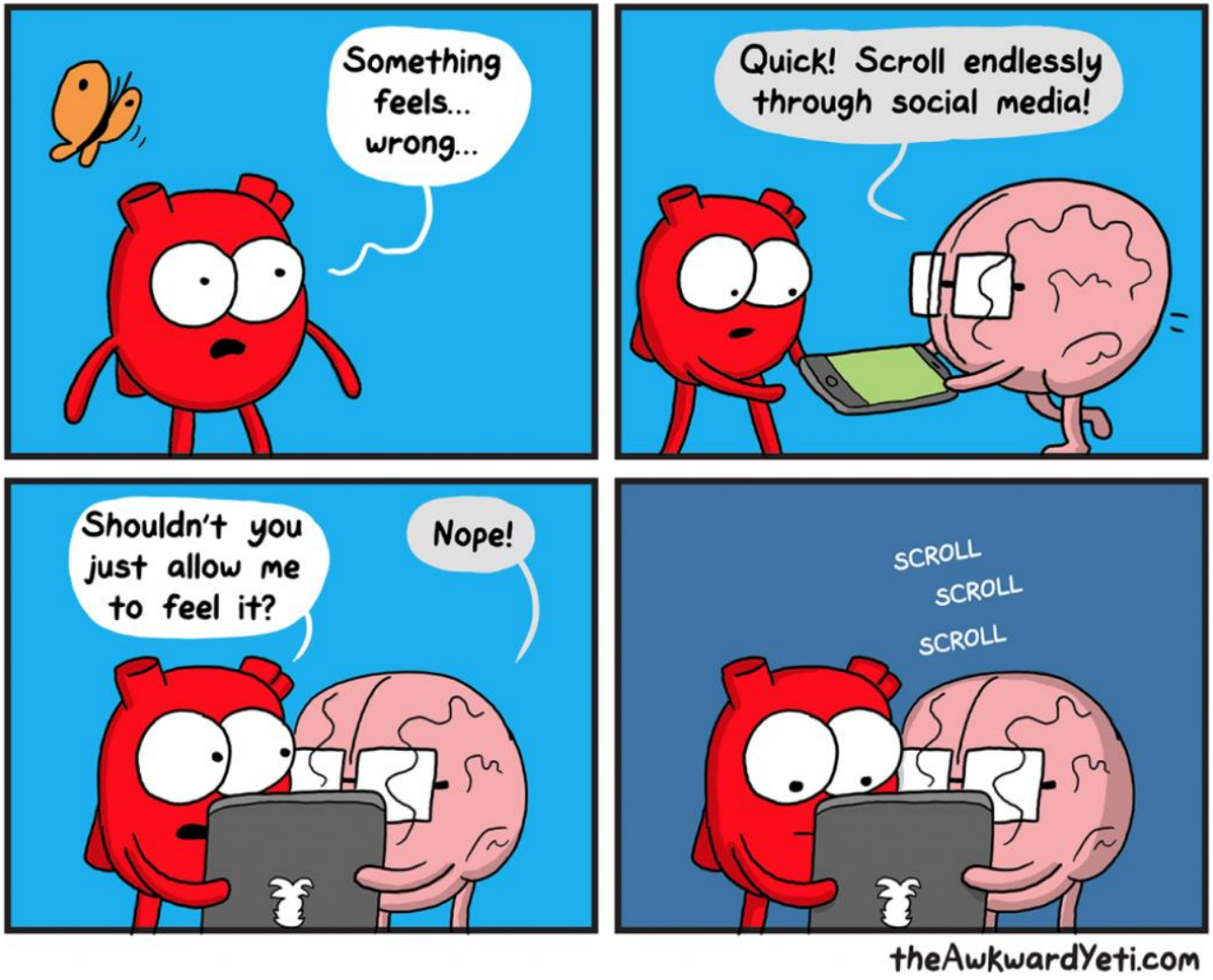
Speak from the Heart
Love your ECGs

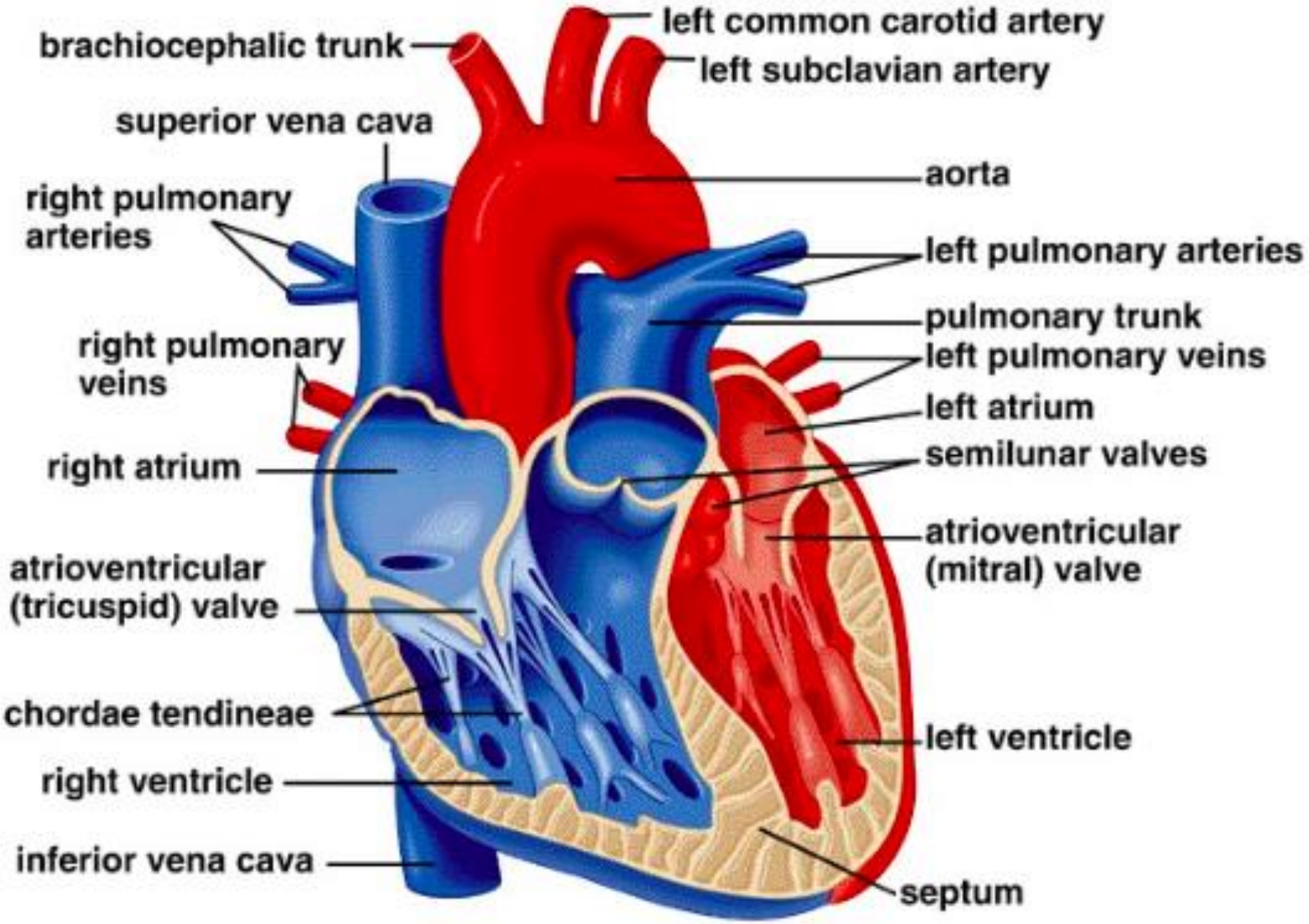
Dr. Jenny Huang


Something feels... wrong...
Quick! Scroll endlessly through social media!
Shouldn't you just allow me to feel it?
Nope!
SCROLL
SCROLL
SCROLL
theAwkwardYeti.com

Overview

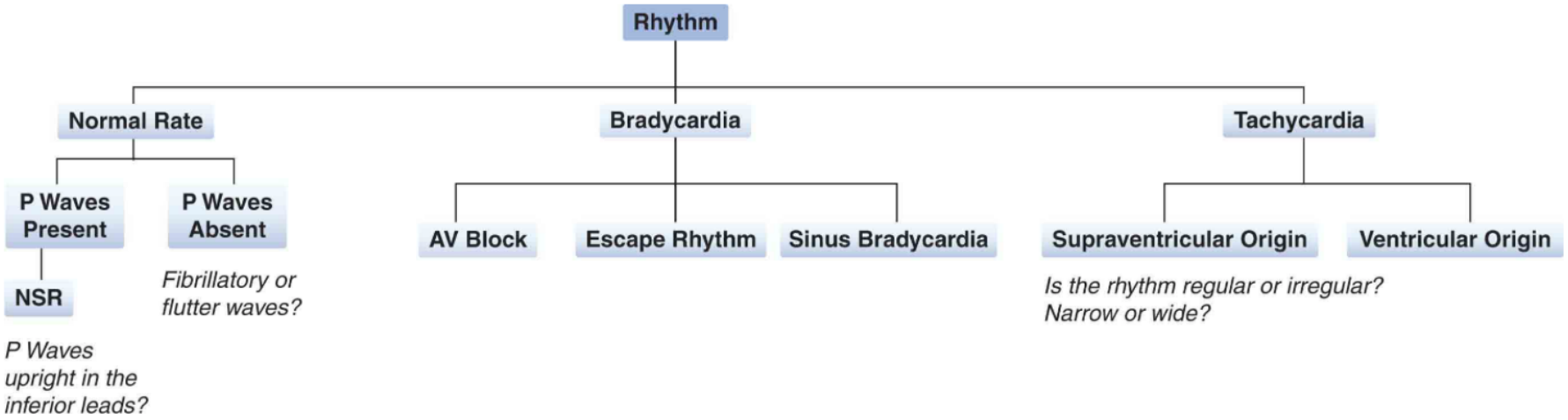
- Heart anatomy
- Basic ECG interpretation revision
- Coronary Anatomy and Corresponding ECG leads
- Acute Coronary Syndrome
  - STEMIS
  - Near STEMIs
  - AMI in BBB

Internal View of Heart

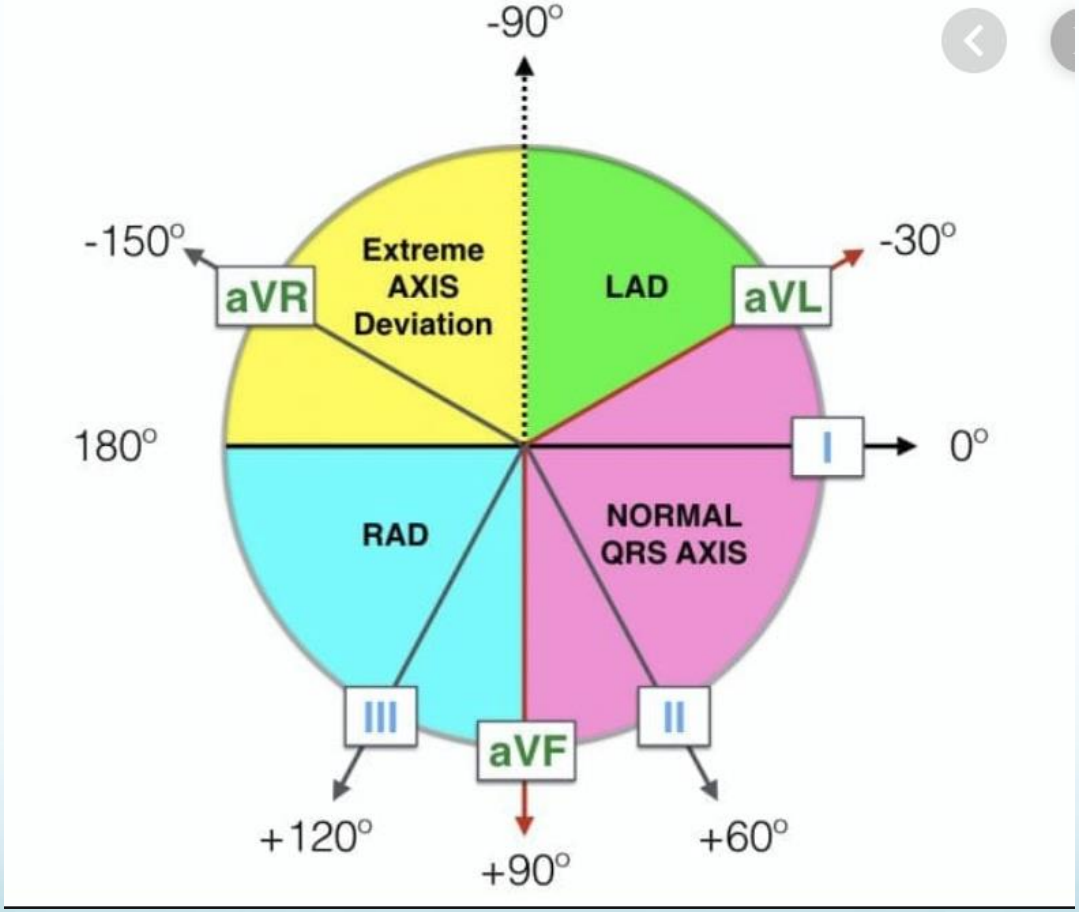


Approach to ECG interpretation

- Clinical History
- Rate and Rhythm
- Axis
- QRS voltage, width
- Interval – PR, QT
- Signs of Ischaemia – ST, T, pathologic Q
- Wave Morphologies – P, QRS, T
- Compare with prior ECG, repeat ECG if concern

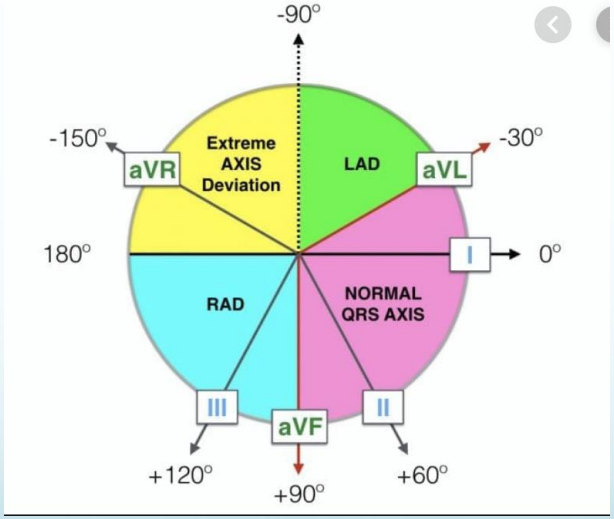

Rhythm
Normal Rate
Bradycardia
Tachycardia
P Waves Present
P Waves Absent
AV Block
Escape Rhythm
Sinus Bradycardia
Supraventricular Origin
Ventricular Origin
NSR
Fibrillatory or flutter waves?
Is the rhythm regular or irregular? Narrow or wide?
P Waves upright in the inferior leads?

