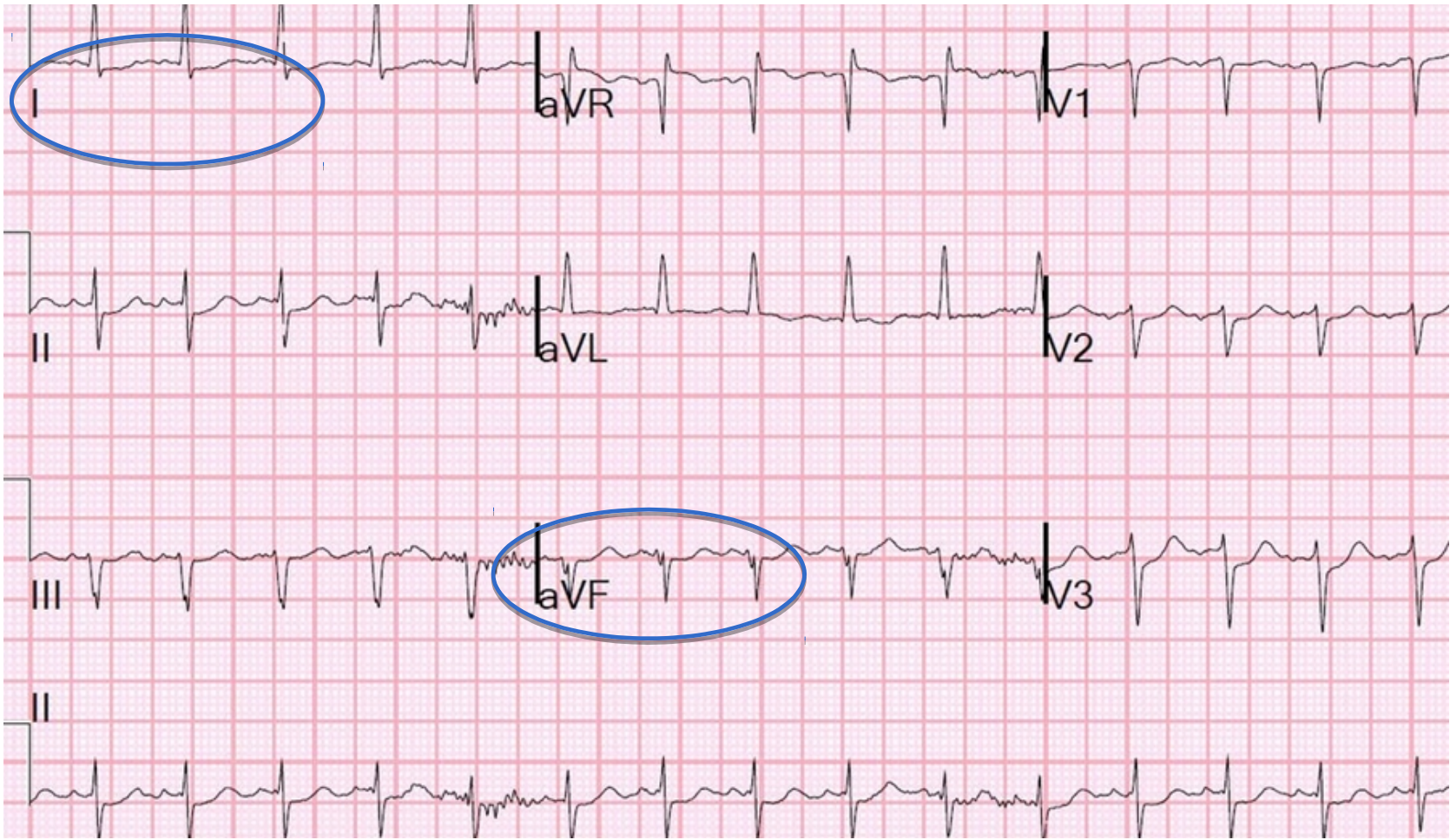
Normal Sinus Rhythm



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

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2a. Axis Net QRS Deflection

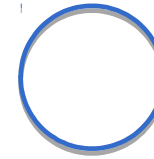
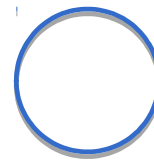
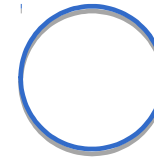
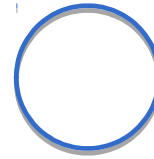
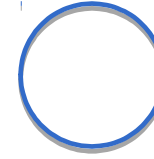
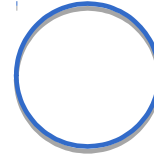


