Sixth Year Clinical Teaching

Dr. Mohammed Ismael Dawood
Assistant Professor of Medicine
University of Fallujah

Abnormal ECG

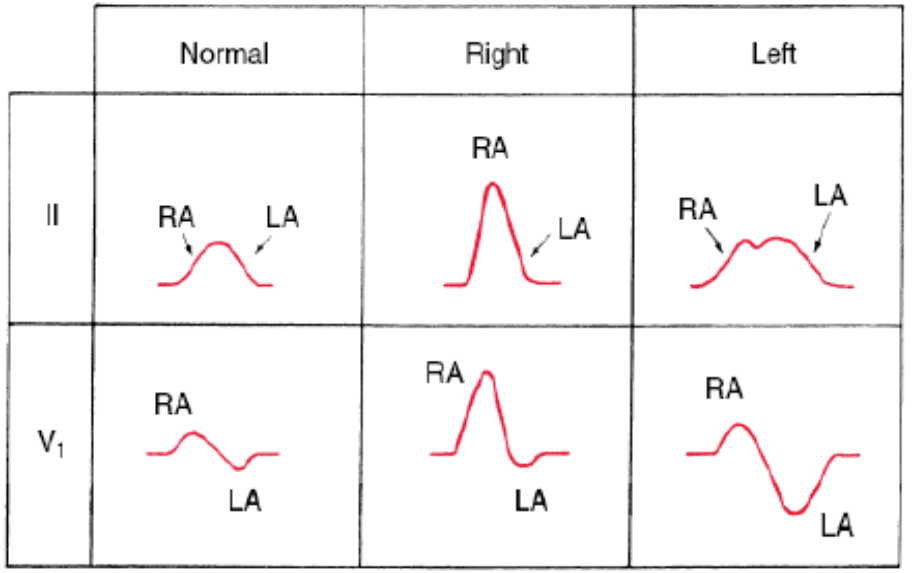
1. Chamber enlargement

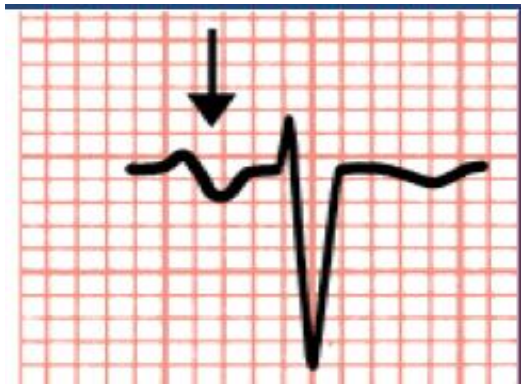
Atrial enlargement

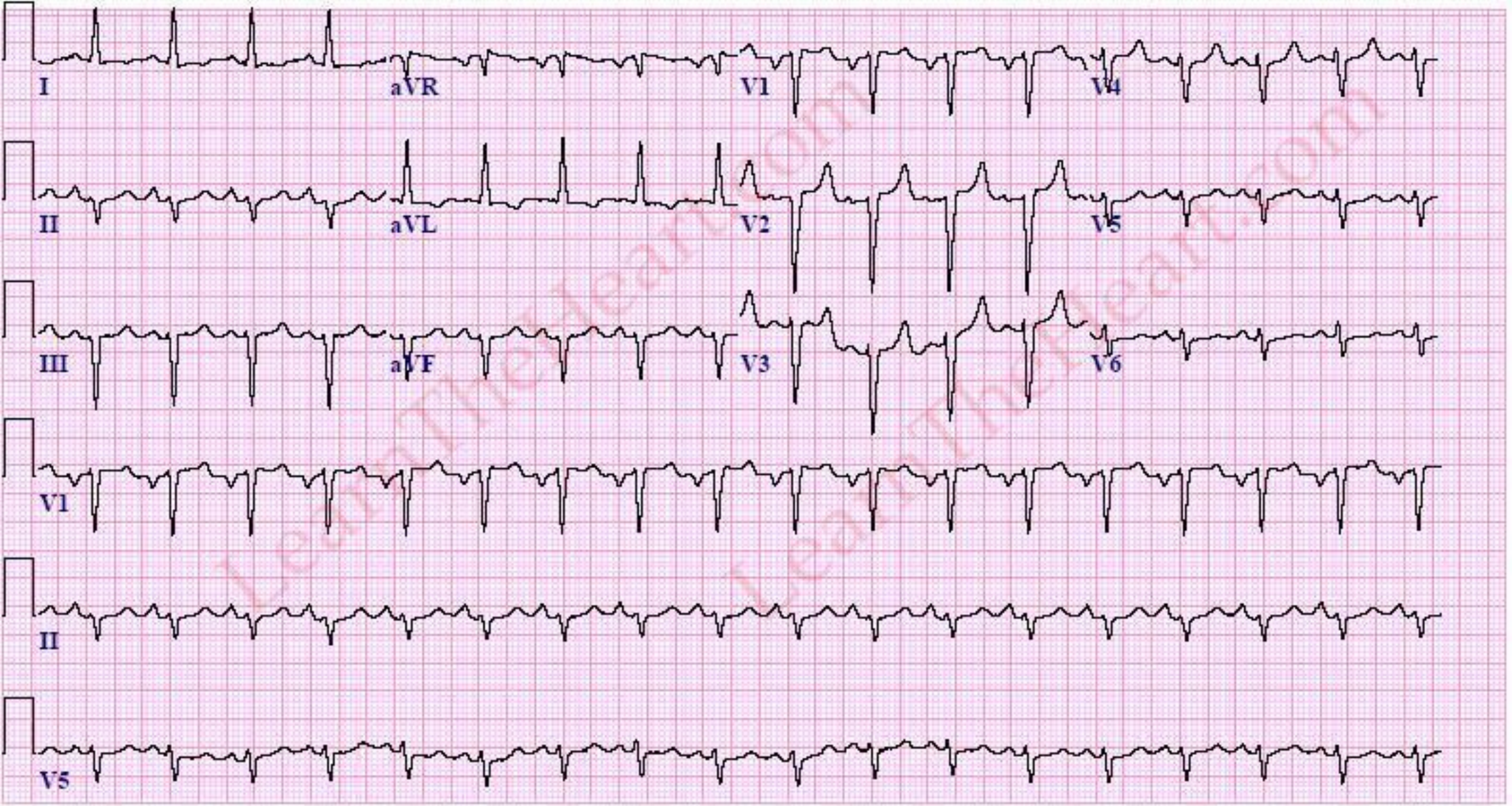
- P wave >> tall and peaked (> 2.5 small squares) (called P pulmonal) >> right atrial enlargement