Axis


-90°
-150°
-30°
aVR
Extreme
AXIS
Deviation
LAD
aVL
180°
I
0°
RAD
NORMAL
QRS AXIS
III
aVF
II
+120°
+90°
+60°

Axis Deviation

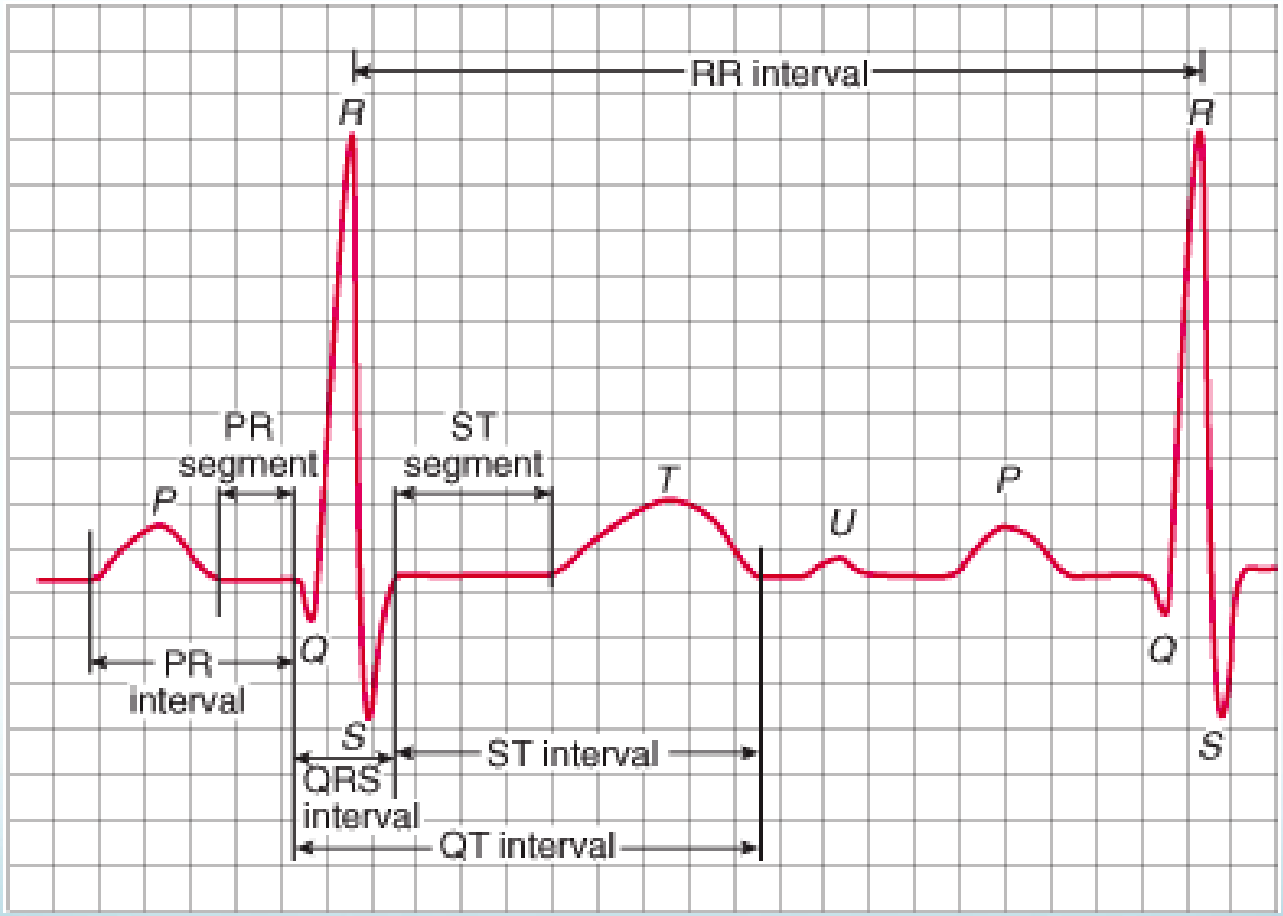
Lead 1	aVF	Axis
+	+	Normal
+	-	L) axis
-	+	R) axis
-	-	Extreme Axis

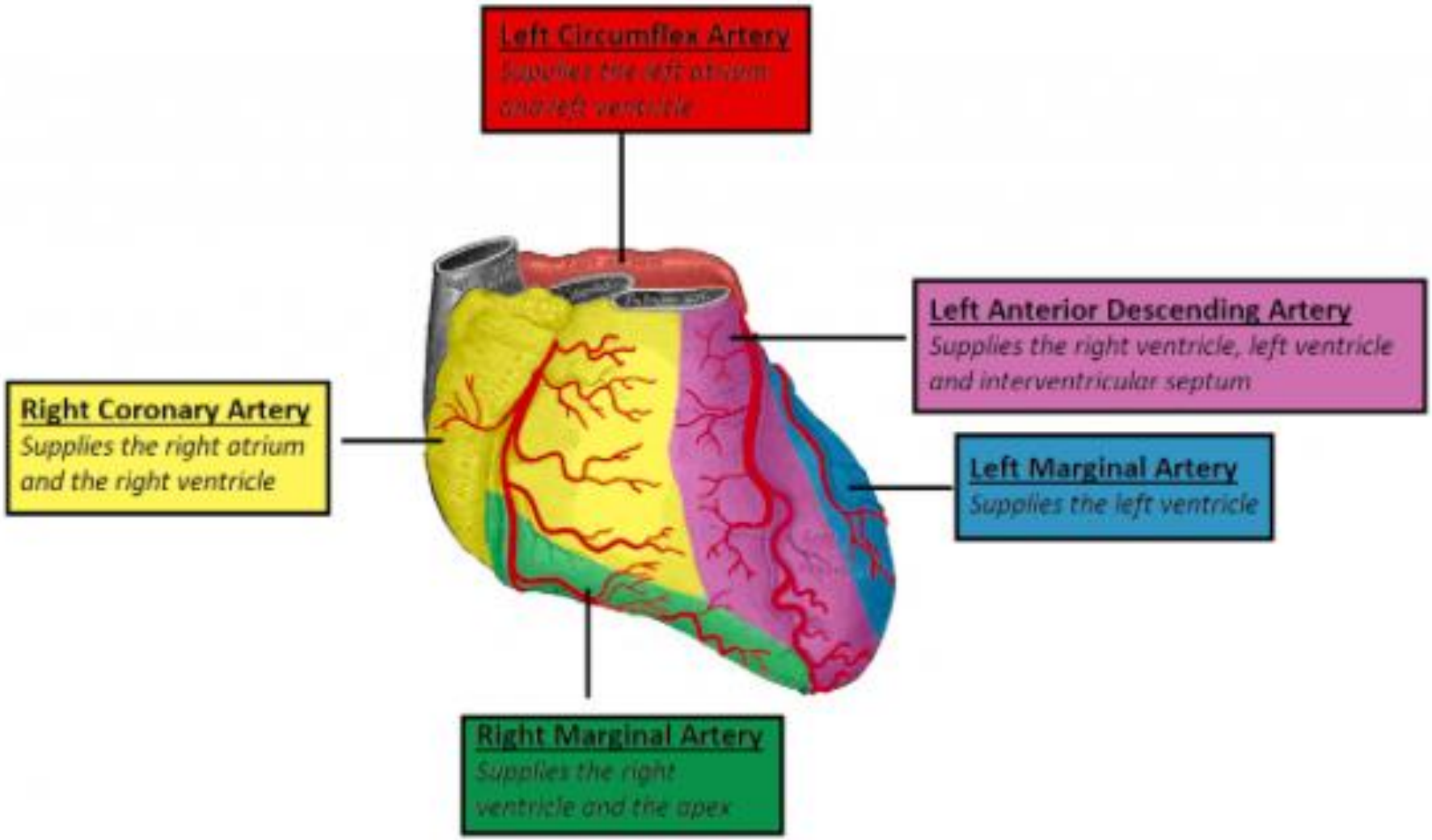


Why does Axis matter?

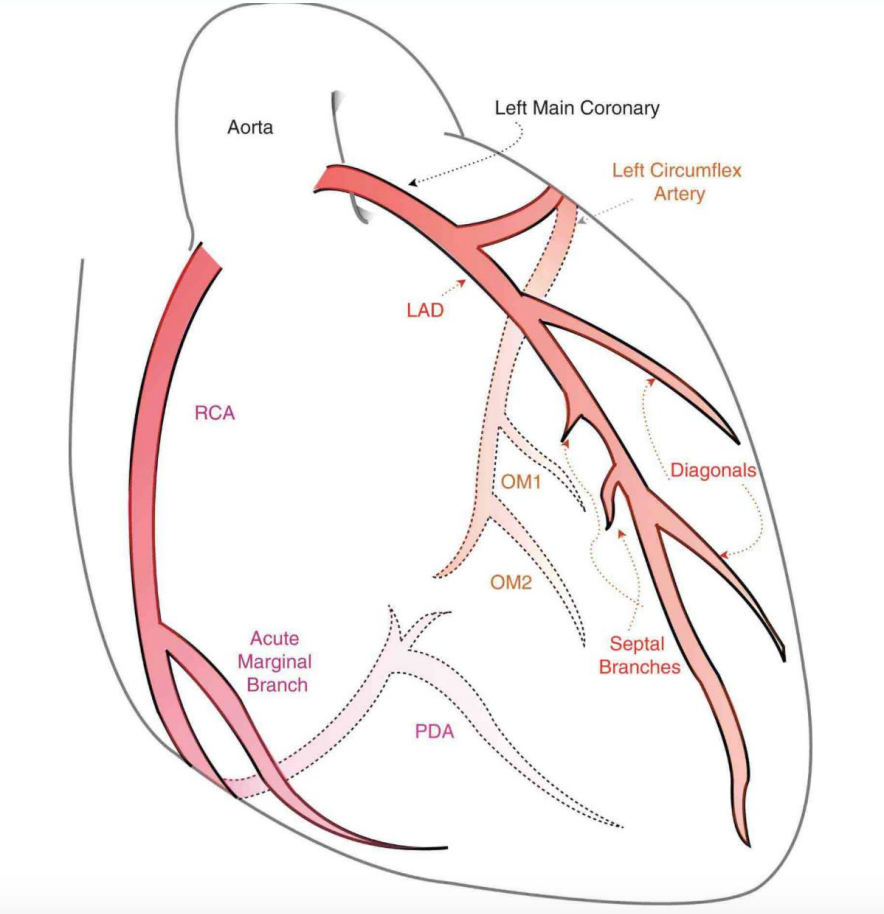
Right Axis Deviation	Left Axis Deviation
R) Ventricular hypertrophy	L) Ventricular hypertrophy
Acute lung disease (PE)	LBBB
Chronic lung disease (COPD)	Paced rhythm
WPW	WPW
Lateral MI	Inferior MI
L) Posterior Fascicular block	L) Anterior Fascicular block
Na channel blocker toxicity	Ventricular ectopy
Ventricular ectopy	

Squigglies

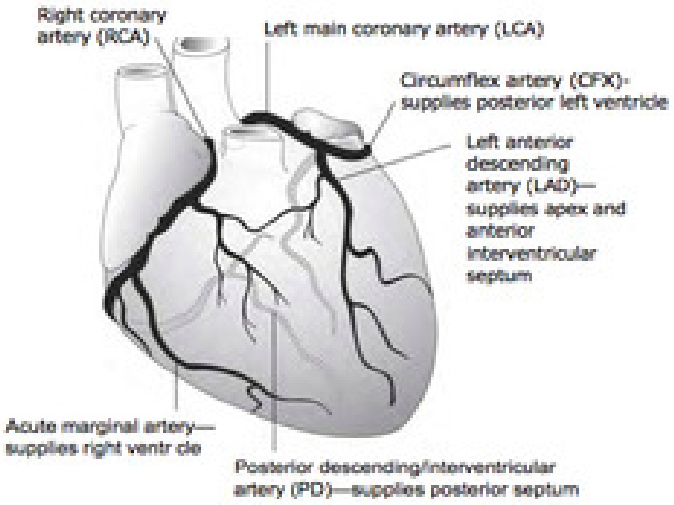

RR interval
R
R
PR
segment
ST
segment
P
T
U
P
PR
interval
Q
Q
S
S
ST interval
QRS
interval
QT interval


Left Circumflex Artery
Supplies the left atrium and left ventricle
Left Anterior Descending Artery
Supplies the right ventricle, left ventricle and interventricular septum
Right Coronary Artery
Supplies the right atrium and the right ventricle
Left Marginal Artery
Supplies the left ventricle
Right Marginal Artery
Supplies the right ventricle and the apex

Coronary Anatomy



Coronary Heart Vessels and Supply



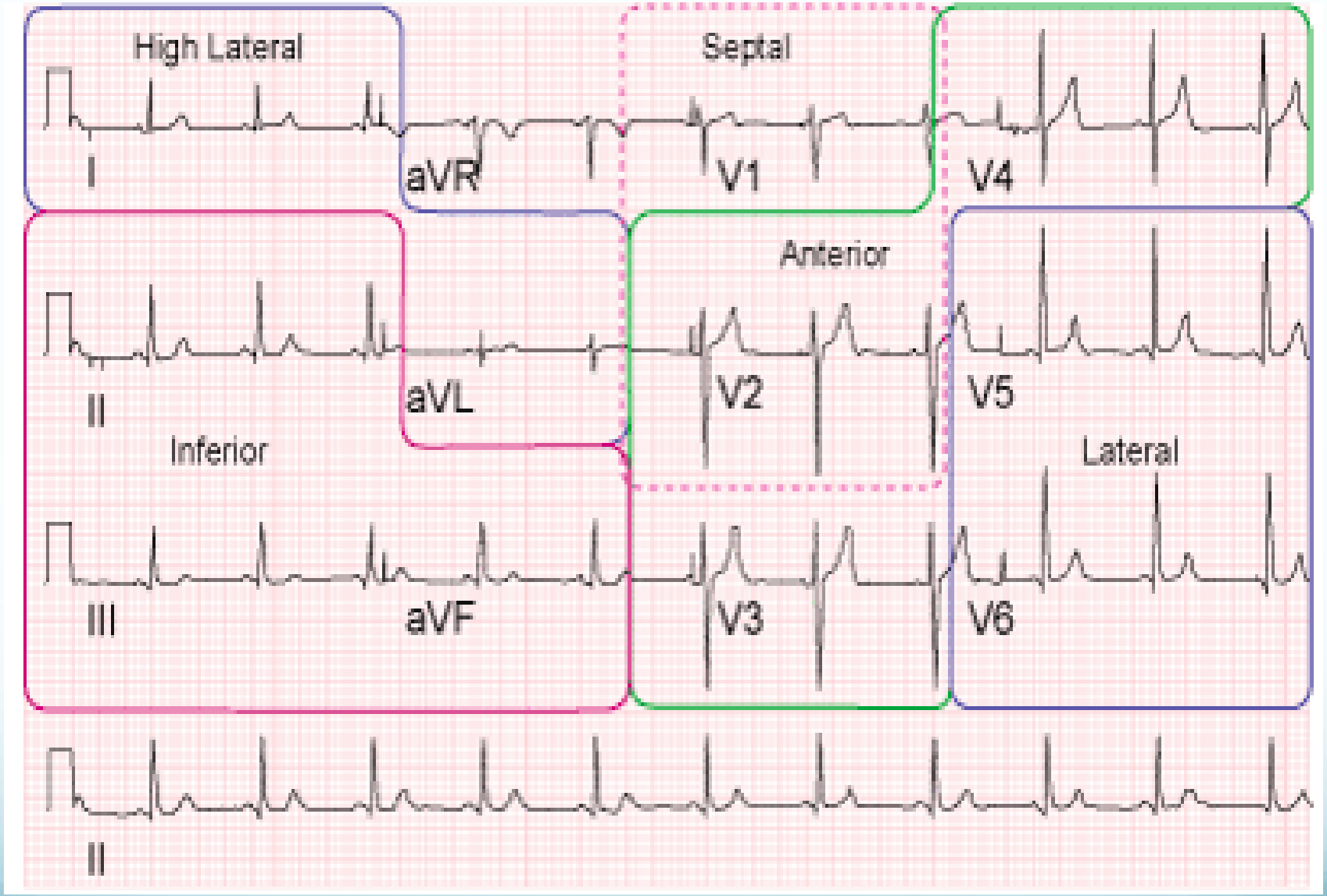
(Adapted, with permission, from Ganong WF. *Review of Medical Physiology*, 19th ed. Stamford, CT: Appleton & Lange, 1999: 592.)