	Lead I	aVF
NL	Positive	Positive
RAD	Negative	Positive
LAD	Positive	Negative
Indet.	Negative	Negative

I – positive aVF – negative

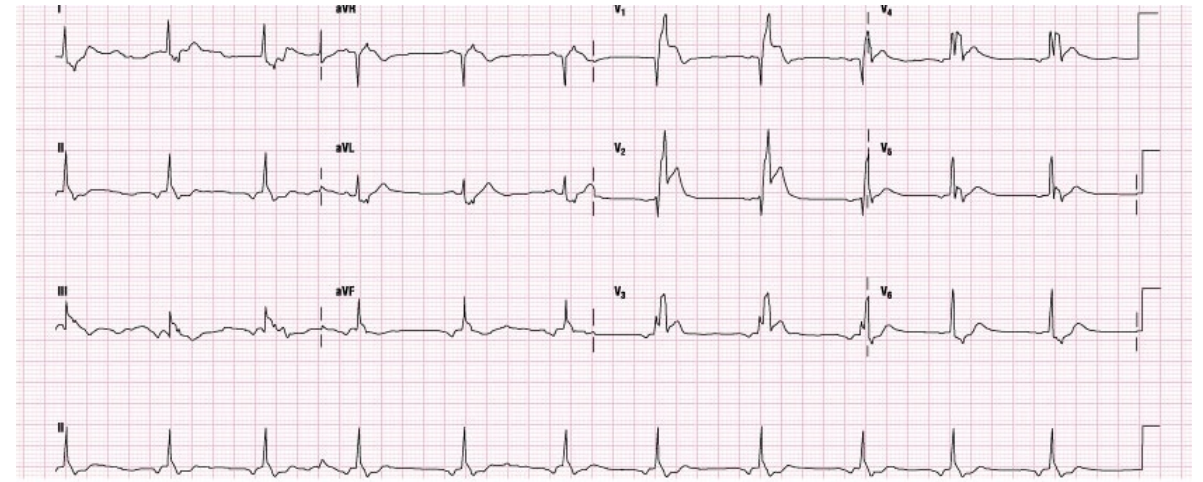
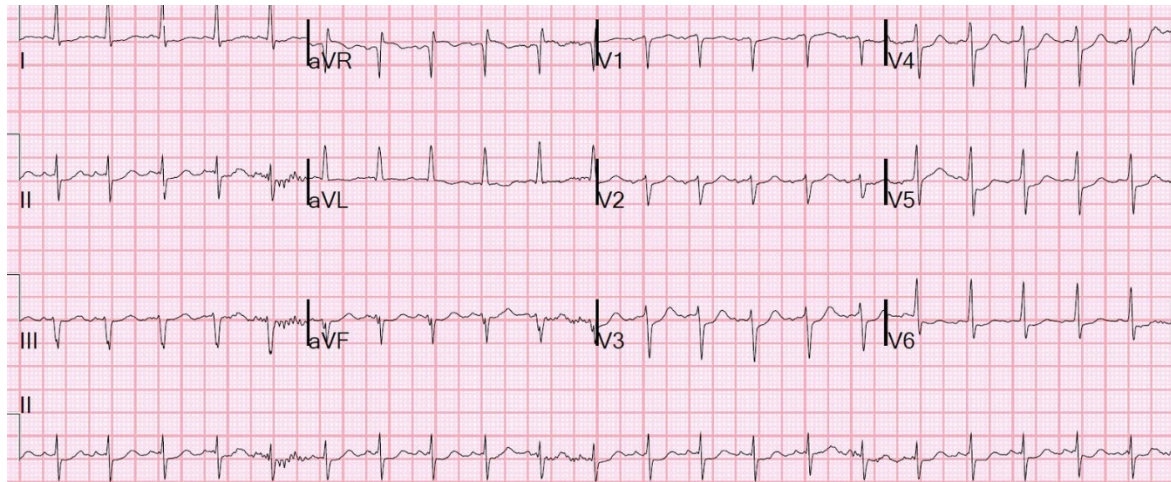
Axis = LAD