- P wave >> broad (> 2.5 small squares) >> left atrial enlargement

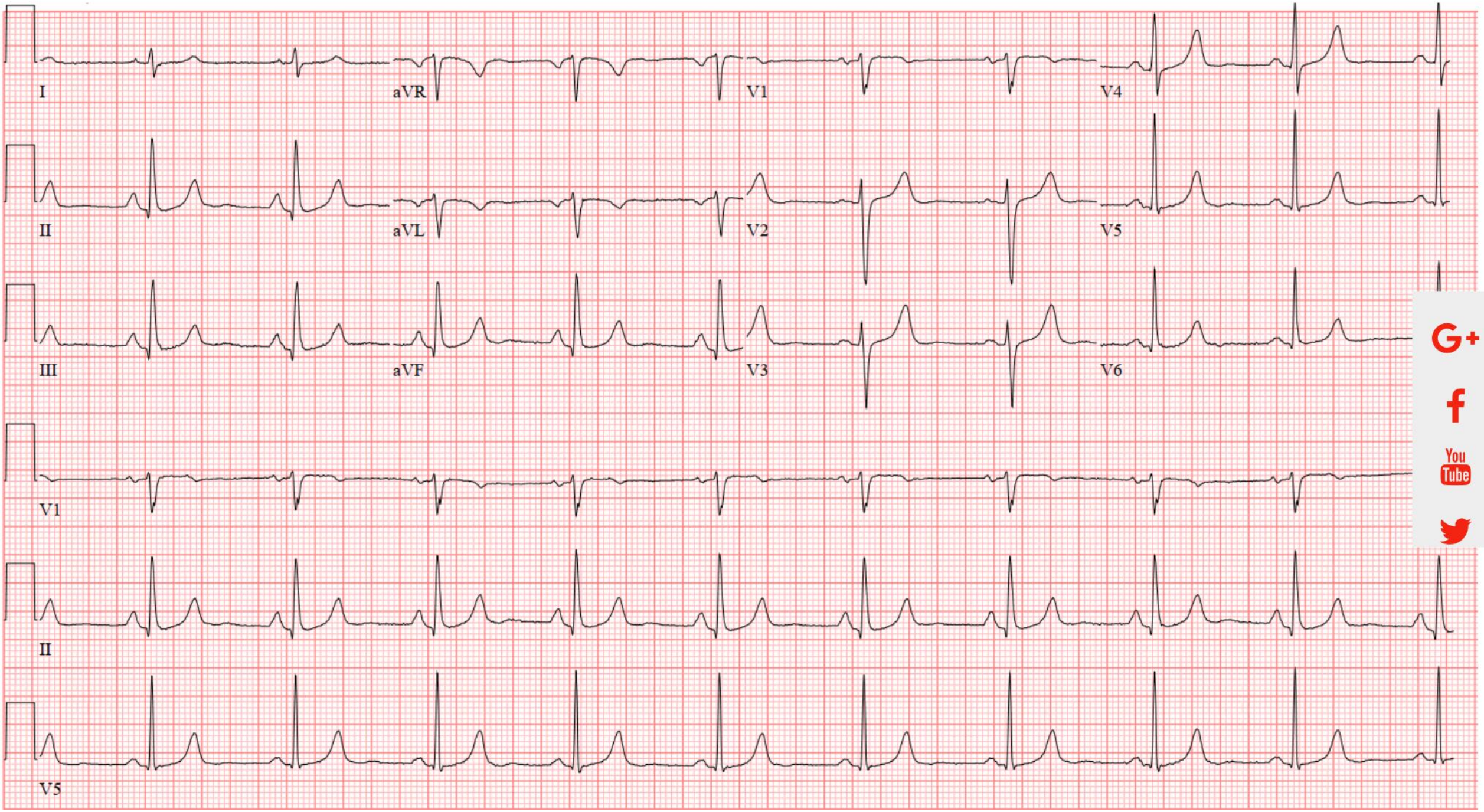
- P wave >> biphasic in V_1
  - ✓ first part represent the right atrium (positive part) >> if enlarged >> right atrial enlargement
  - ✓ second part represent the left atrium (negative part) >> if enlarged >> left atrial enlargement







25mm/s 10mm/mV 150Hz 005C 12SL 250 CID: 1 EID:Unconfirmed EDT: ORDER:


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

Ventricular enlargement

Check QRS in $V_{1,2,5,6}$

- Normally in $V_{1,2}$ >> S wave bigger than r wave
- Normally in $V_{5,6}$ >> R wave bigger than s wave

If you find in $V_{1,2}$ S wave bigger than r wave, but the S wave is so deep (exaggeration of normal) (S wave more than 5 big squares) >> left ventricular hypertrophy

Voltage criteria of exaggeration of normal :

- S wave > 5 big squares in V_1 or V_2
- R wave > 5 big squares in V_5 or V_6
- The summation of S + R waves ≥ 7 big squares

This is means left ventricular enlargement

As the cardiac muscle hypertrophied and the blood supply didn't change so, the cardiac muscle will show some changes (strain ischemia) :

- Depressed ST segment
- Inverted T wave
- Or one of them

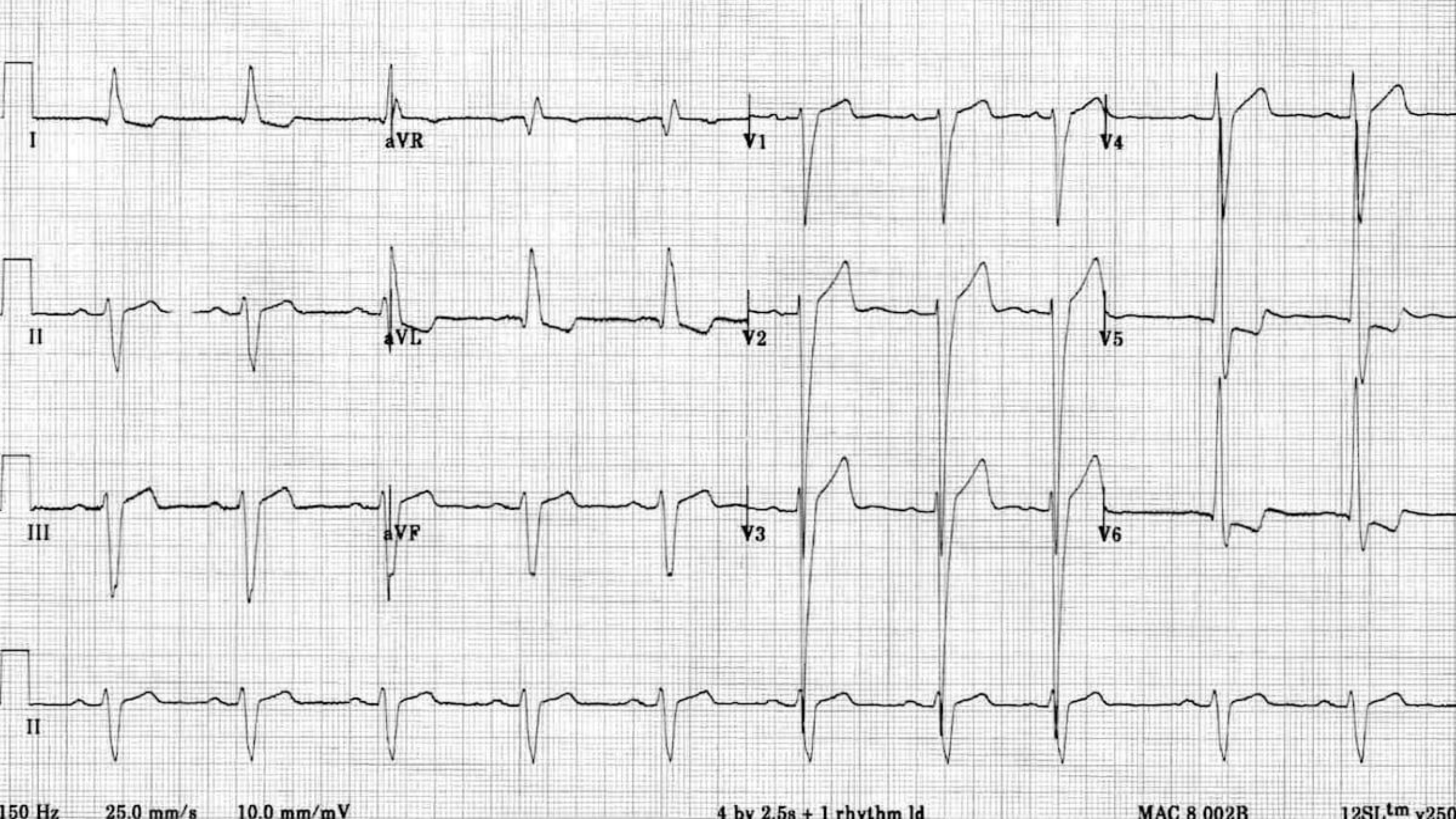
These changes will take place in lead V_5 and V_6 as we are talking about left ventricle