Coronary Artery	Cardiac Muscle	Conduction System
RCA	RV-lateral/posterior wall LV-inferior wall	SA node (45%)* AV node (90%)* Bundle of His Right Bundle
LAD	RV-anterior wall LV-septum/apex/ anterior wall	Left Bundle
LCx	LV-lateral/posterior wall	Left Bundle SA node (55%)* AV node (10%)*

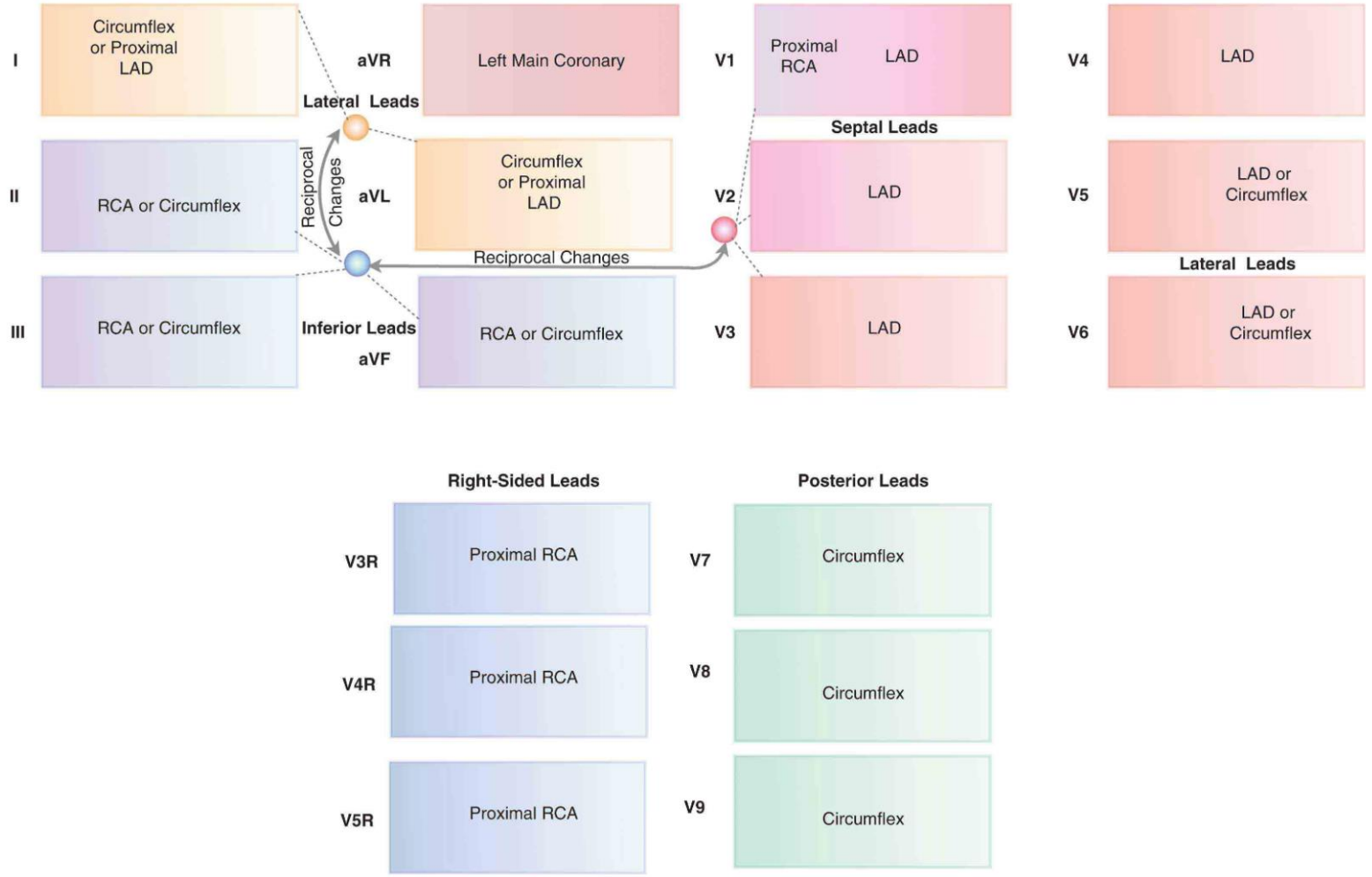
* Represents the percentage of the population in which this feature occurs.

CODE STEMI

- A Code STEMI can be authorised by an ED consultant between 0800 – 2200 for patients with chest pain consistent with ischaemia and who meet ECG criteria:
- ≥ 2.5 mm ST elevation in leads V2-3 in men under 40 years, or ≥ 2.0 mm ST elevation in leads V2-3 in men over 40 years
- ≥ 1.5 mm ST elevation in V2-3 in women
- ≥ 1 mm ST elevation in other leads
- Please discuss the following cases with the cardiology registrar prior:
- New LBBB
- Other STEMI equivalent patterns on ECG
- Uncertain clinical picture

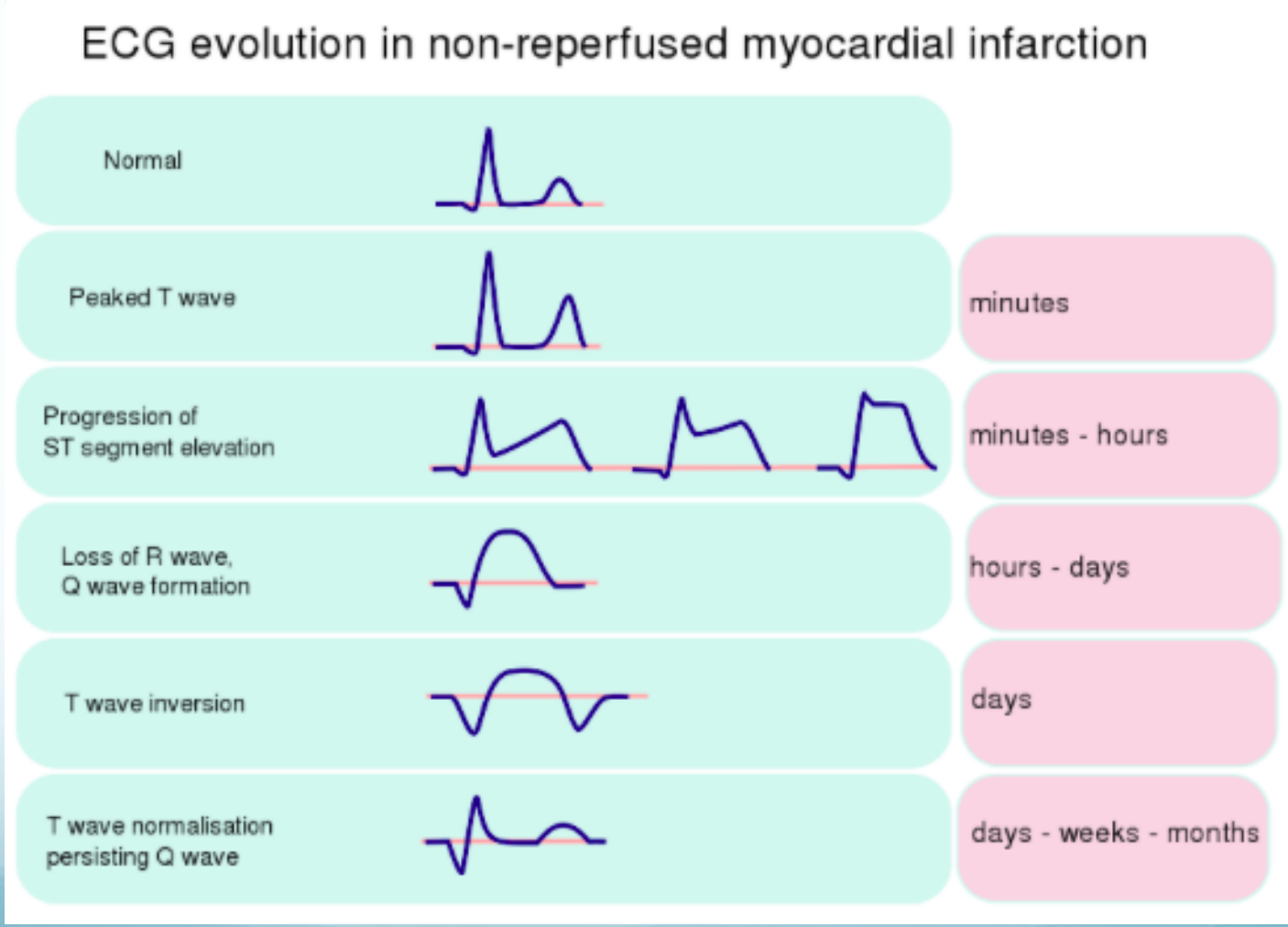

High Lateral
Septal
I
aVR
V1
V4
Anterior
II
aVL
V2
V5
Inferior
Lateral
III
aVF
V3
V6
II

Localizing the Infarct



A map of ECG leads and their associated coronary artery anatomy. Colored circles represent groupings of ECG leads.

STEMI Evolution

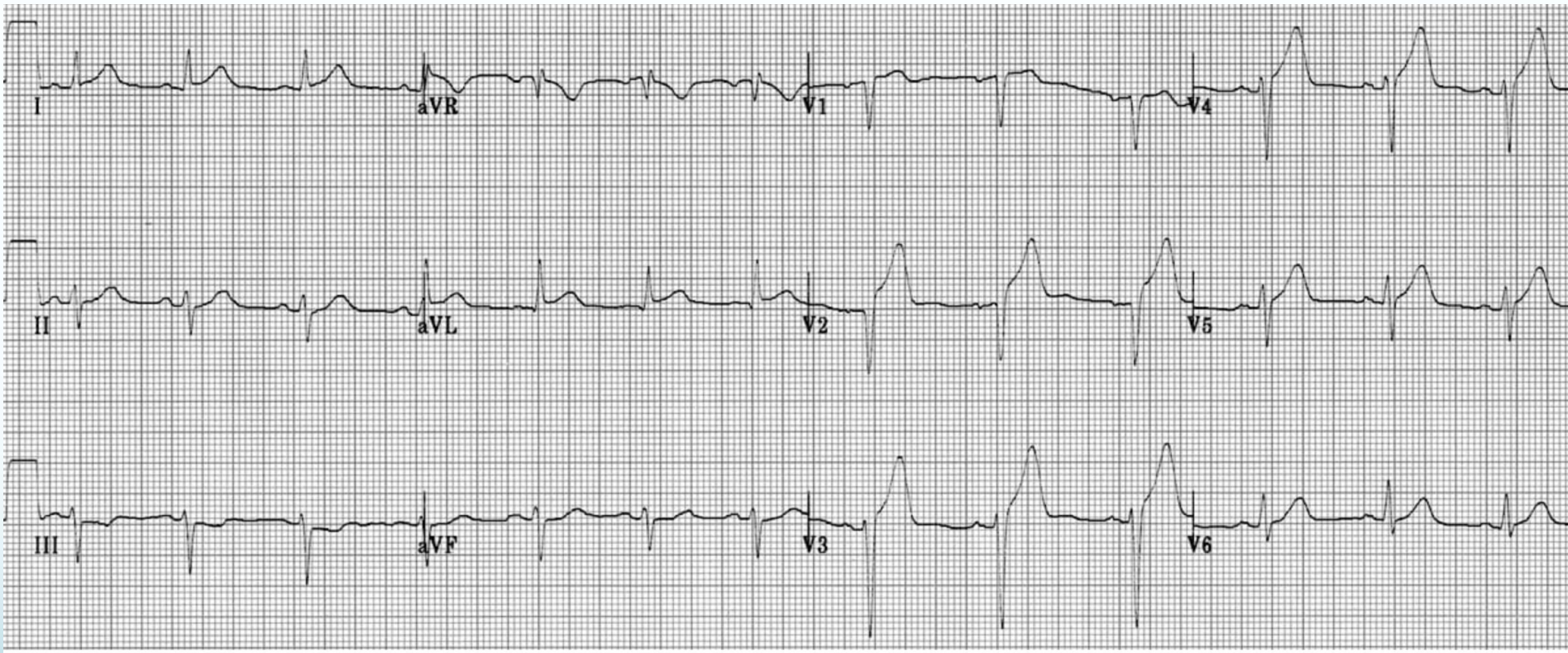


Causes of ST Elevation

- Acute Myocardial Infarction
- Coronary Vasospasm
- Pericarditis/Myocarditis
- Benign Early Repolarization
- LBBB
- LVH
- Ventricular Aneurysm
- Brugada Syndrome
- Ventricular Paced Rhythm
- Raised Intracranial Pressure
- Takotsubo cardiomyopathy
- Pulmonary embolism
- Hypothermia
- Hyperkalaemia/Hypercalcaemia
- Cardioversion


Acute Coronary Syndrome
STEMIs
Near STEMIs
AMI in BBB
Anterior MI
Inferior
Posterior MI
Right Ventricular MI
Lateral MI
deWinter T
Wellens
STE in aVR
MI in LBBB
MI in RBBB