4. Assess R-Wave Progression

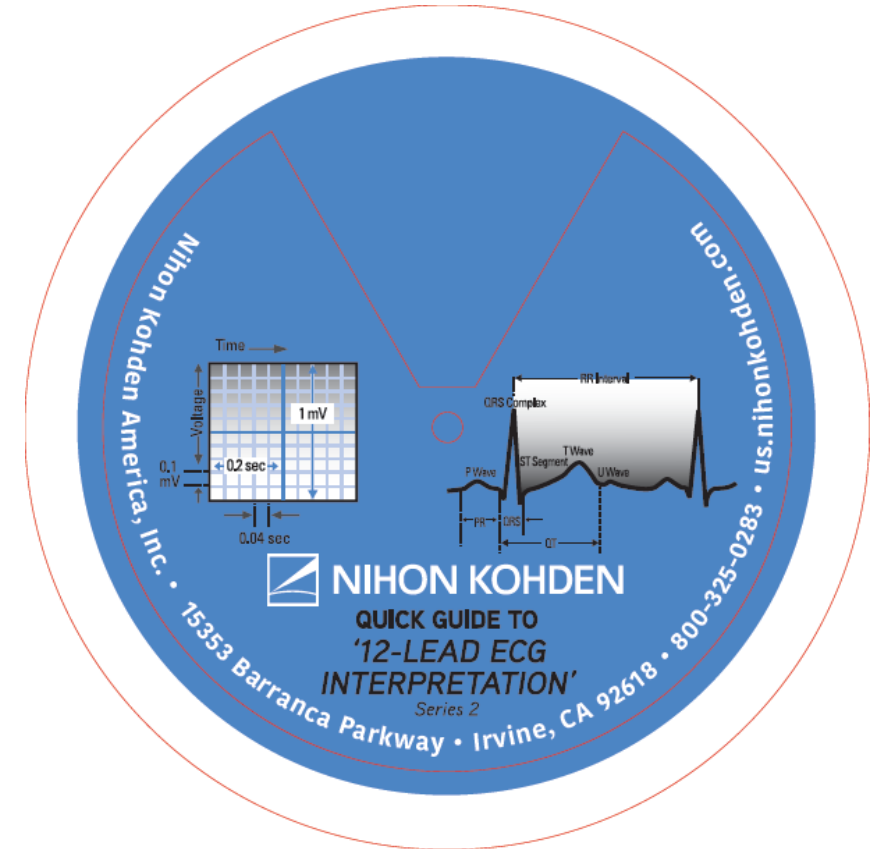
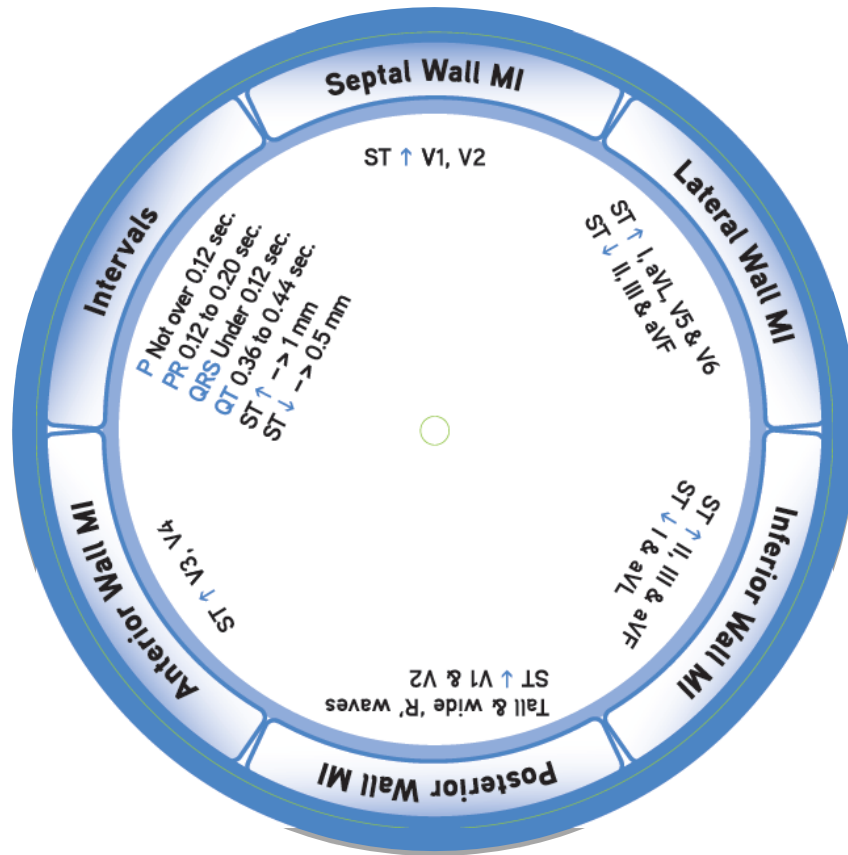