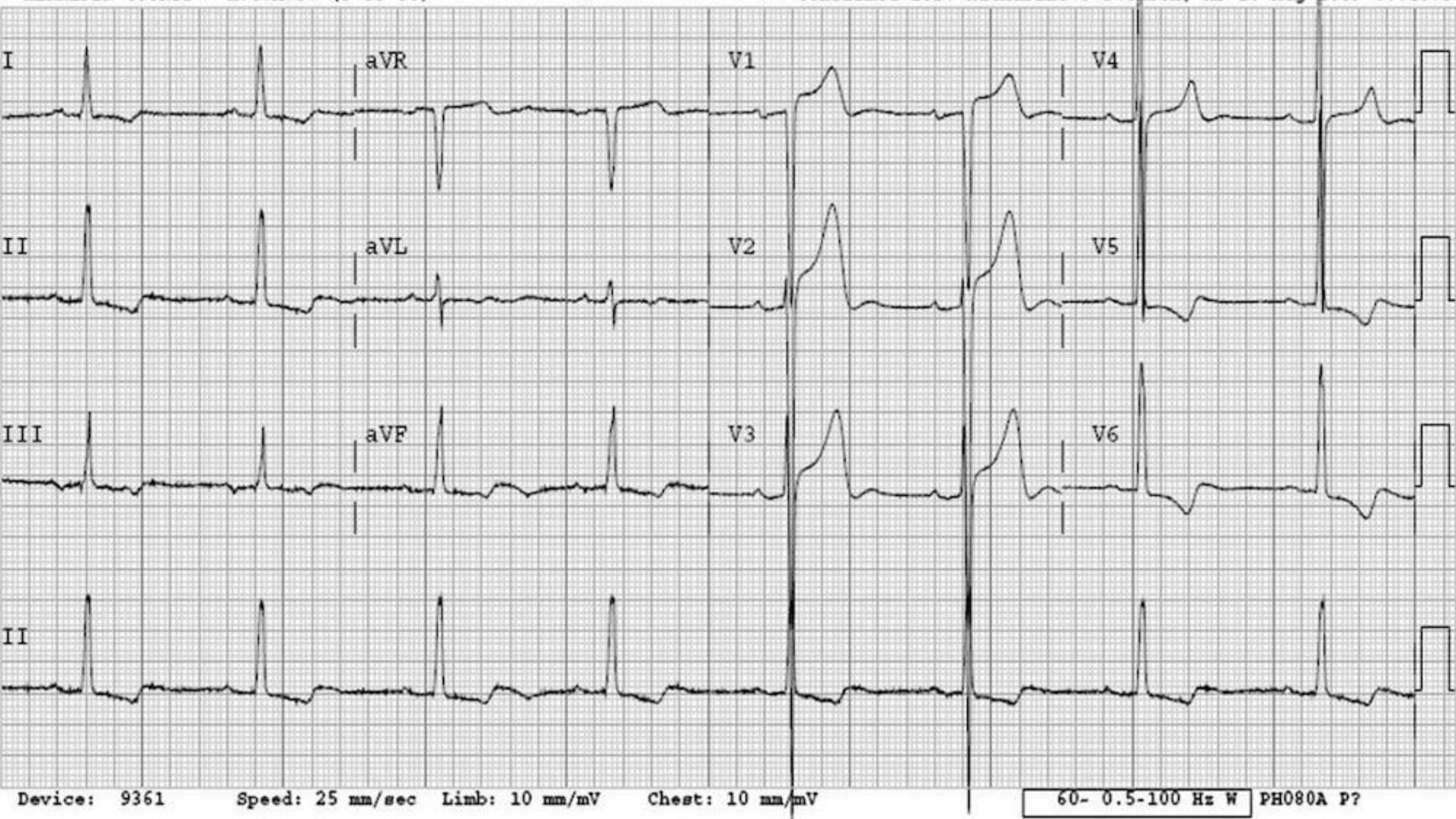
The voltage criteria of LVH are:

- S in V_1 + R in (V_5 or V_6) >35 mm (Sokolow)
- R in V_4–V_6 >25 mm; R in aVL >11 mm (Framingham)
- S in V_3 + R in aVL >28 mm in men (Cornell)

Besides voltage criteria, other features of LVH are:

- Left axis deviation of the QRS complex
- Left atrial enlargement: P mitrale
- ST segment depression and T wave inversion in leads V_5 and V_6: LV strain pattern **(Fig. 7.8).**


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
MAC 8 002B
12SL tm v250


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Device: 9361
Speed: 25 mm/sec
Limb: 10 mm/mV
Chest: 10 mm/mV
60- 0.5-100 Hz W
PH080A P?

How to know that the right ventricle is enlarged ?

If you found reversal of normal (R wave > s wave in $V_{1, 2}$) or (S wave > r wave in $V_{5,6}$)

As the cardiac muscle hypertrophied and the blood supply didn't change so, the cardiac muscle will show some changes (strain ischemia) :

- Depressed ST segment
- Inverted T wave
- Or one of them

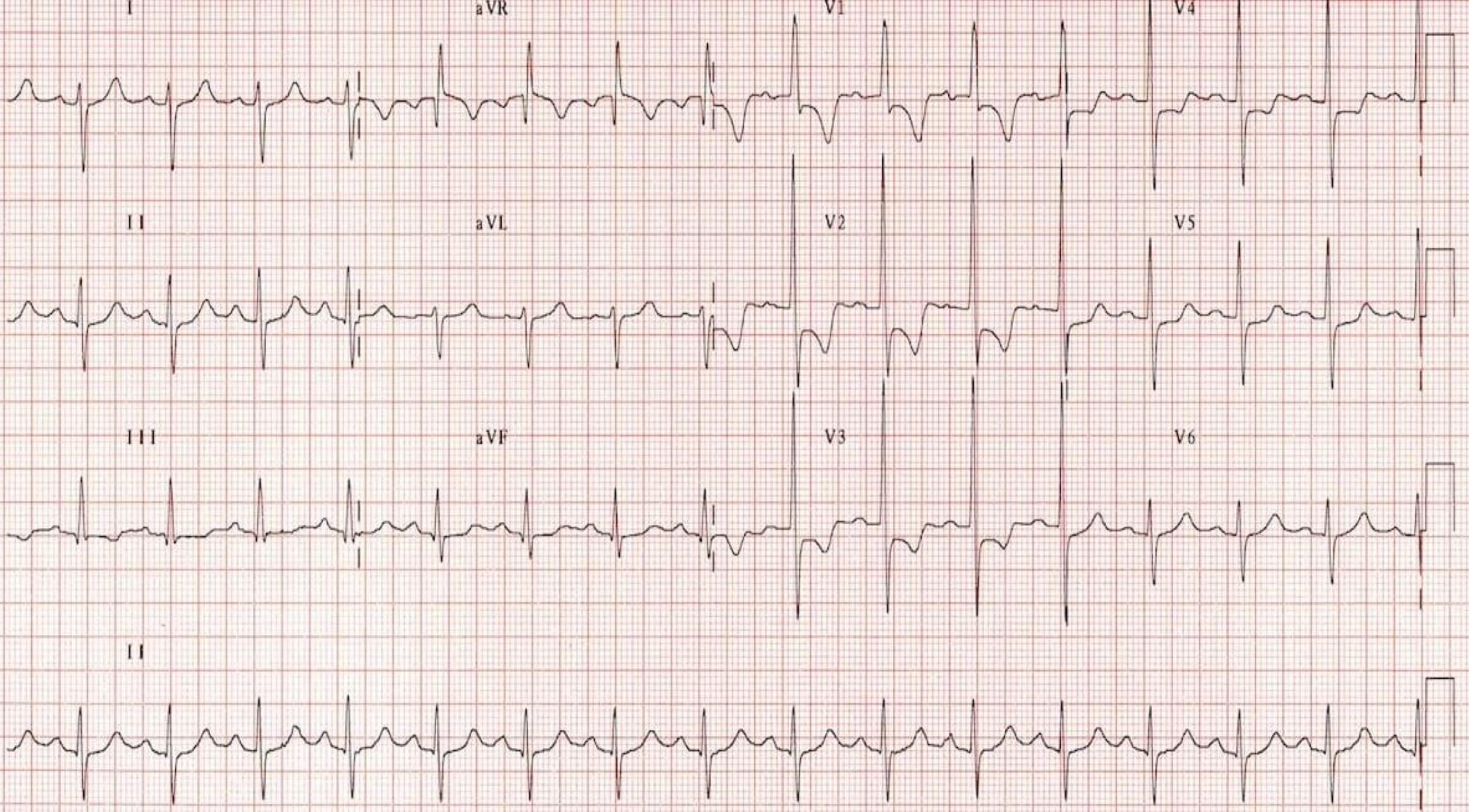
These changes will take place in lead V_1 and V_2 as we are talking about right ventricle

The voltage criteria of RVH are:

- R wave in V_1 more than 4 mm
- R/S ratio in V_1 more than 1
- S wave in V_6 more than 7 mm
- R in V_1 + S in V_6 more than 10 mm.