STEMIs


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

Anterior MI

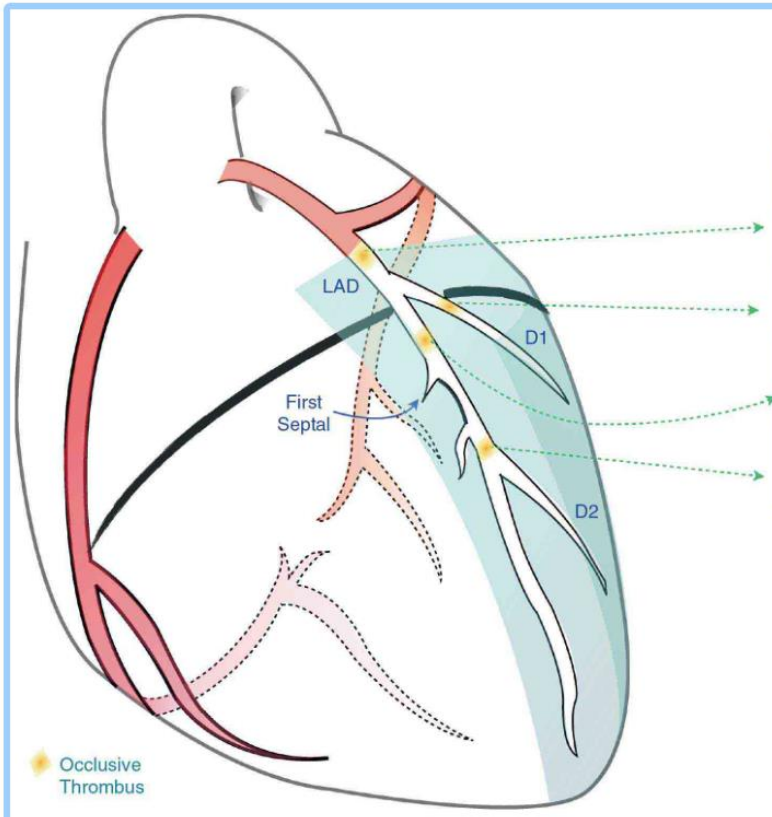
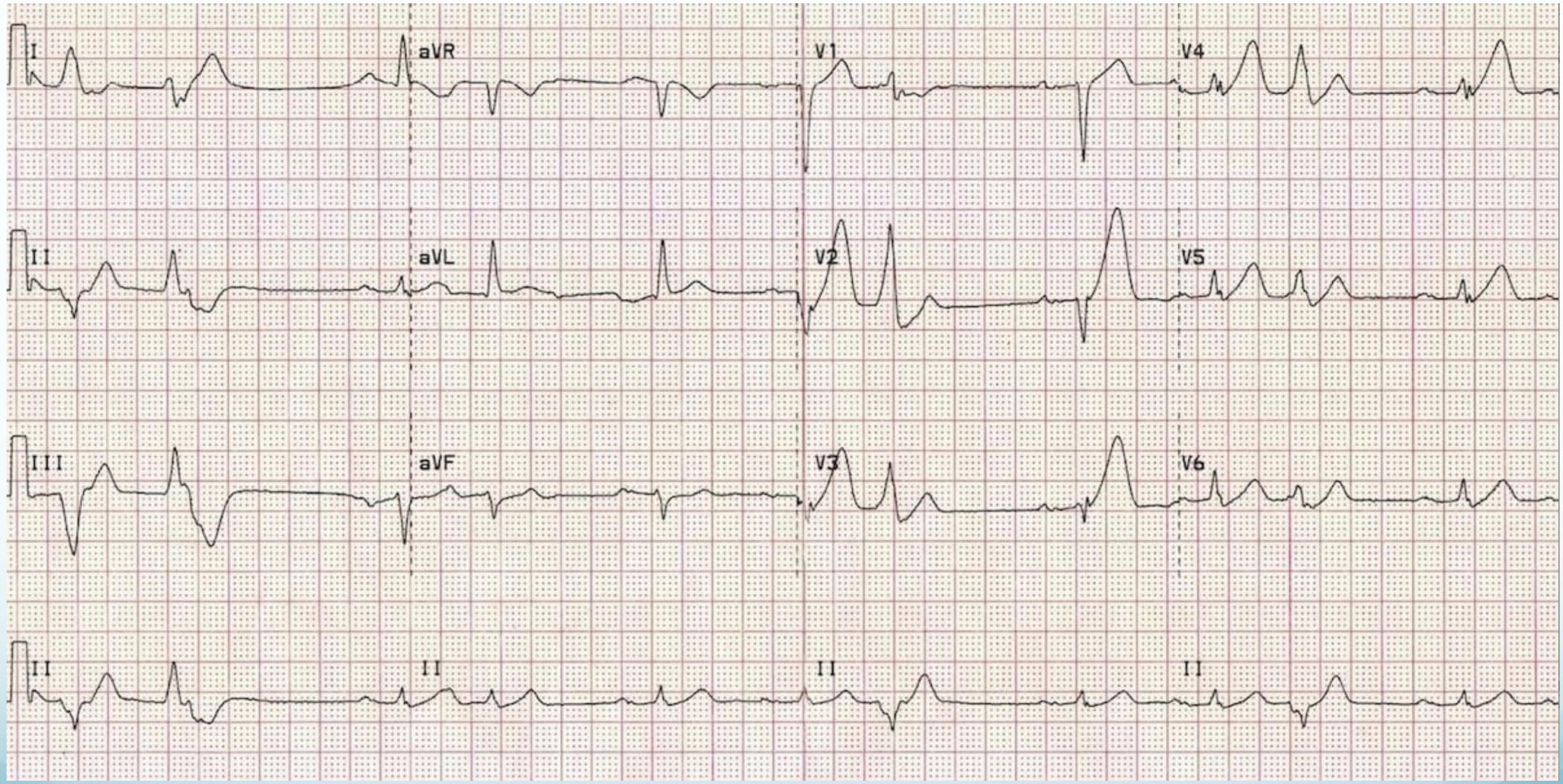
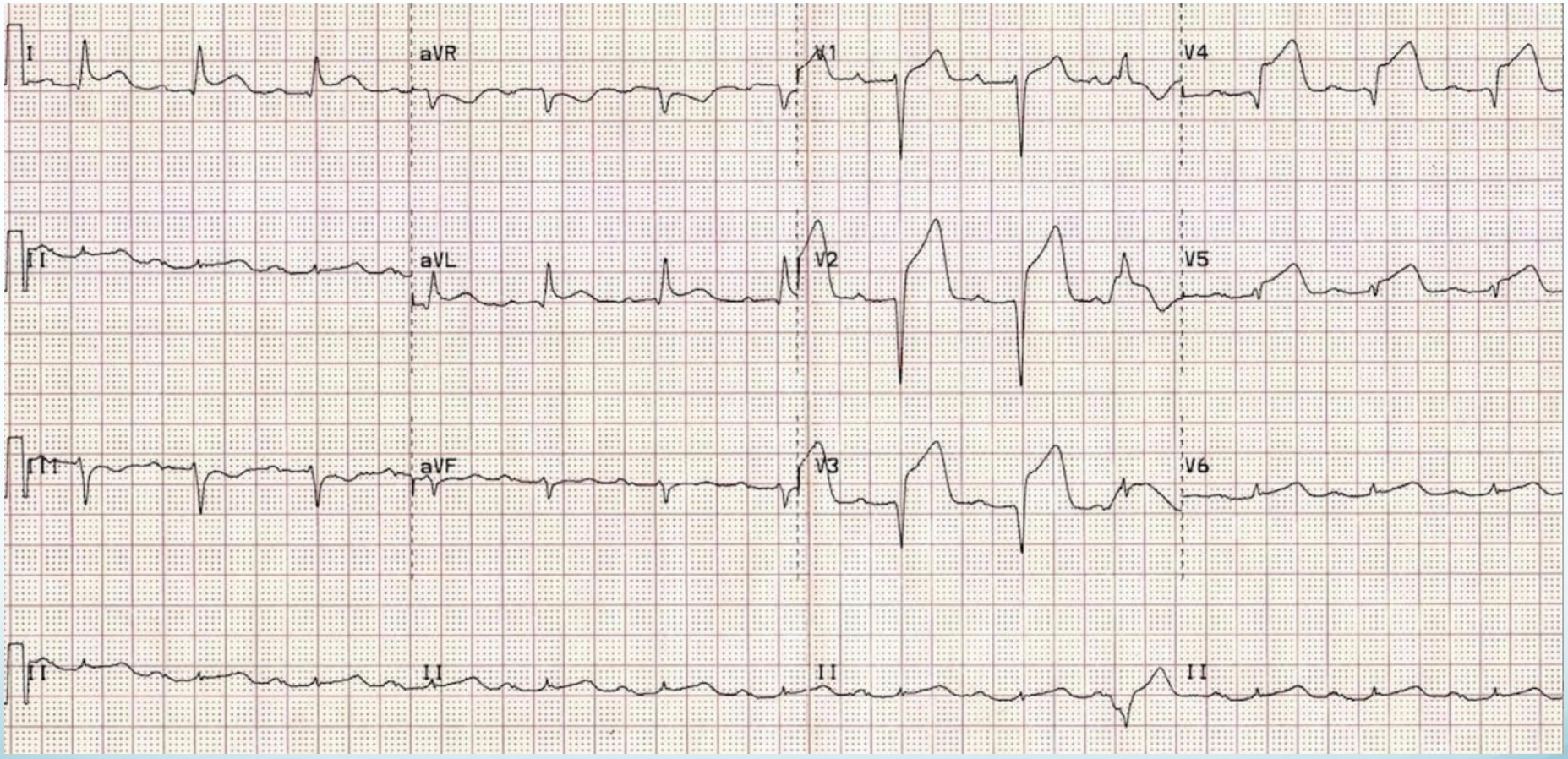


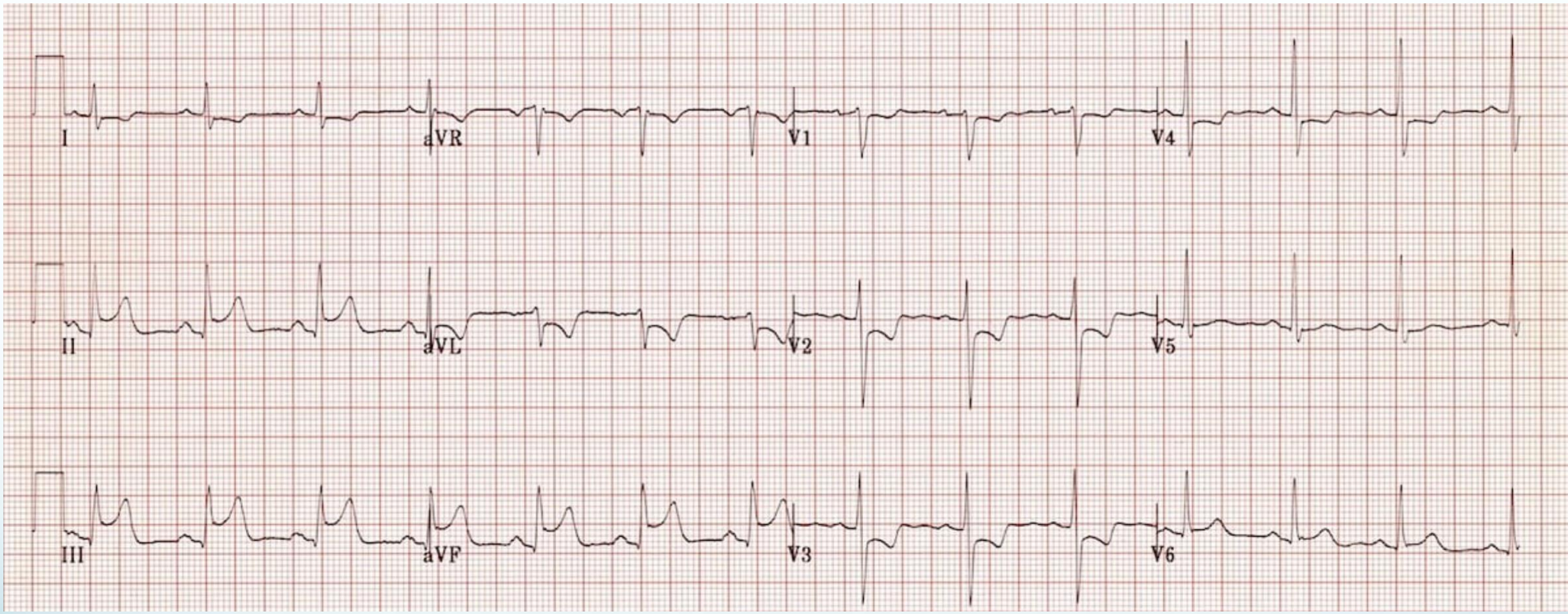
TABLE 12.1 Different Types of Anterior MI

Type of Anterior MI	Location of Occlusion		Leads with STE
Extensive anterior	Proximal LAD	Proximal to first diagonal branch	V1-V6, 1, and aVL
Lateral	Diagonal branch	First diagonal branch	I and aVL
Anteroseptal	Proximal LAD	Distal to first diagonal, proximal to first septal branch	V1-V4
Apical	Distal LAD	Distal to first diagonal and first septal branches	V5-V6

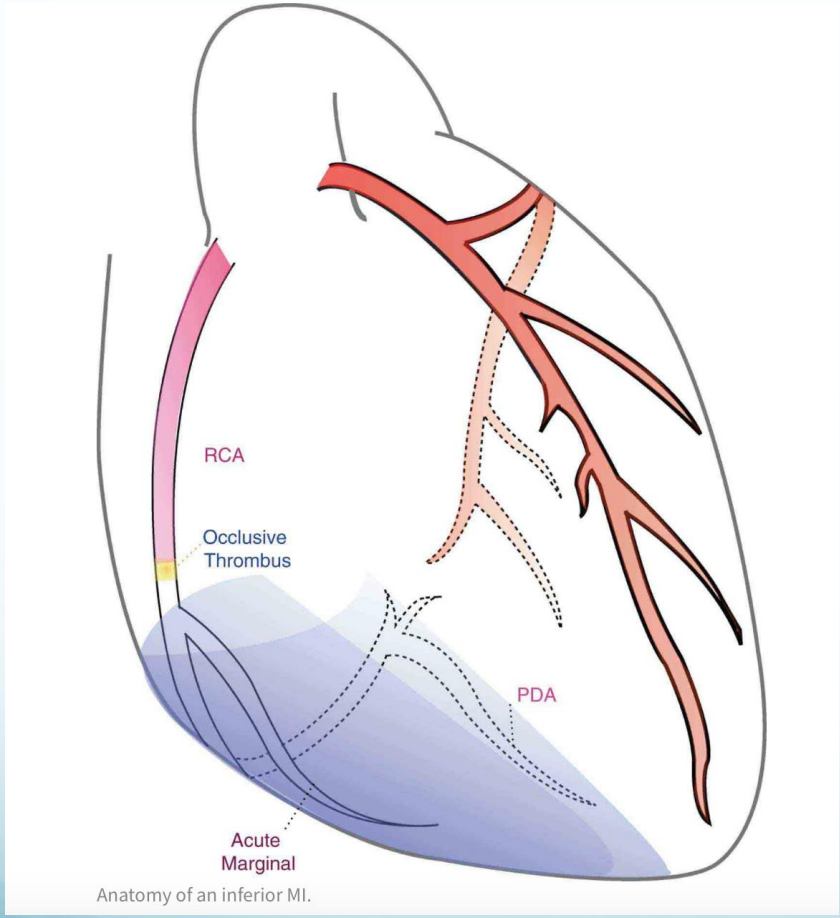
Figure 12.9 Representative locations of different LAD lesions.