5. Compare and Assess

Previous 12 Leads and Presenting Clinical Data



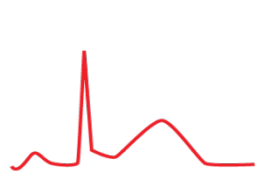
Assess the 12 Lead ECG for MI



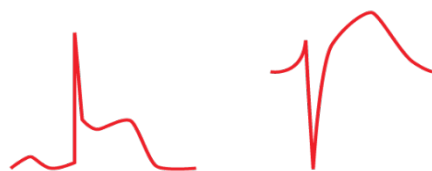
Principal Indicators of Acute Infarction

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

ST Segment Elevation (= Injury)

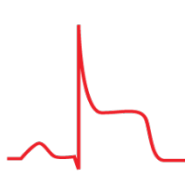


Early ("Hyperacute") Stage

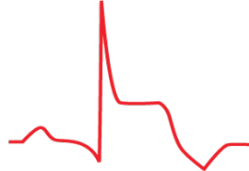


Caved ("Frowny") ST Segment Elevation (= Acute Injury Pattern)

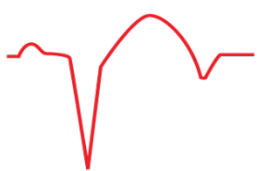
Development of Q-Waves



Early Q-Wave Development



Established Q-Wave Stage



QS Complex

T-Wave Inversion (= Ischemia)



Early T-Wave Inversion

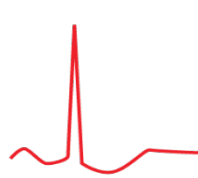


Deeper, Symmetric T-Wave Inversion (= Ischemia)