Besides voltage criteria, other features of RVH are:

- Right axis deviation of the QRS complex
- Right atrial enlargement: P pulmonale
- S-T segment depression and T wave inversion in leads V_1 and V_2: The RV strain pattern **(Fig. 7.7).**


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

If someone has biventricular hypertrophy,

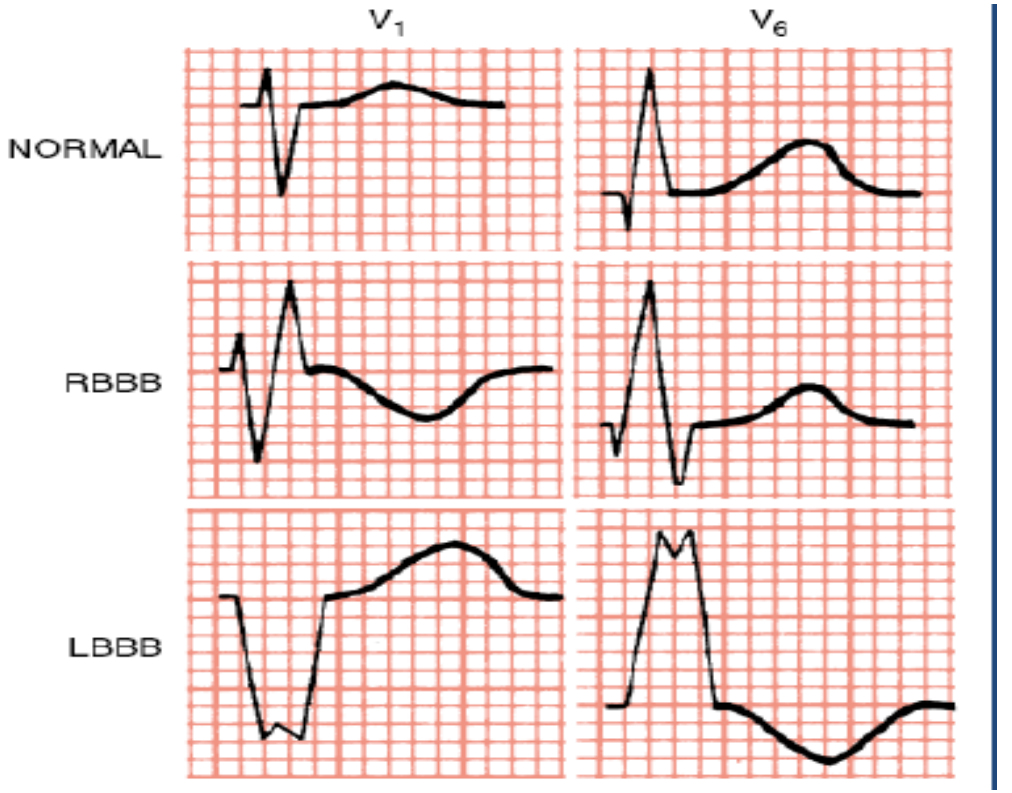
The strain ischemia will appear in V_1 , V_2 and appears also in V_5 and V_6

2. Bundle Branch Block (BBB)

How to detect bundle branch block ?

Look at QRS complex, you will find the shape of M (RSR')

- M shaped in V_1 or V_2 >> right bundle branch block
- M shaped in V_5 or V_6 >> left bundle branch block



What are the benefits of QRS complex ?

- Shape
- Direction
- Voltage

I mean, look at the QRS complex checking the shape, direction and the voltage

Shape :

- M shaped >> bundle branch block

if normal shaped, look at direction

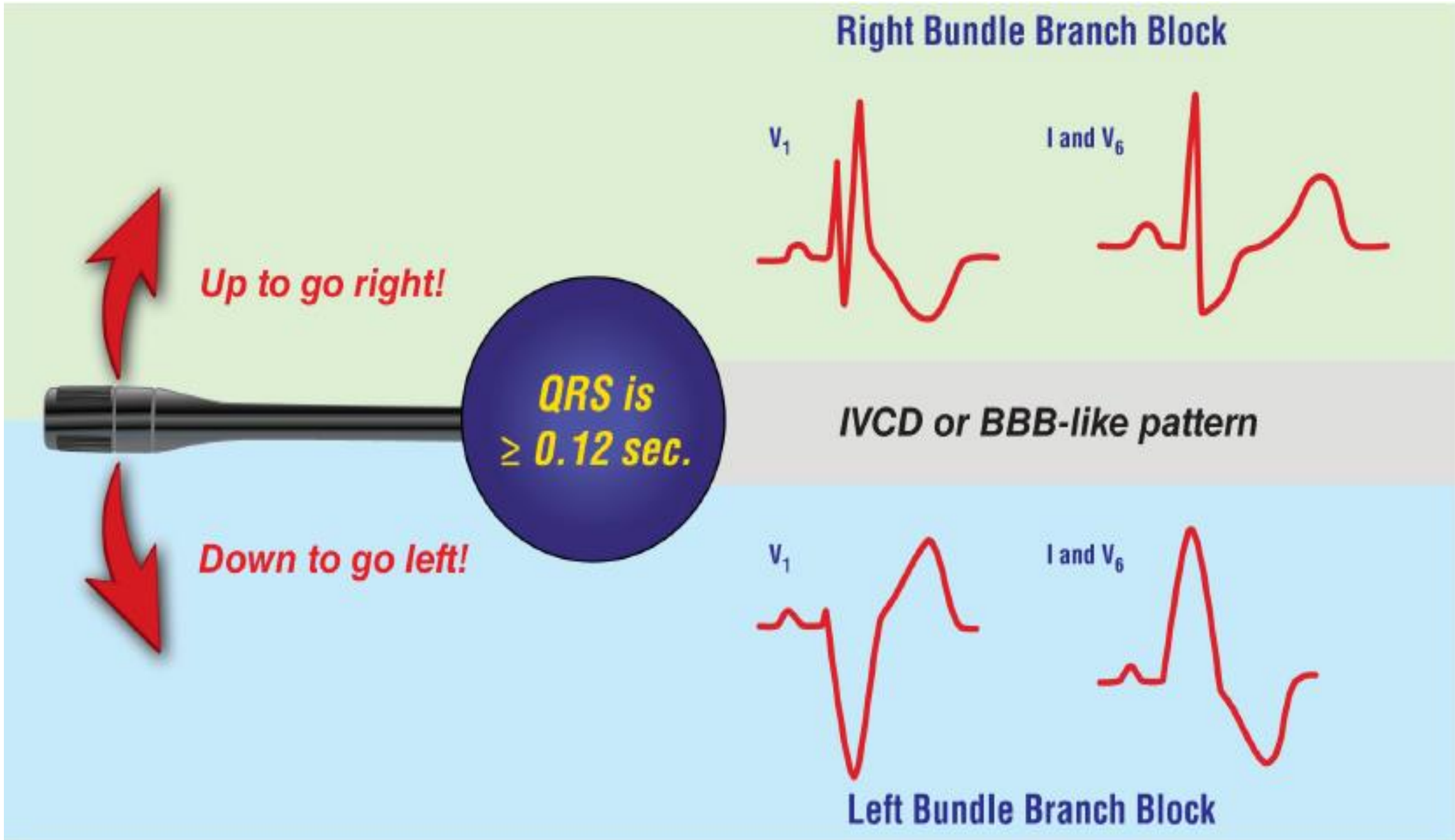
Direction :