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


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


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

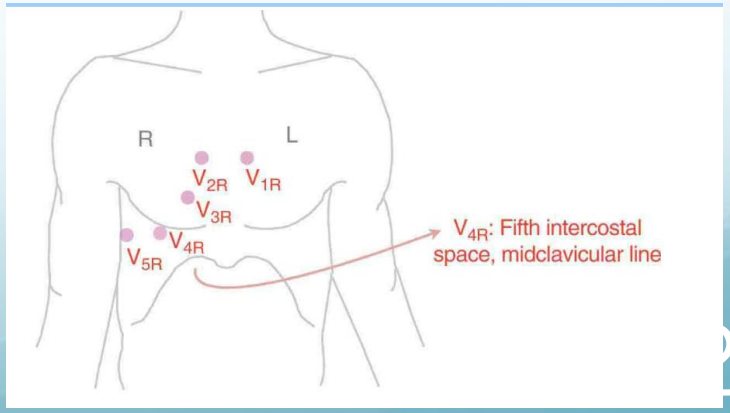
Inferior MI

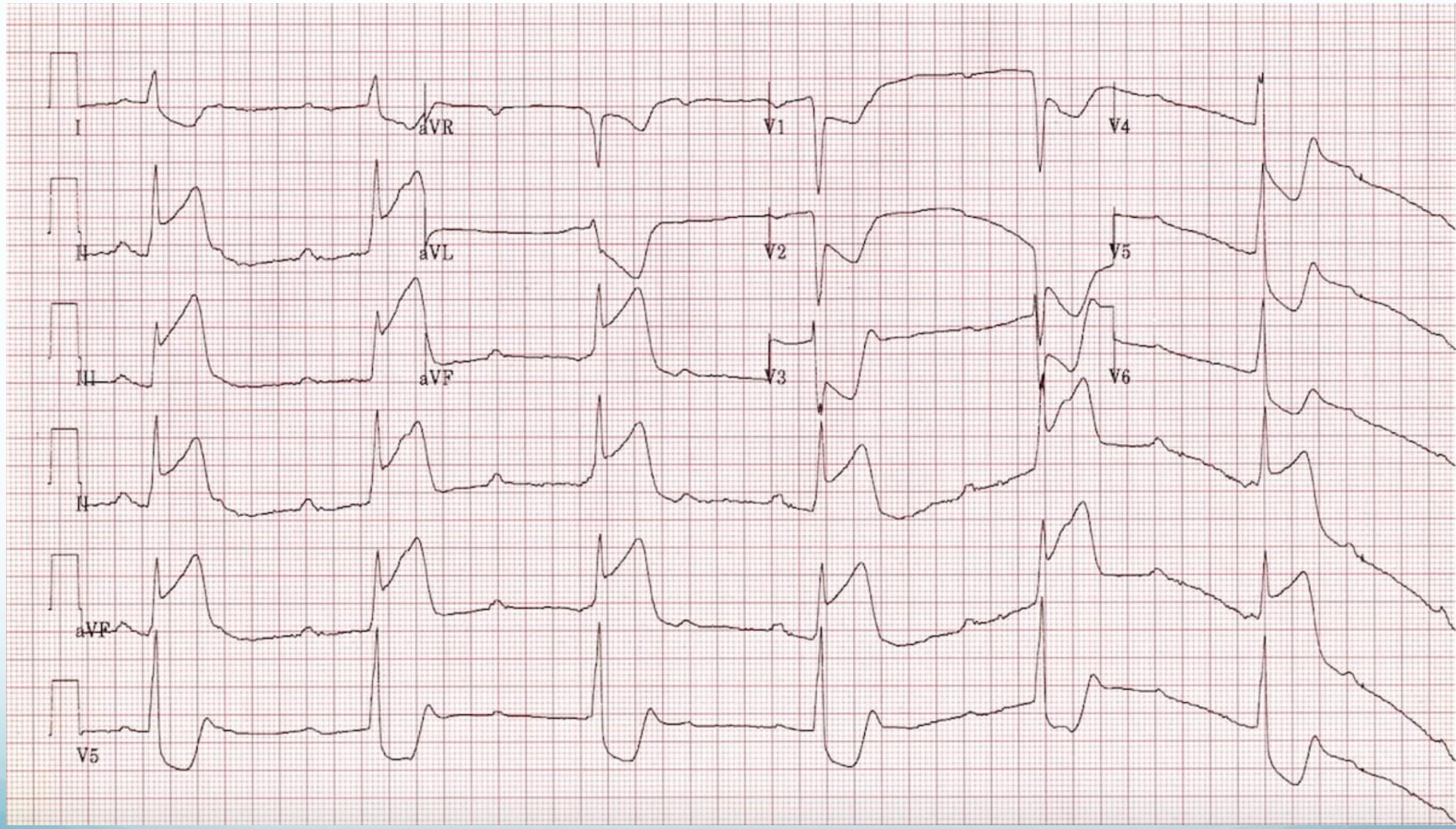


Anatomy of an inferior MI.

Subtype

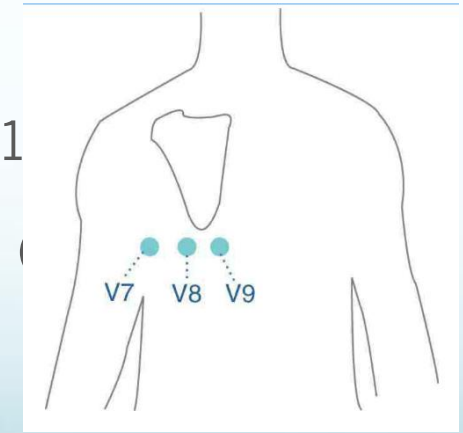
- Isolated IMI – II, III, aVF (do R) leads to look for R) ventricular infarct
- Inferoposterior MI – STD in V1-V3
- Inferolateral MI – STE in lateral V5-V6
- R) Ventricular MI – STE in R) sided precordial leads (V3R-V6R)

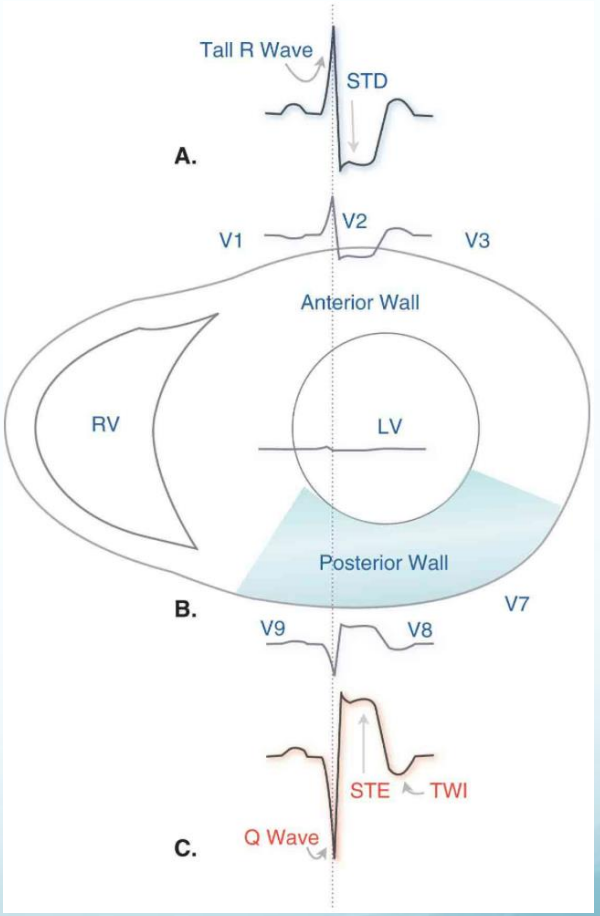


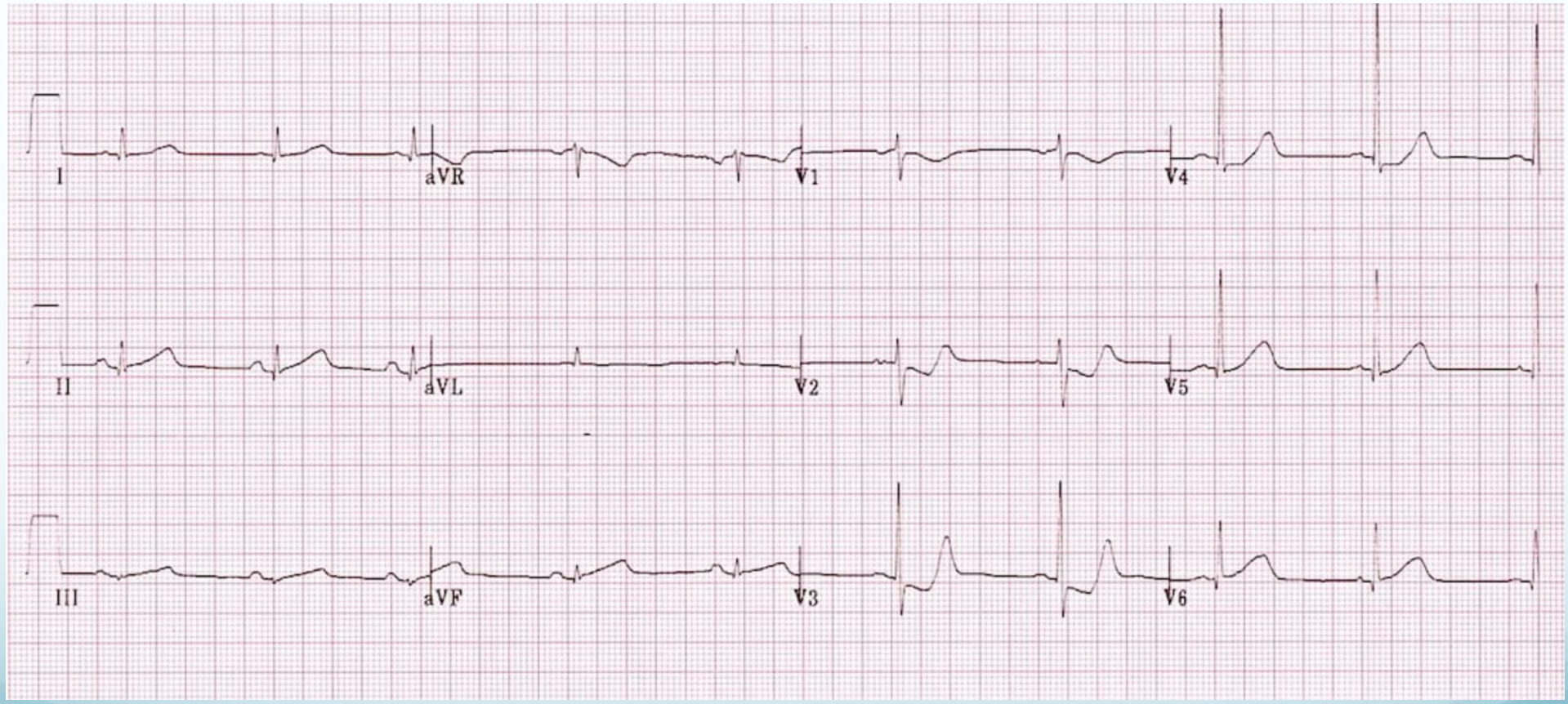

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
aVF
V5

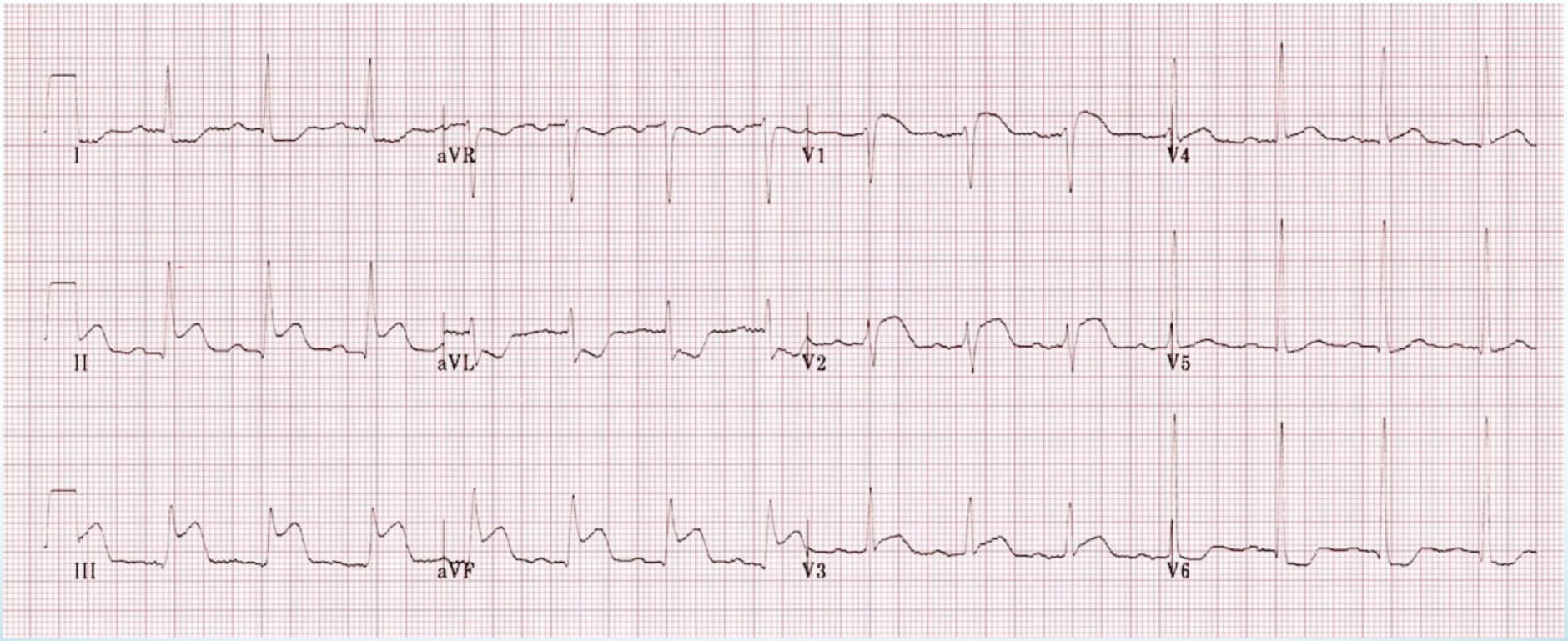
Posterior MI

- Occlusion of LCx or first OM – supplies blood to lateral and posterior walls of ventricle
- Associated with lateral and inferior infarct
- STD V1-V3
- Prominent R wave in V1
- STE in Posterior Leads (9)