Reciprocal ST Segment Depression



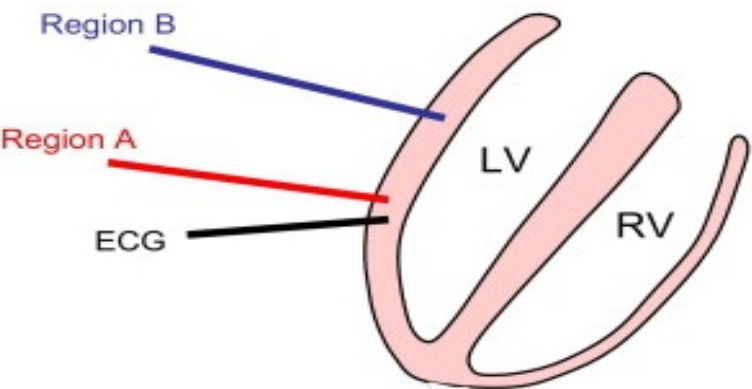
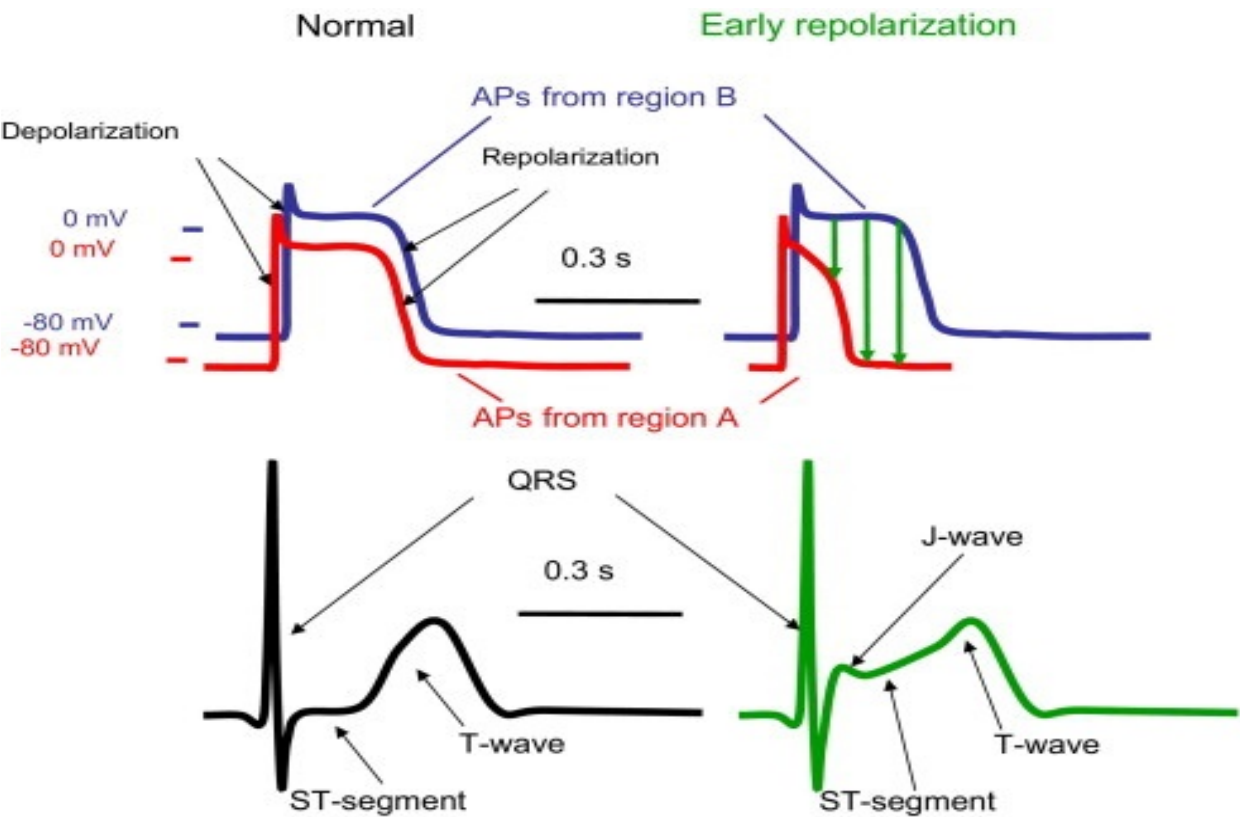
Mirror Image ST Depression



Subtle Reciprocal ST Segment Depression

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

Why Does the ST Elevate?