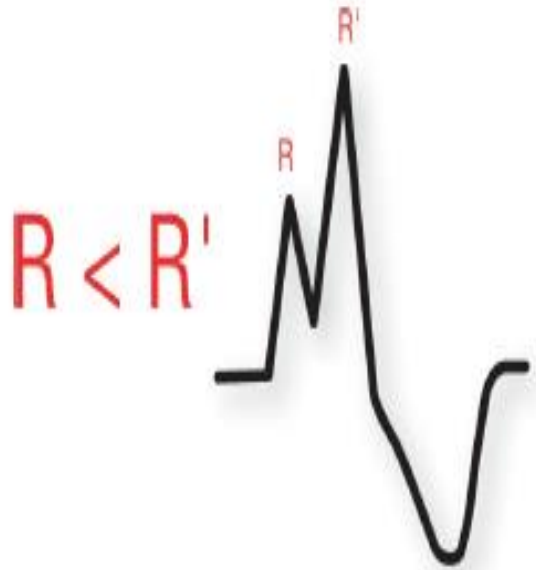
- Reversal of normal >> right ventricular enlargement

If normal shaped and normal direction, look at the voltage

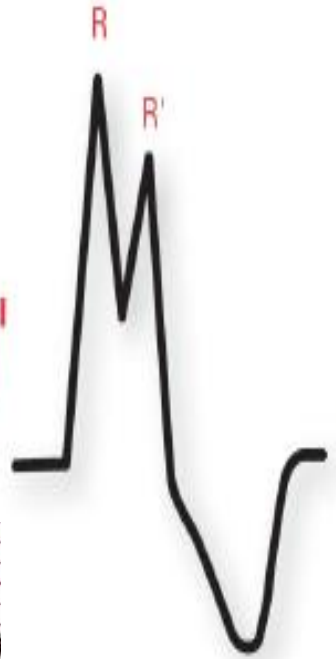
Voltage :

Exaggeration of normal >> left ventricular enlargement

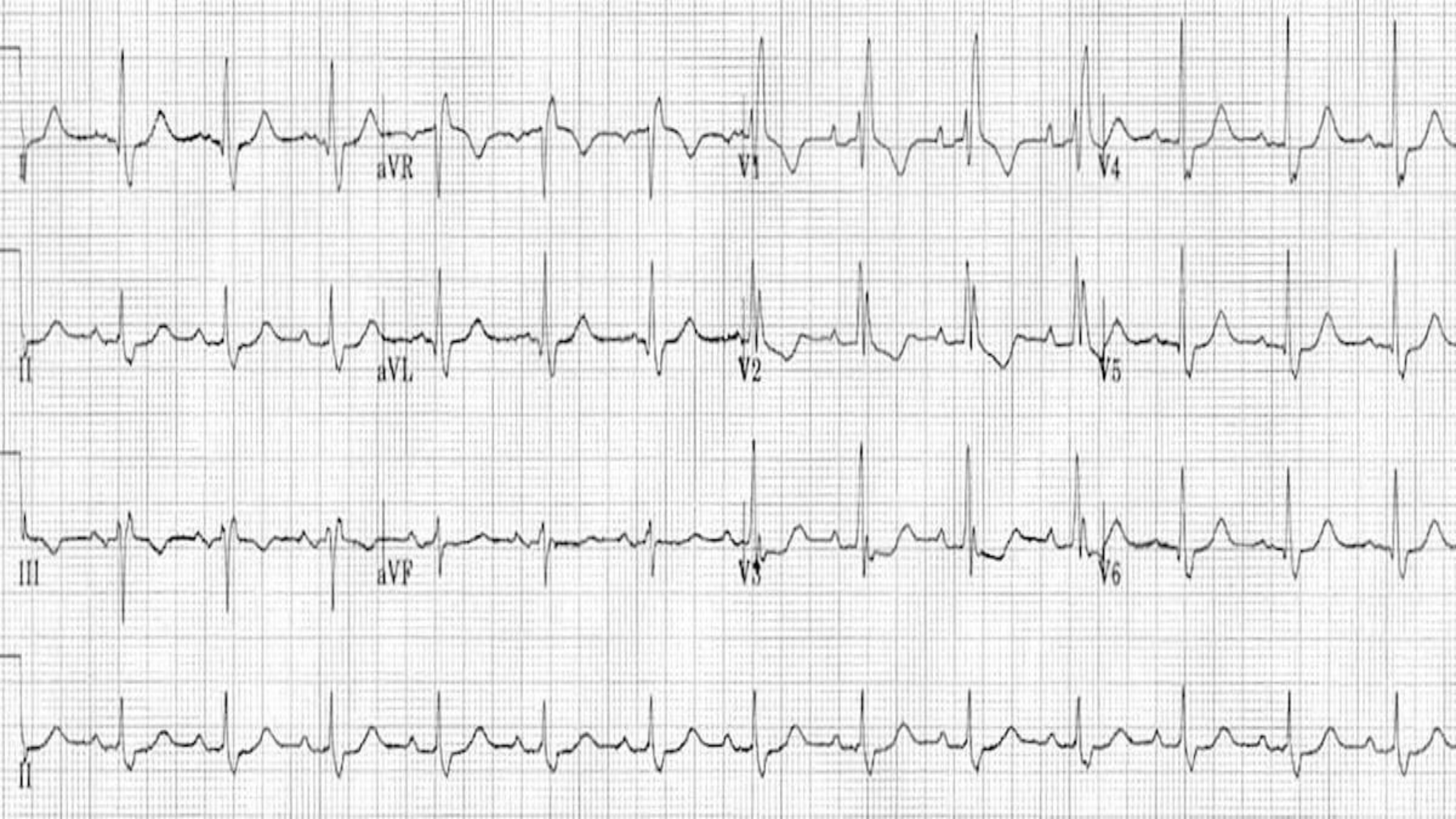

Right Bundle Branch Block
V1
I and V6
Up to go right!
QRS is
≥ 0.12 sec.
IVCD or BBB-like pattern
Down to go left!
V1
I and V6
Left Bundle Branch Block