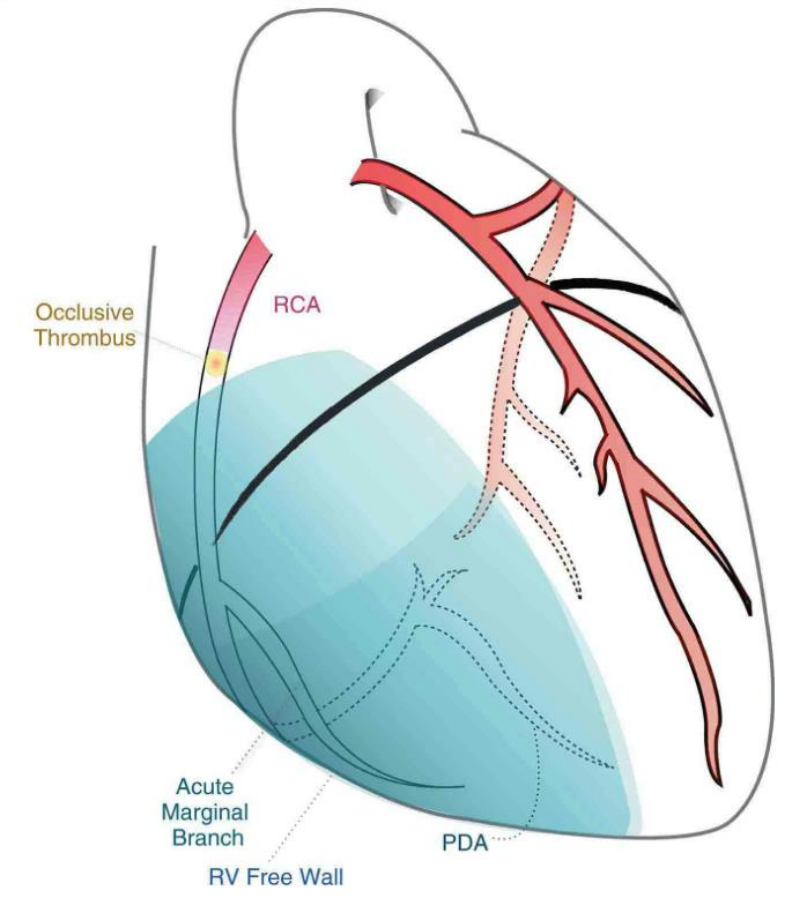





I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6


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

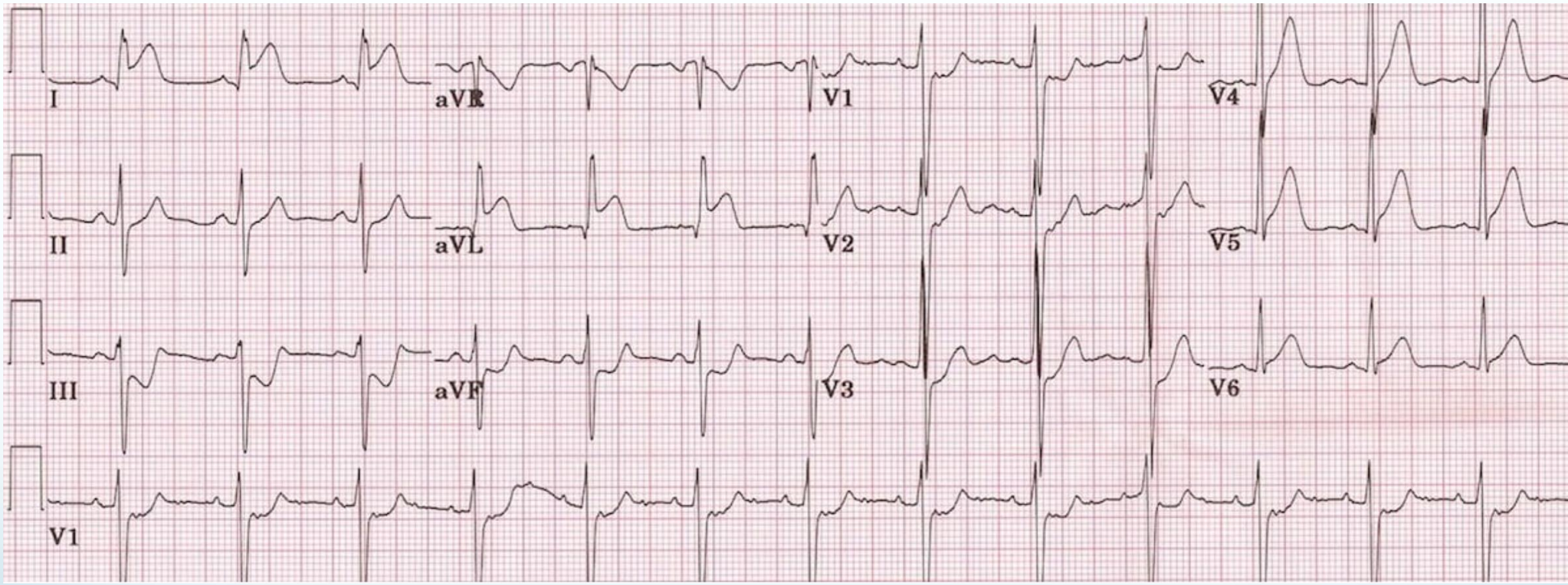
Right Ventricular MI



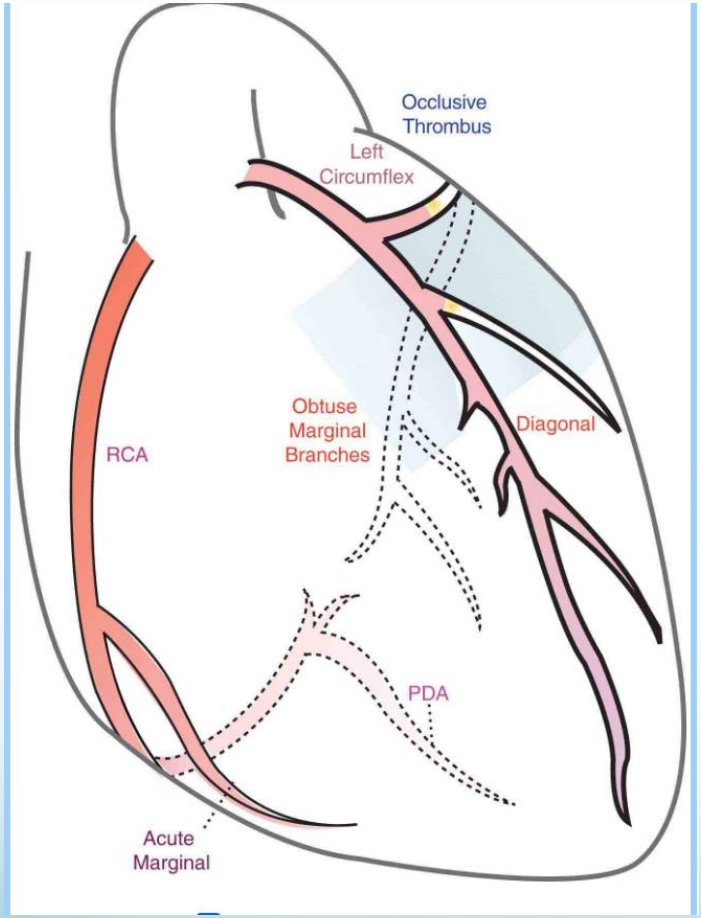
- STE in V1
- STE in III>STE in II
- STE in V4R – V6R

Complication

- Hypotension (Systolic and Diastolic Dysfunction)
- Hypoxaemia (R to L Shunt or P.E)
- Bradycardia (Vagal or AV block)
- AF
- APO

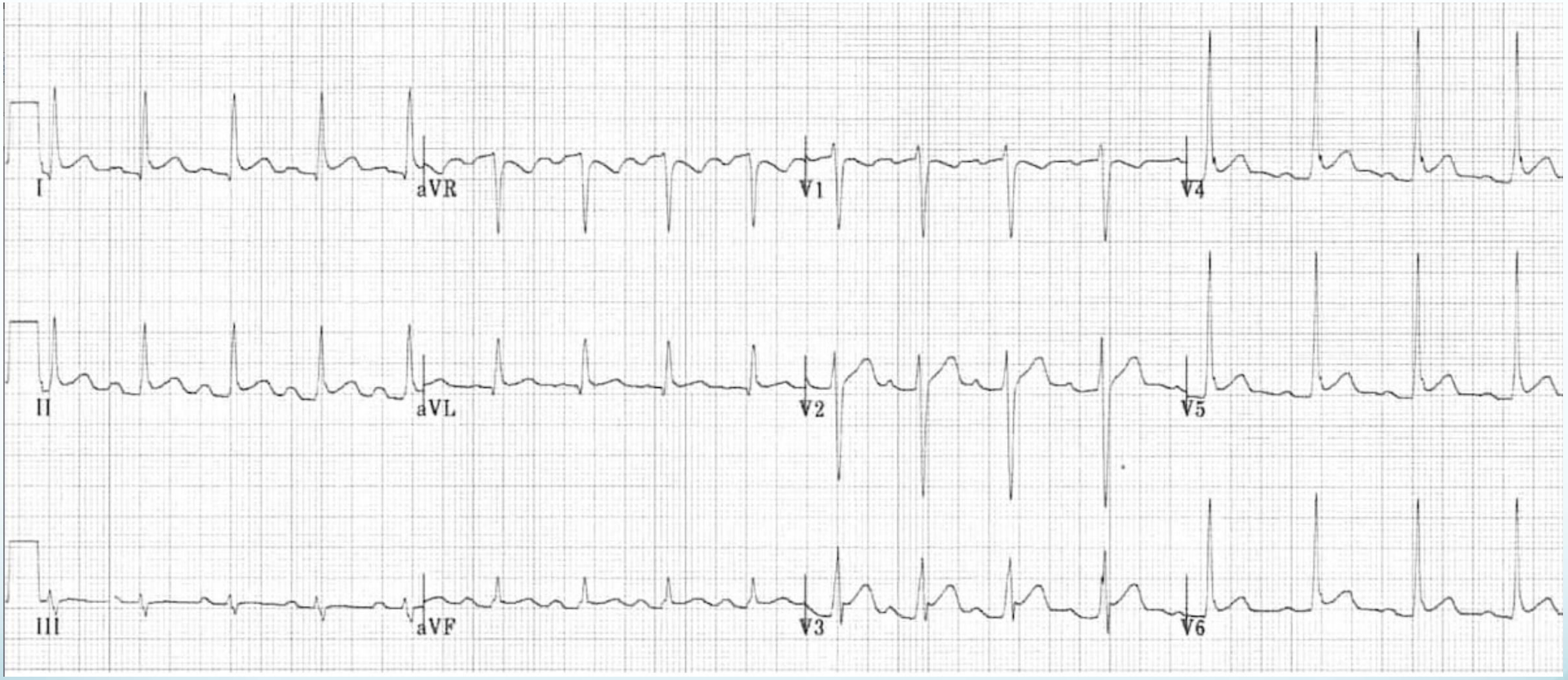

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1

Lateral MI



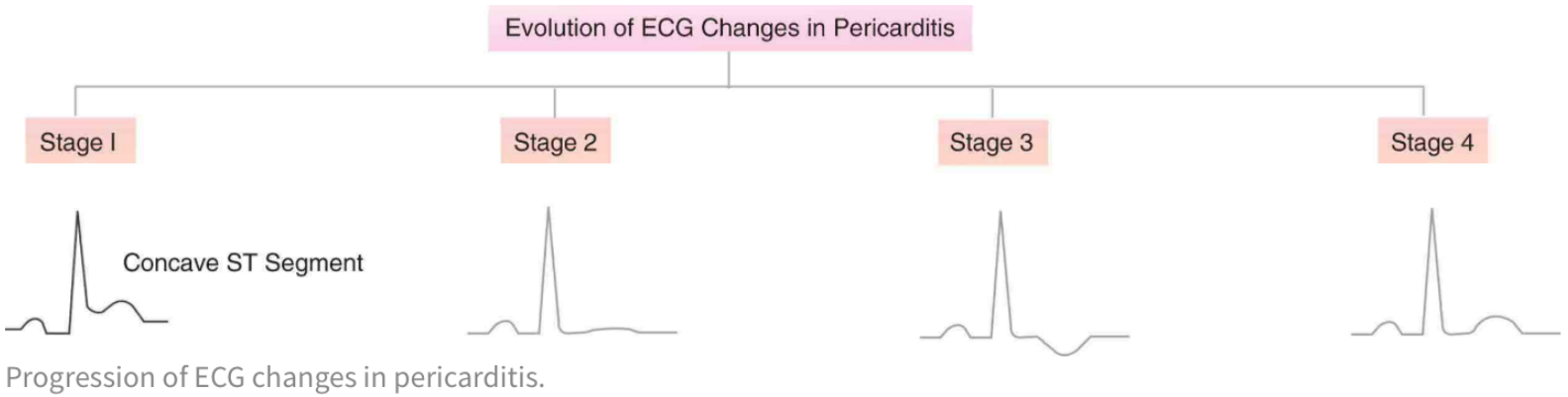
- L) Circumflex or Diagonal branch involvement
- STE in aVL only or in lead I or in lead V5, V6, may be less than 1mm
- STD in leads II, III and aVF
- STD in V1-V3 when circumflex occlusion results in posterior wall (posterolateral MI)

STEMI mimmicks


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

Pericarditis

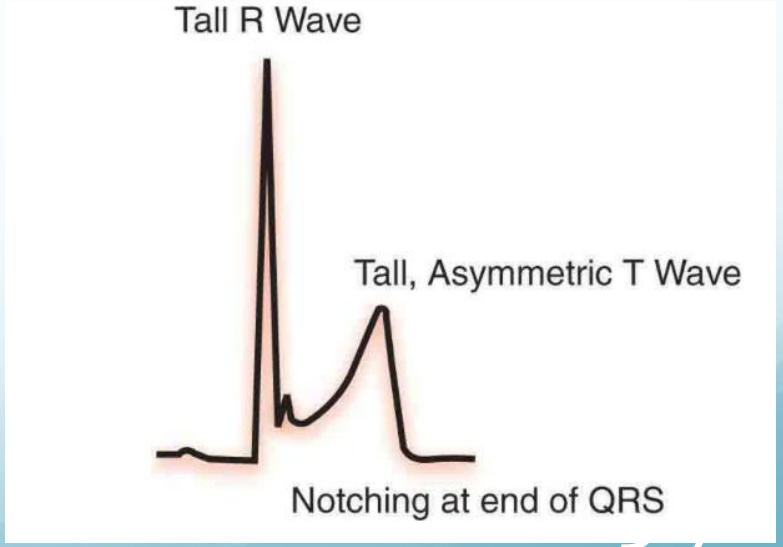
Diffuse STE except aVR and V1 typically Concave ST segment



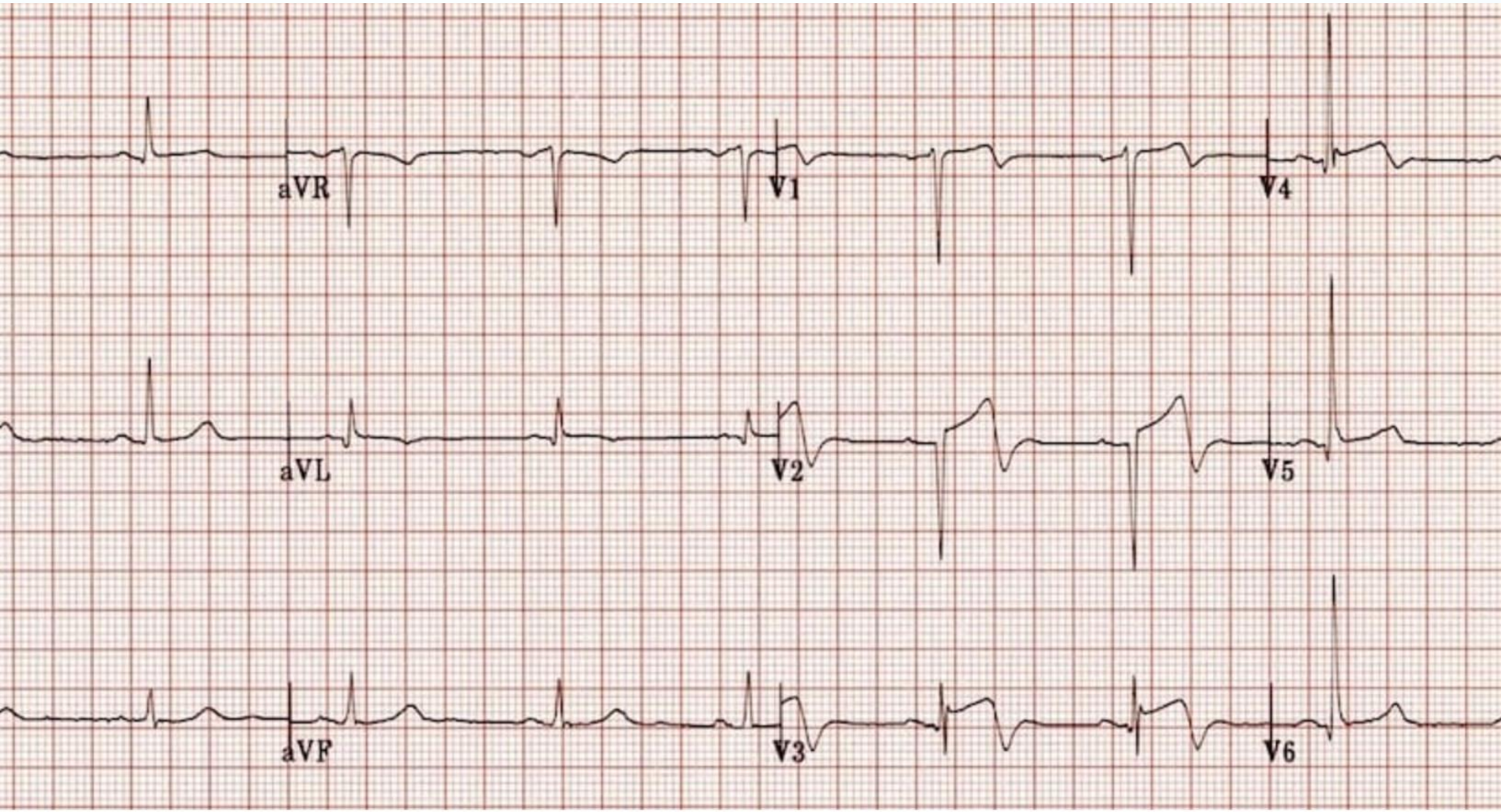
Progression of ECG changes in pericarditis.