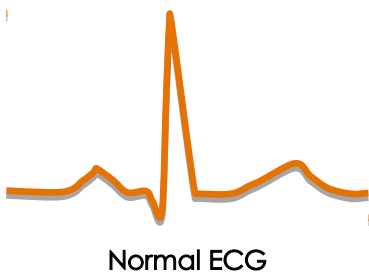
Evolution of an Infarct

Transmural Infarction

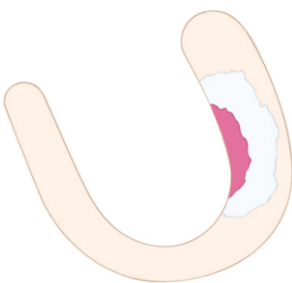
Before Coronary Occlusion



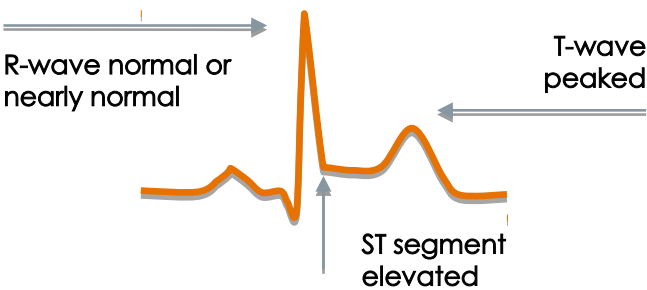
Heart muscle normal



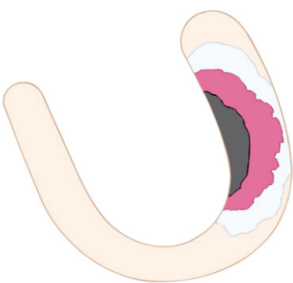
Onset and First Several Hours



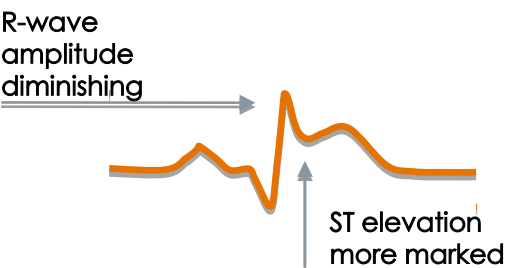
Subendocardial injury and myocardial ischemia. No cell death (infarction) yet.