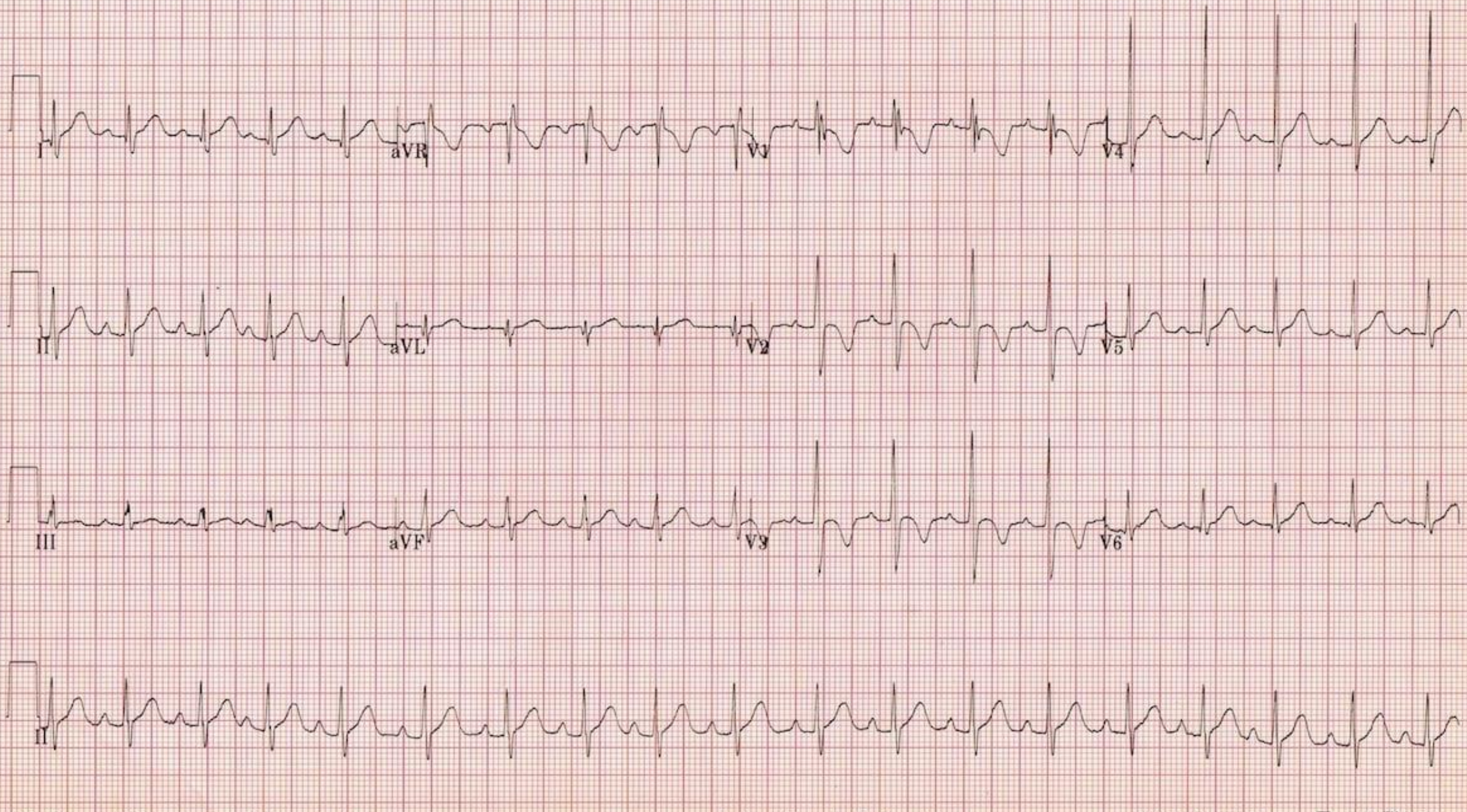


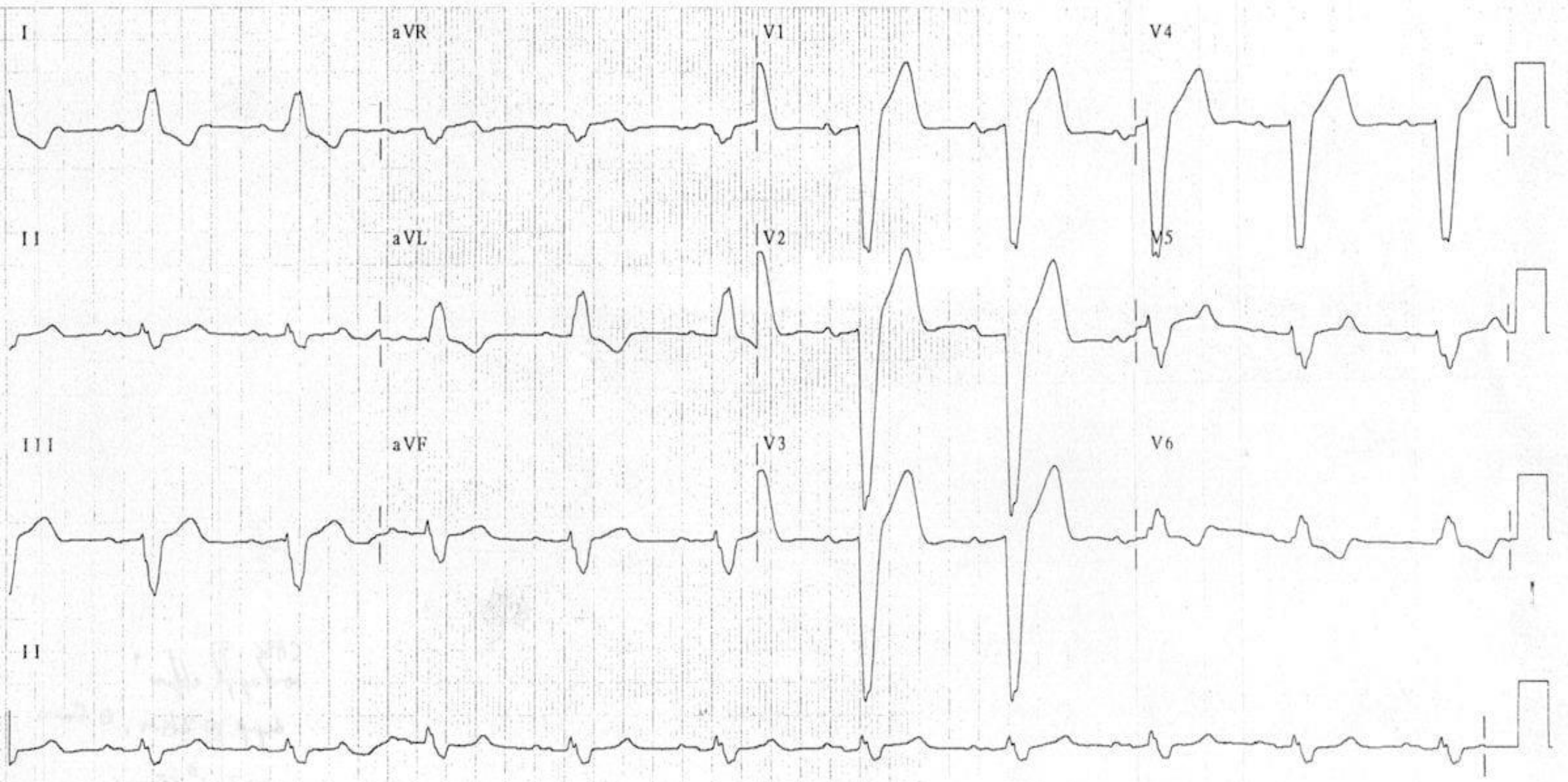
Typical morphology of RSR' wave in a right bundle branch block