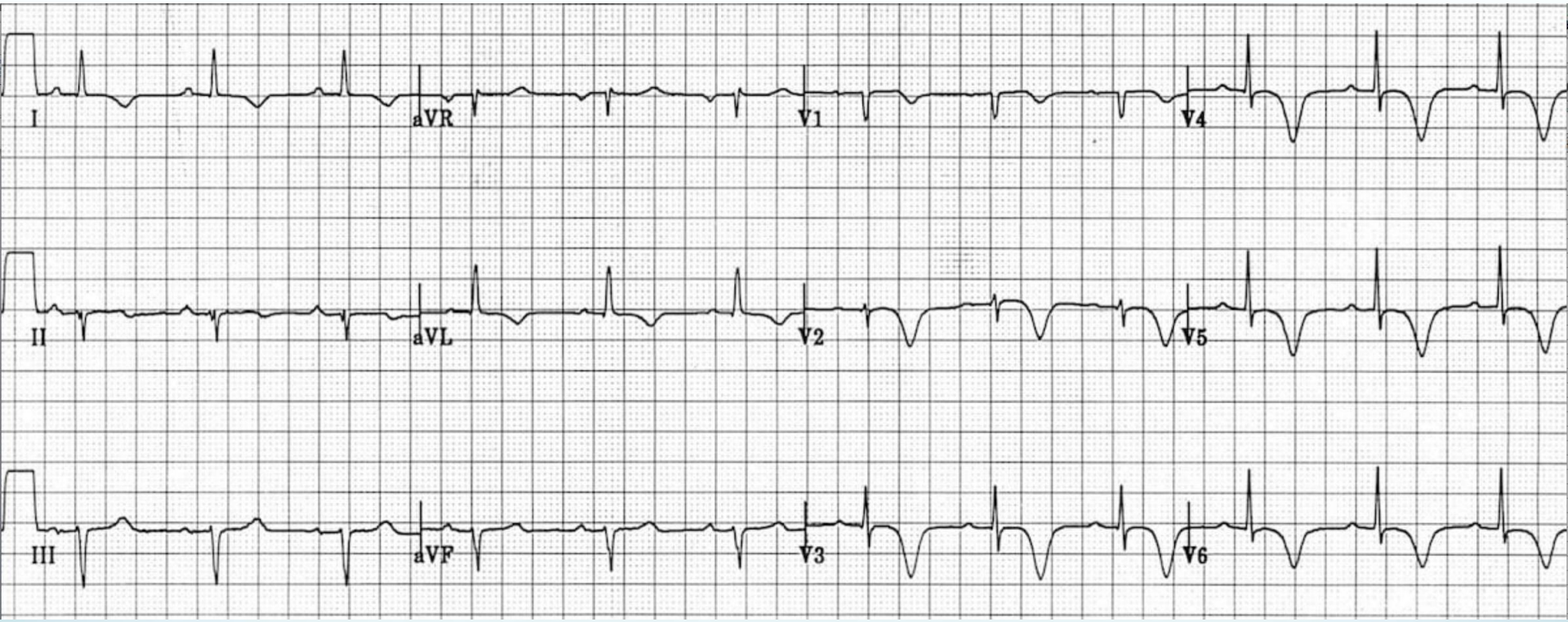
Benign Early Repolarization

- ECG
  - J point STE
  - Notch or slur at end of QRS wave
  - Concave upward morphology
  - Tall R wave
  - Tall asymmetric T waves
  - Reciprocal depression Absent
- Ddx
  - Pericarditis
  - Subtle MI



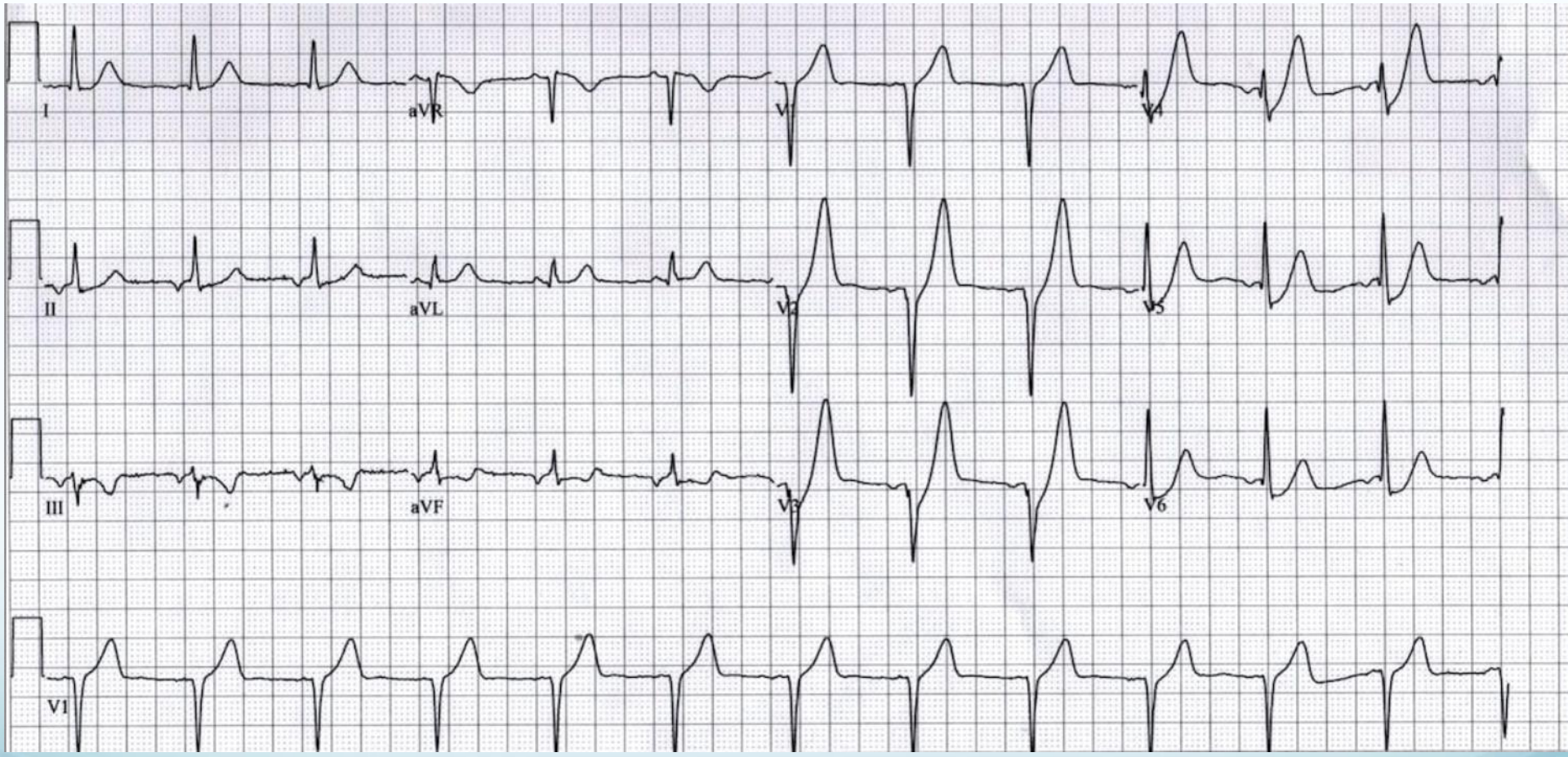
Near STEMIs


aVR
V1
V4
aVL
V2
V5
aVF
V3
V6


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

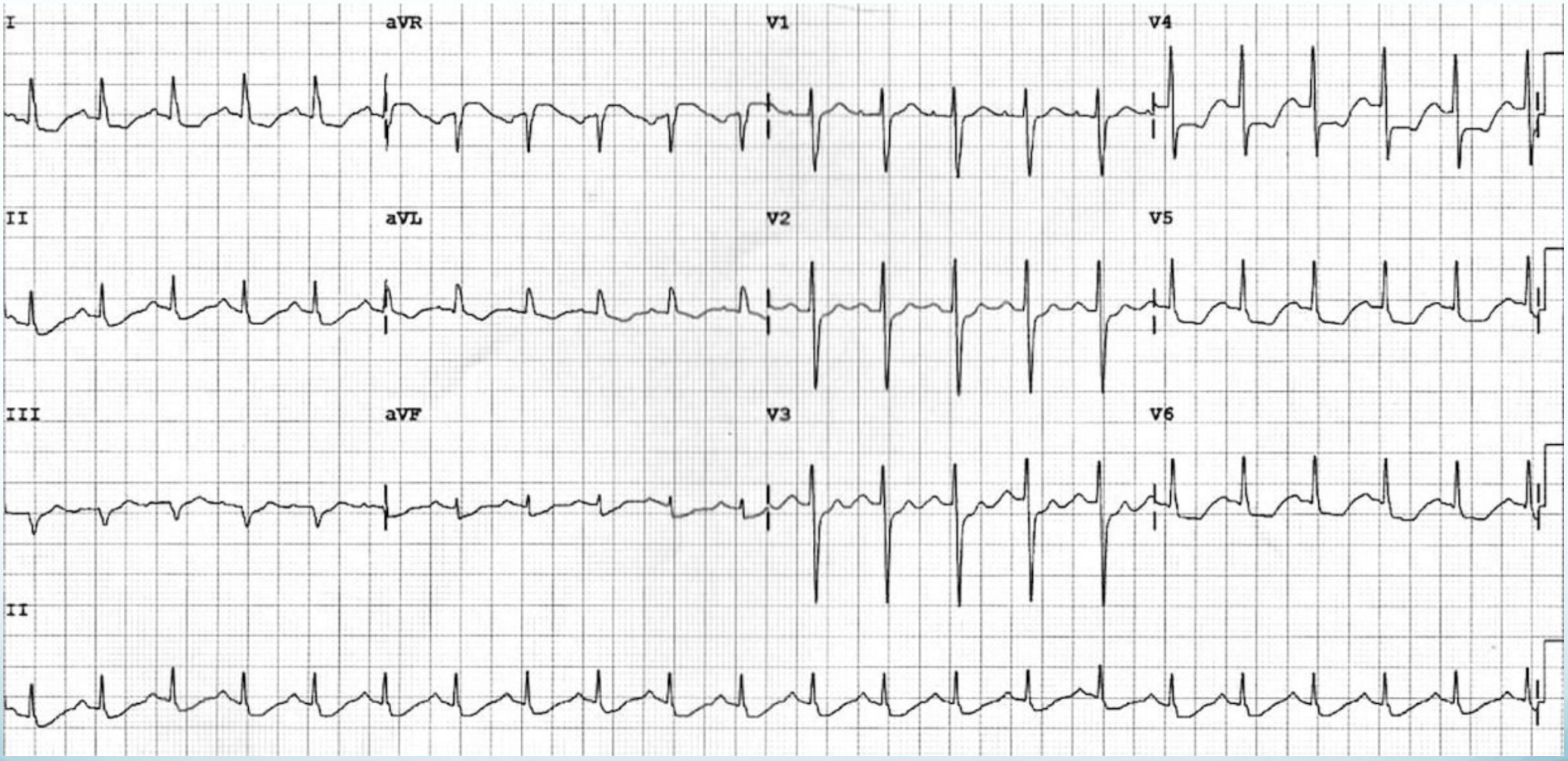
Wellens' Syndrome

- Highly Specific for **critical stenosis of LAD**
- ECG pattern present in **pain free state**
- Type A
  - Biphasic precordial T wave with terminal negativity in V2, V3
  - Minor precordial STE
- Type B
  - Deep symmetrical TWI throughout anterolateral leads


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

De Winter's Syndrome

- Seen in **~2% of acute LAD occlusions**
- ST depression leading to prominent T wave
- Subtle STE in aVR>0.5mm
- Near complete stenosis of vessel
- Consider HyperK


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

STE in aVR

- **Left Main occlusion**, subtotal or complete proximal LAD or 3VD
- Diffuse ST depression in >6 leads (most prominent in I,II and V4-6)
- Prominent STE in aVR ≥ 1mm
- Non-coronary causes
  - Diffuse subendocardia ischaemia (due to O2 supply/demand mismatch)
  - Recent defibrillation or cardioversion
  - Significant tachycardia
  - Hypothermia
  - Neurocardiogenic causes
    - SAH
    - Stroke
    - Seizure

MI in LBBB

- Sgarbossa Criteria
  - STE≥1mm concordant with QRS complex
  - STE≥5mm discordant with QRS complex
  - STD≥1mm in lead V1, V2 or V3