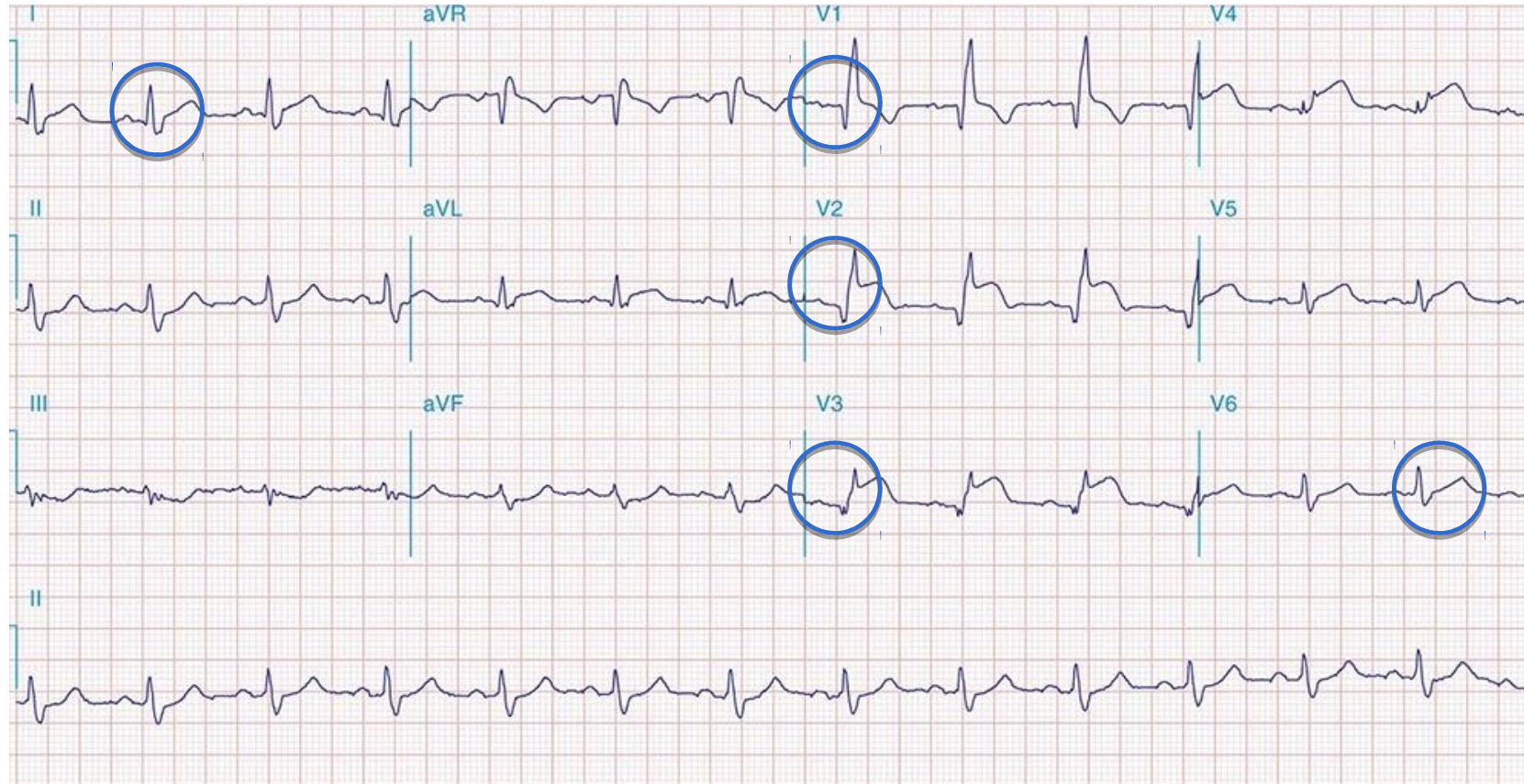
First Day



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



Acute Antero-Septal MI



ST Elevations

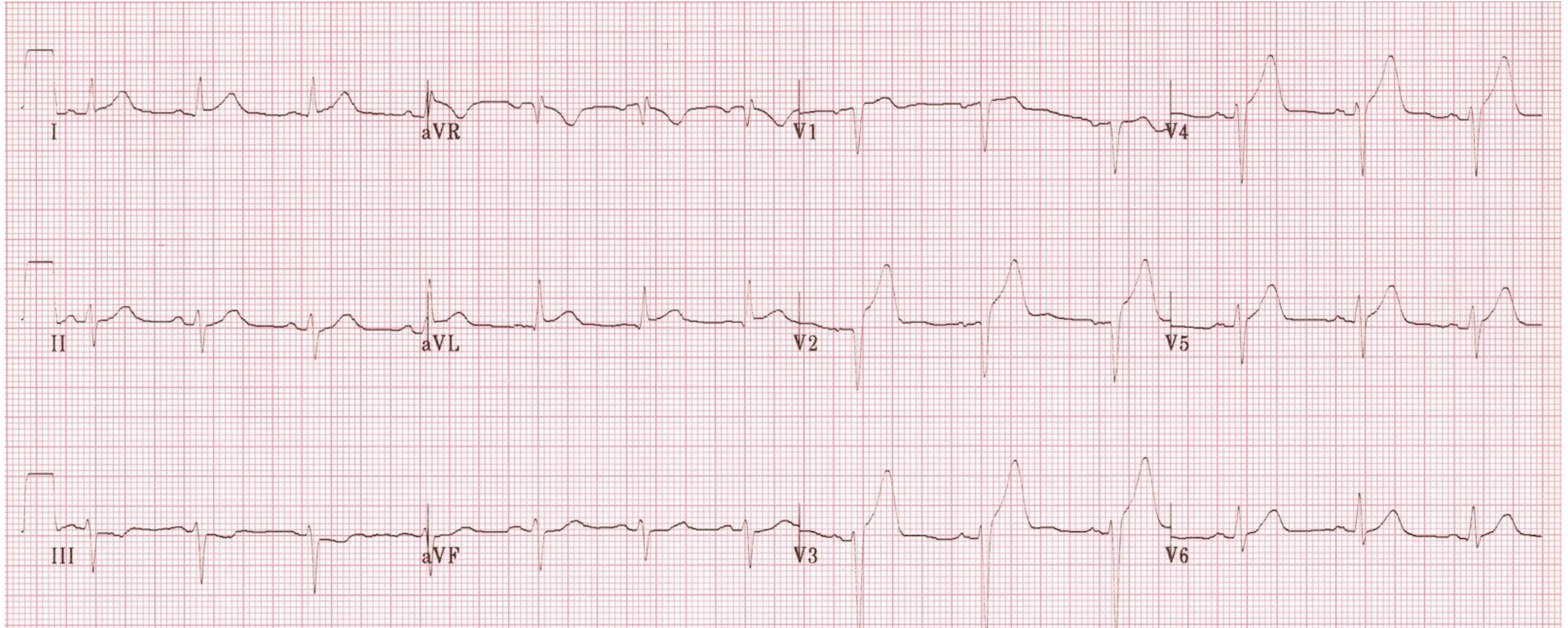
V1-V4

Q-Waves

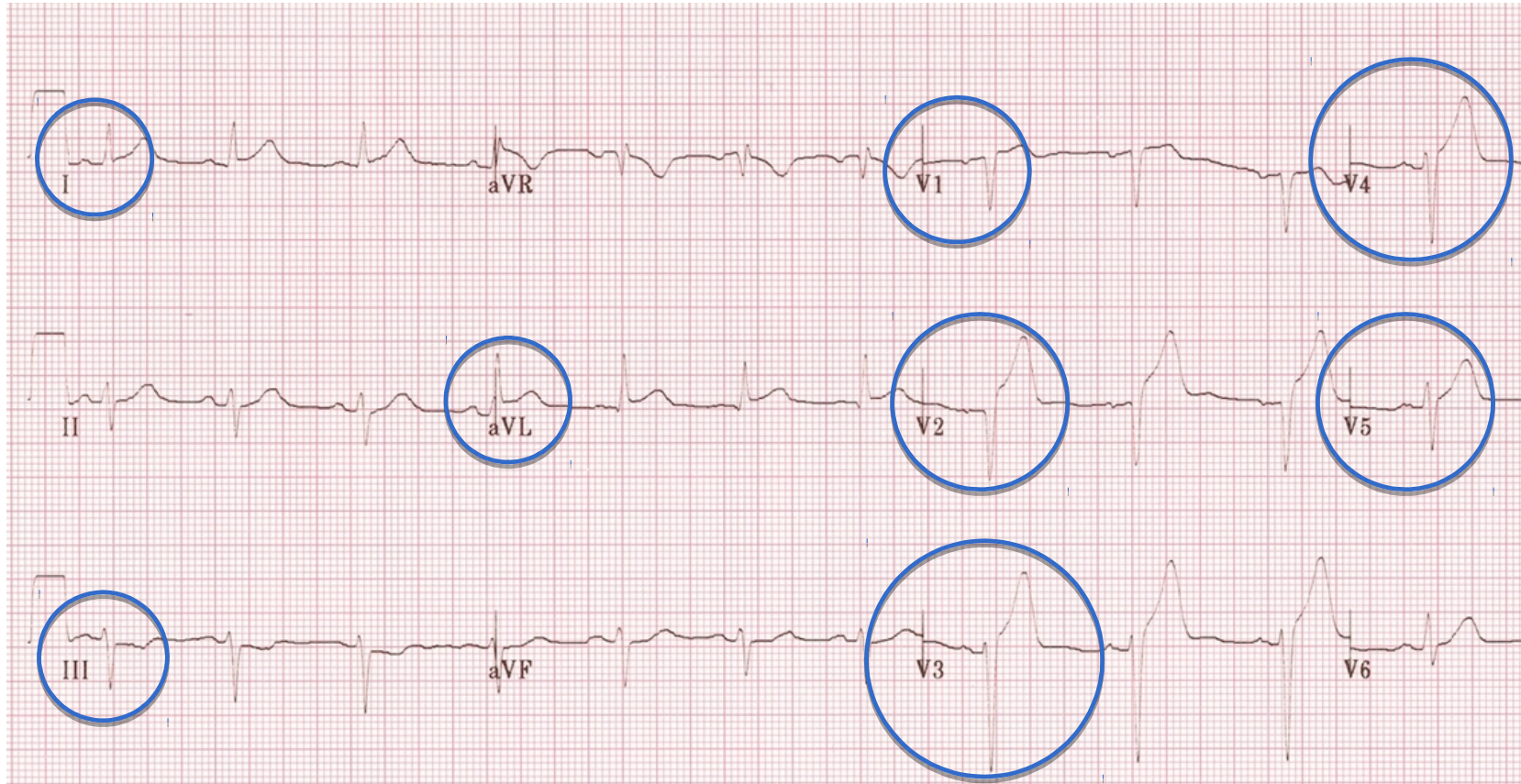
Terminal R-Wave

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

1. AACN, (1998). Clinical reference for critical care nurses, 4th Edition. Mosby, St. Louis.
2. Bell, N. (1992). Clinical significance of ST-segment monitoring. Critical Care Nursing Clinics of North America, 4 (2).
3. Drew, B. (2002). Celebrating the 100th birthday of the electrocardiogram: Lessons learned from research in cardiac monitoring. American Journal of Critical Care, 11 (4).
4. Goode, D.P. (1984). The human body: The heart, the living pump. Torstar books, NY.
5. Grauer, K. (1998). A practical guide to ECG interpretation (2nd edition). Mosby, St. Louis.
6. Leeper, B. (2001). ST-segment monitoring across the continuum. AACN NTI News, July.
7. Meltzer, L. (1965). Intensive coronary care: A manual for nurses. Philadelphia, Charles.
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