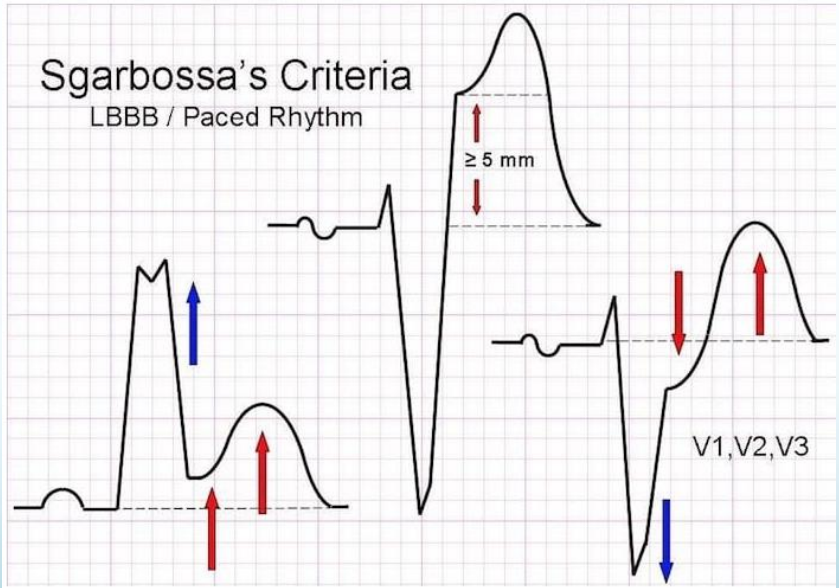
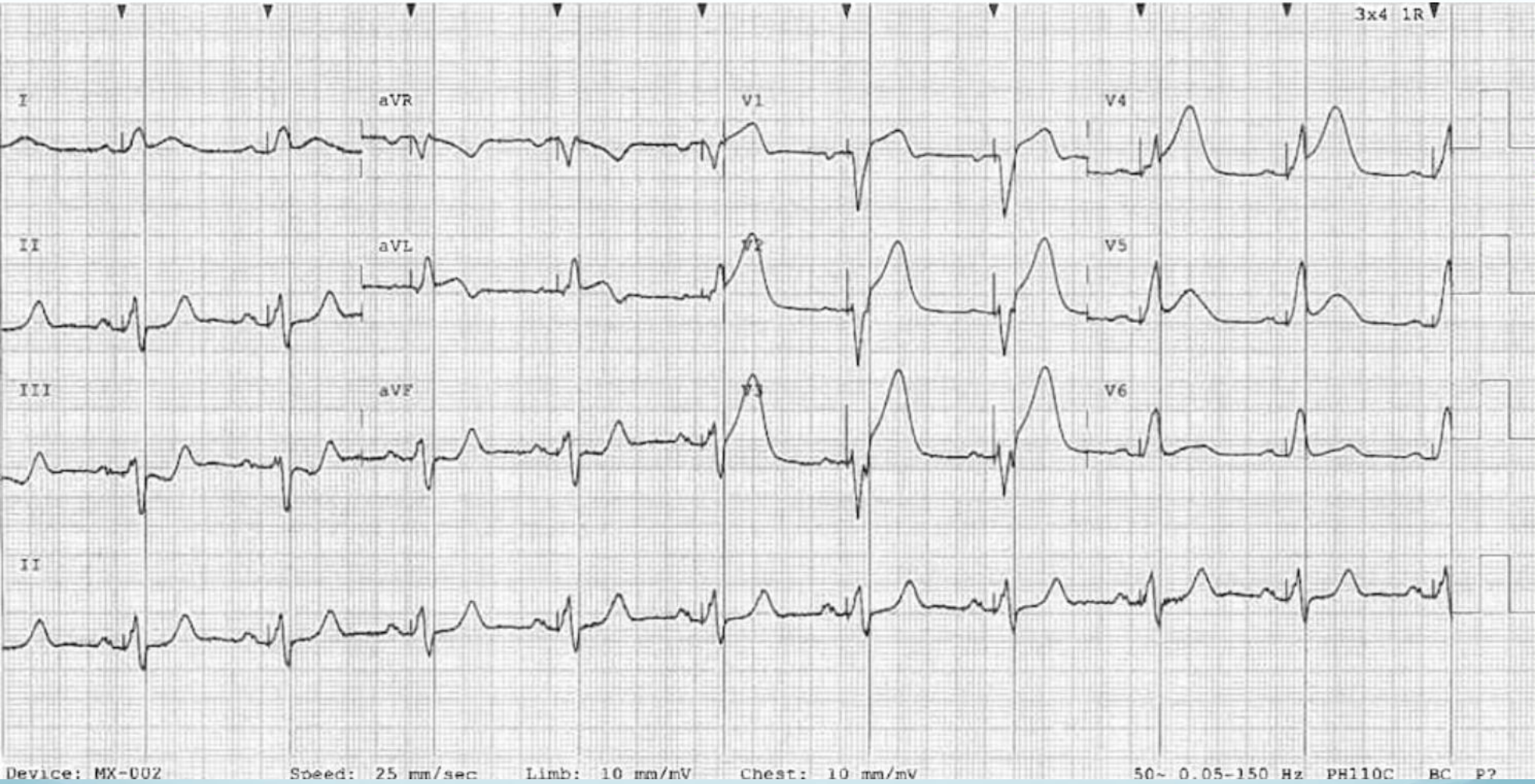
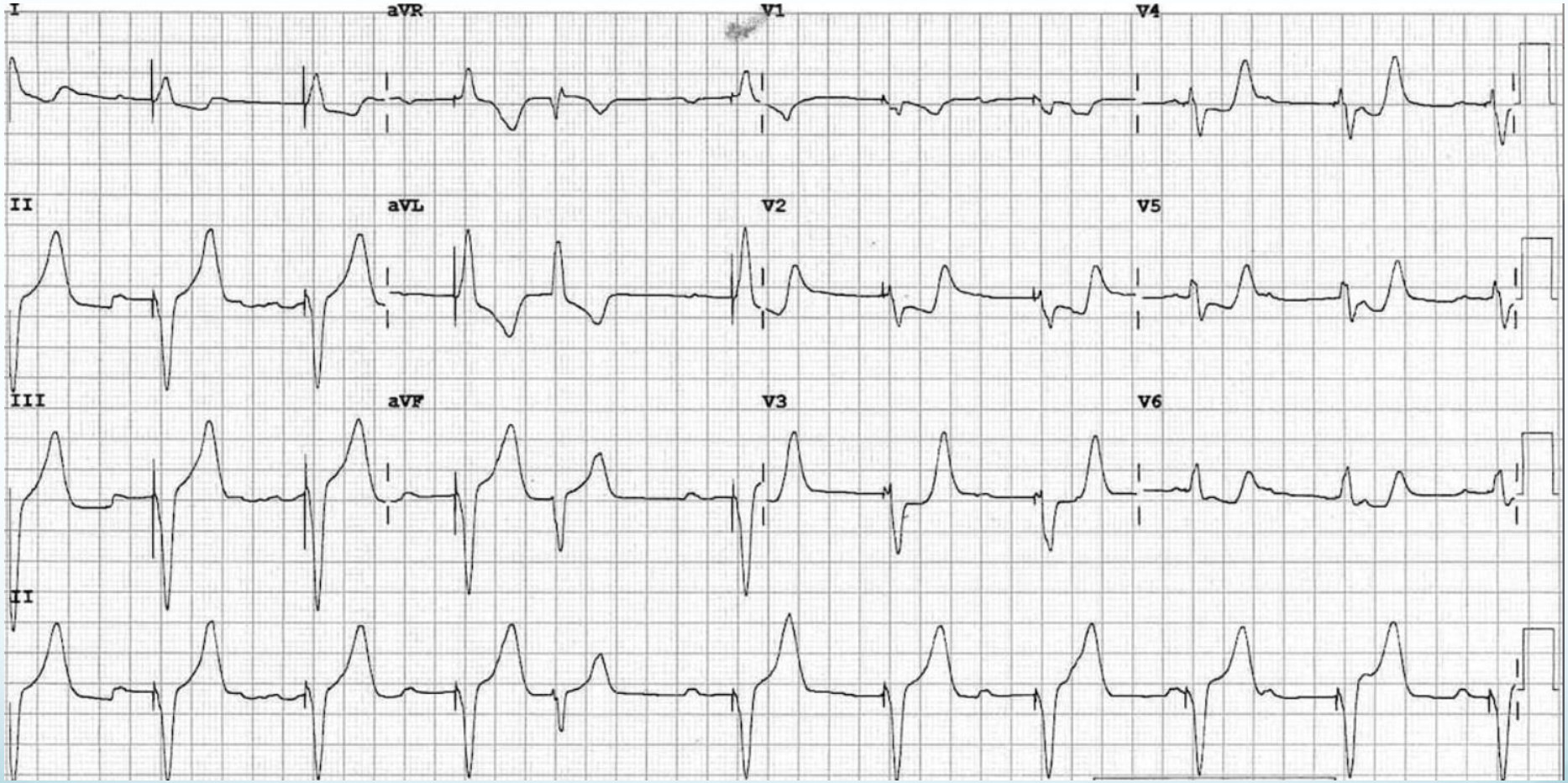


Image: ECGMedicalTraining.com

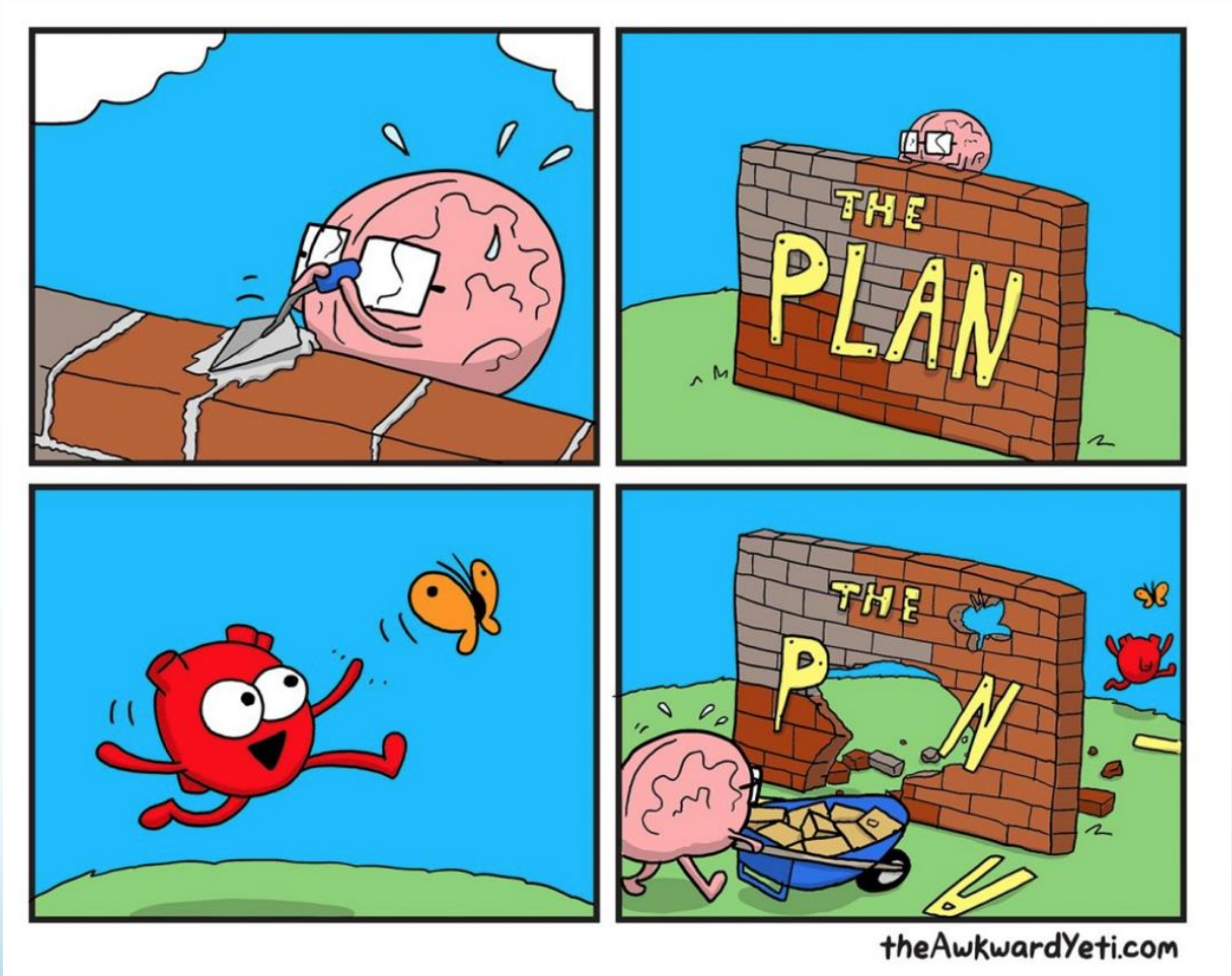

3x4 1R
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Device: MX-002
Speed: 25 mm/sec
Limb: 10 mm/mV
Chest: 10 mm/mV
50~ 0.05-150 Hz PH110C BC P2


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

Summary

- ECG interpretation: Hx, Rate, Rhythm, Axis, QRS, ischaemia (ST, T, Q, wave morphologies, prior ECG)
- Localising infarct
- Acute Coronary Syndrome
  - STEMIs (Anterior, Inferior, Lateral, Posterior, R) ventricular)
  - Near STEMIs (DeWinter, Wellen's, aVR STE)
  - MI in BBB (Sgarbossa)
- If in doubt, reassess patient and **repeat ECG**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References

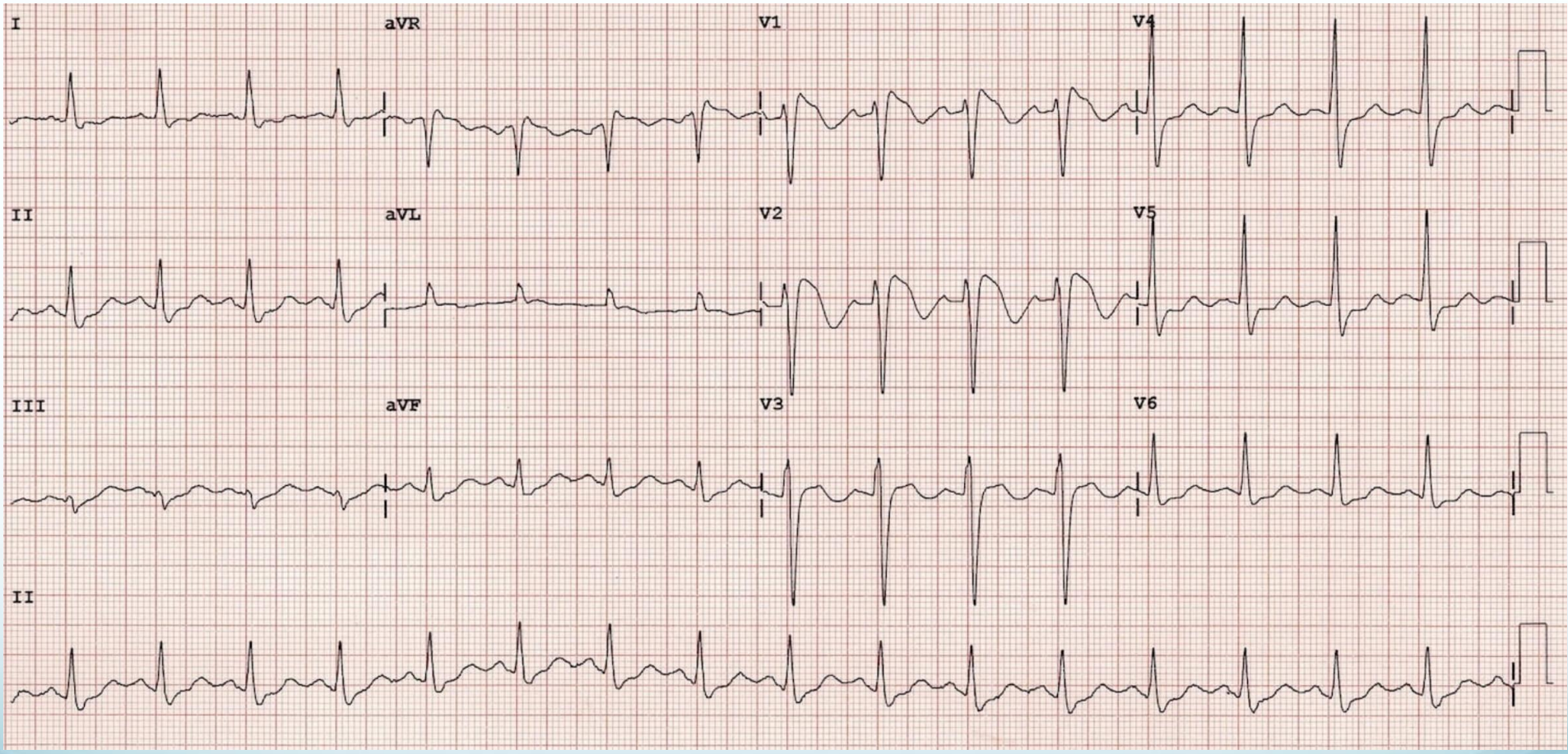
- Life in the Fast Lane
- A Visual Guide of ECG Interpretation (Martindale, Brown)
- Dr. Amal Mattu

L) Ventricular Hypertrophy

- Chest lead voltage criteria (Sokolow-Lyon) S in V1 +R in V5 or V6 >-35mm

R) Ventricular Hypertrophy

- Limb leads: R) axis deviation
- Precordial Leads: V1: R>S
- V6: S>R


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

Brugada Syndrome

- High incident of sudden cardiac death
- High incidence in southeast Asia
- Definitive treatment = ICD
- Clinical Criteria
  - VF or VT
  - FHx of sudden cardiac death <45y.o.
  - Coved-type ECGs in famly members
  - Inducibility of VT with programmed electrical stimulation
  - Syncope
  - Nocturnal agonal respiration