Typical morphology of RSR' wave from an ectopic ventricular focus

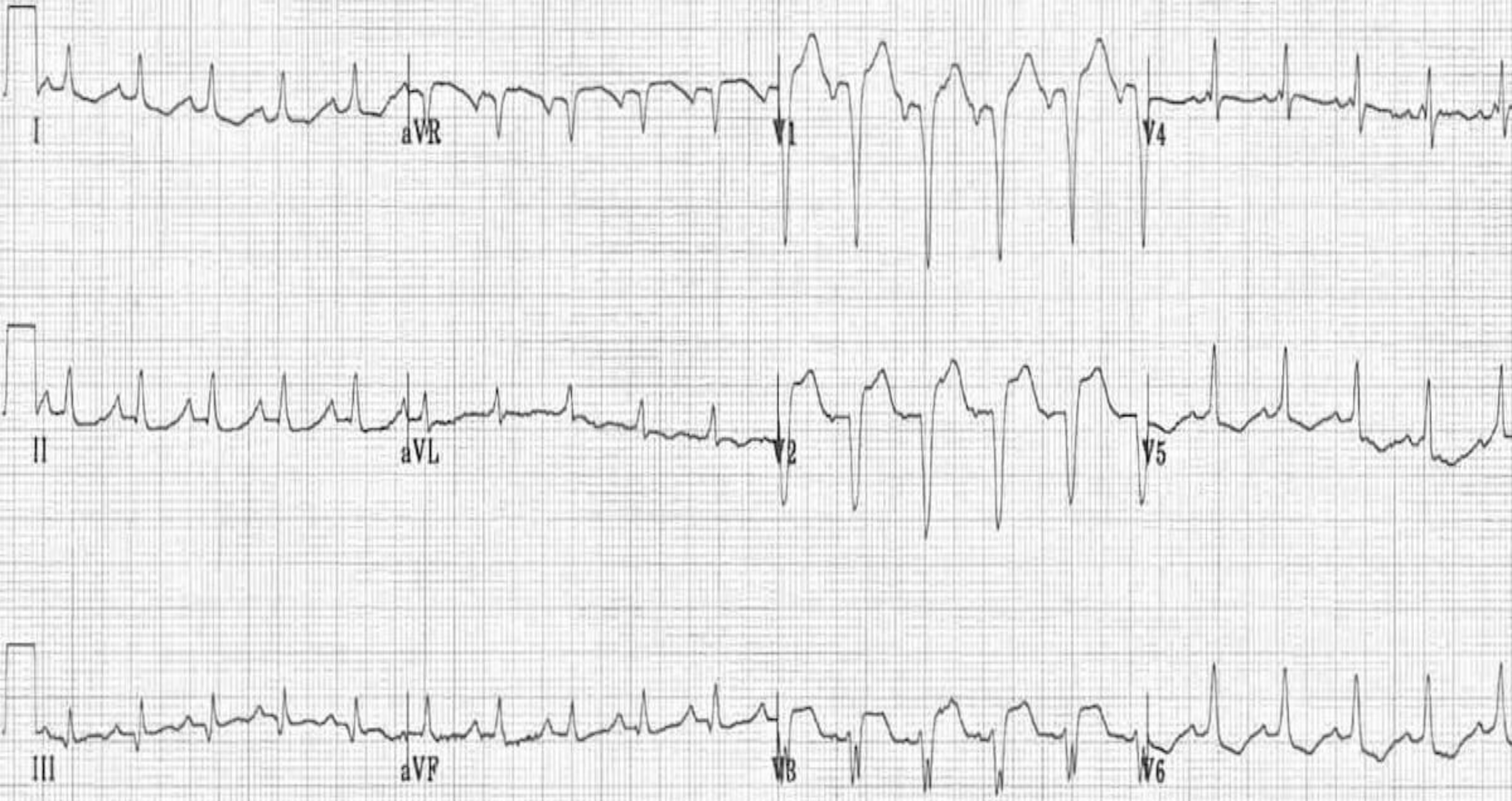

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
150 Hz
25.0 mm/s
10.0 mm/mV
4 by 2.5s + 1 rhythm ld
MAC5K 008B
12SL™v237



LOC 00000-0000 Speed:25 mm/sec Li..10 mm/mV Chest:10 mm/mV

F 50∿ 0.5-150 Hz W HP708 00156


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

3. Coronary Ischemia (MI & ischemia)

In brief

- Area of necrosis >> pathological Q
- Tissue damage >> elevated ST segment
- Ischemia >> inverted T wave or peaked T

Notes ☺

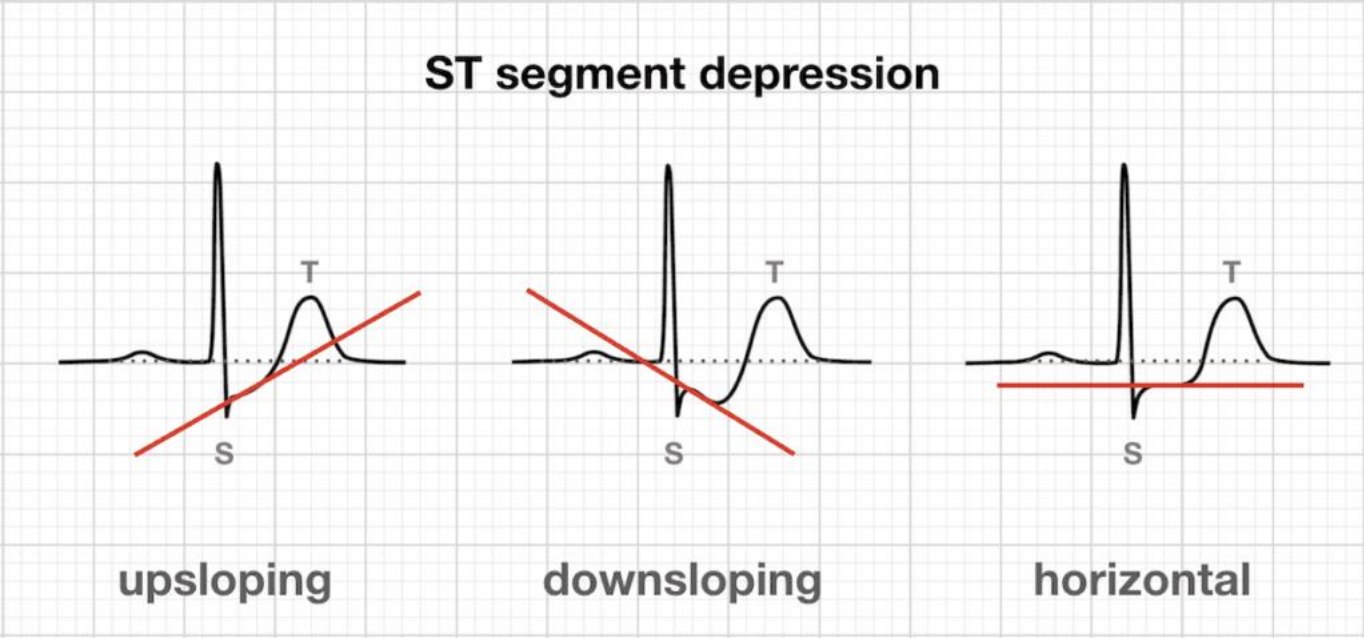
- Presence of pathological Q >> old myocardial infraction
- Finger print of MI >> is the pathological Q
- Elevated ST segment with pathological Q >> recent Myocardial infarction

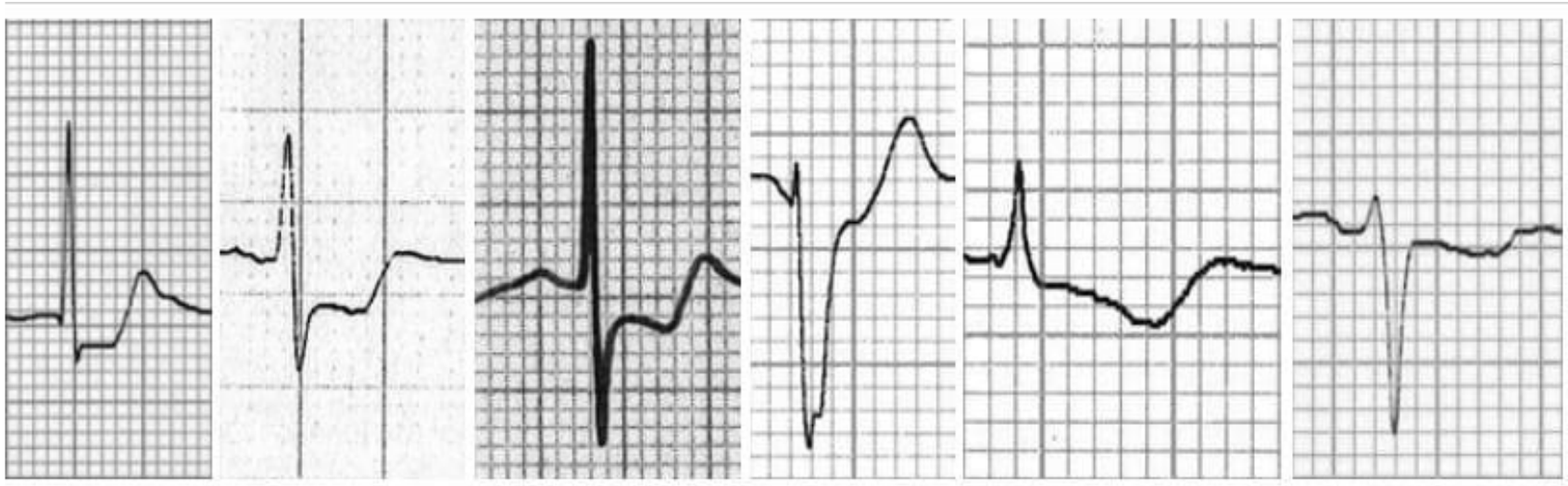
The earliest ECG changes seen with an acute transmural ischemia/infarction typically occur in the ST-T complex in sequential phases:

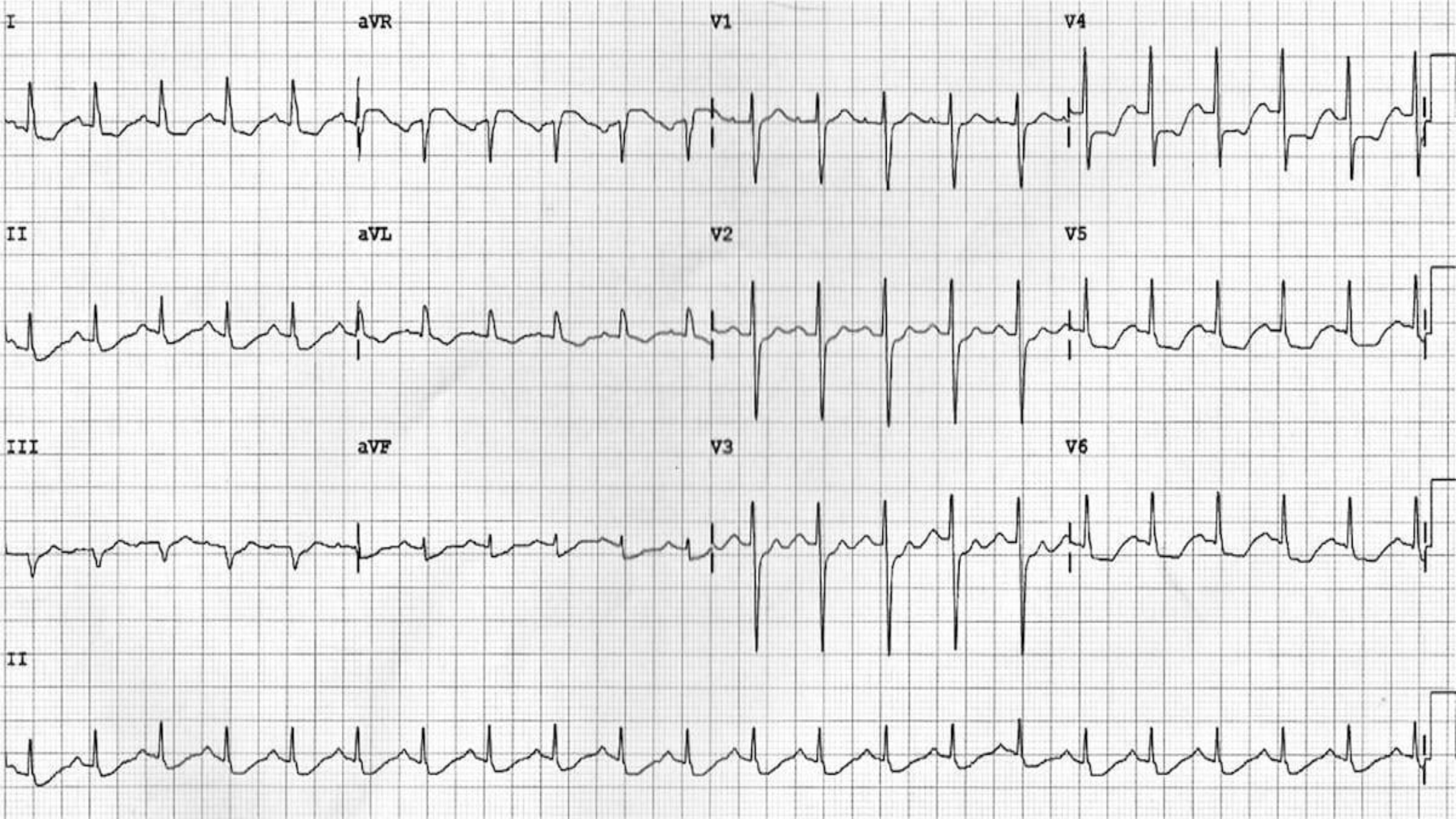
1. The acute phase is marked by the appearance of ST segment elevations and sometimes tall positive (hyperacute) T waves in multiple (usually two or more) leads. The term "STEMI" refers to this phase.

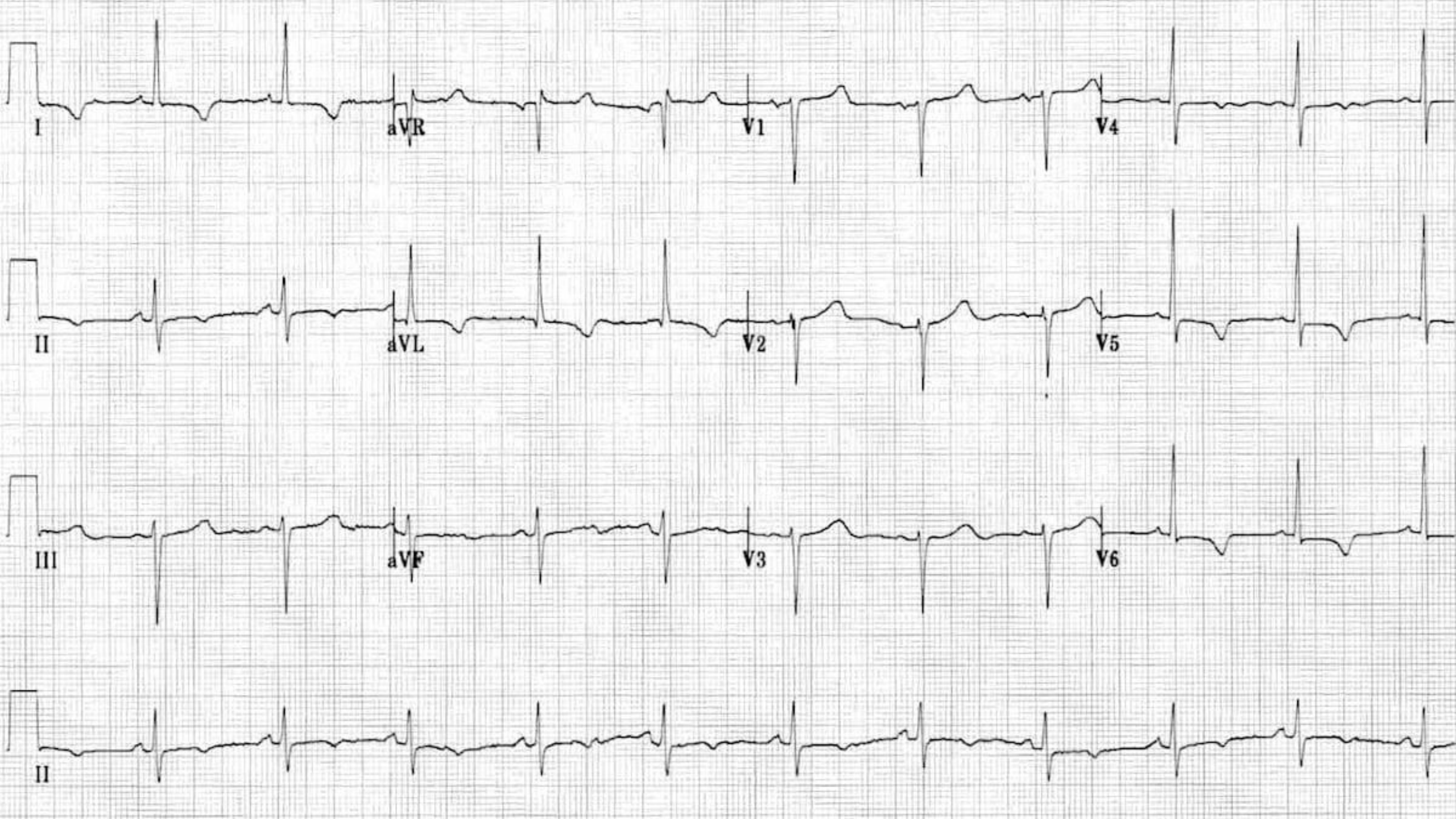
2. The evolving phase occurs hours or days later and is characterized by deep T wave inversions in the leads that previously showed ST elevations. Transmural MIs can also be

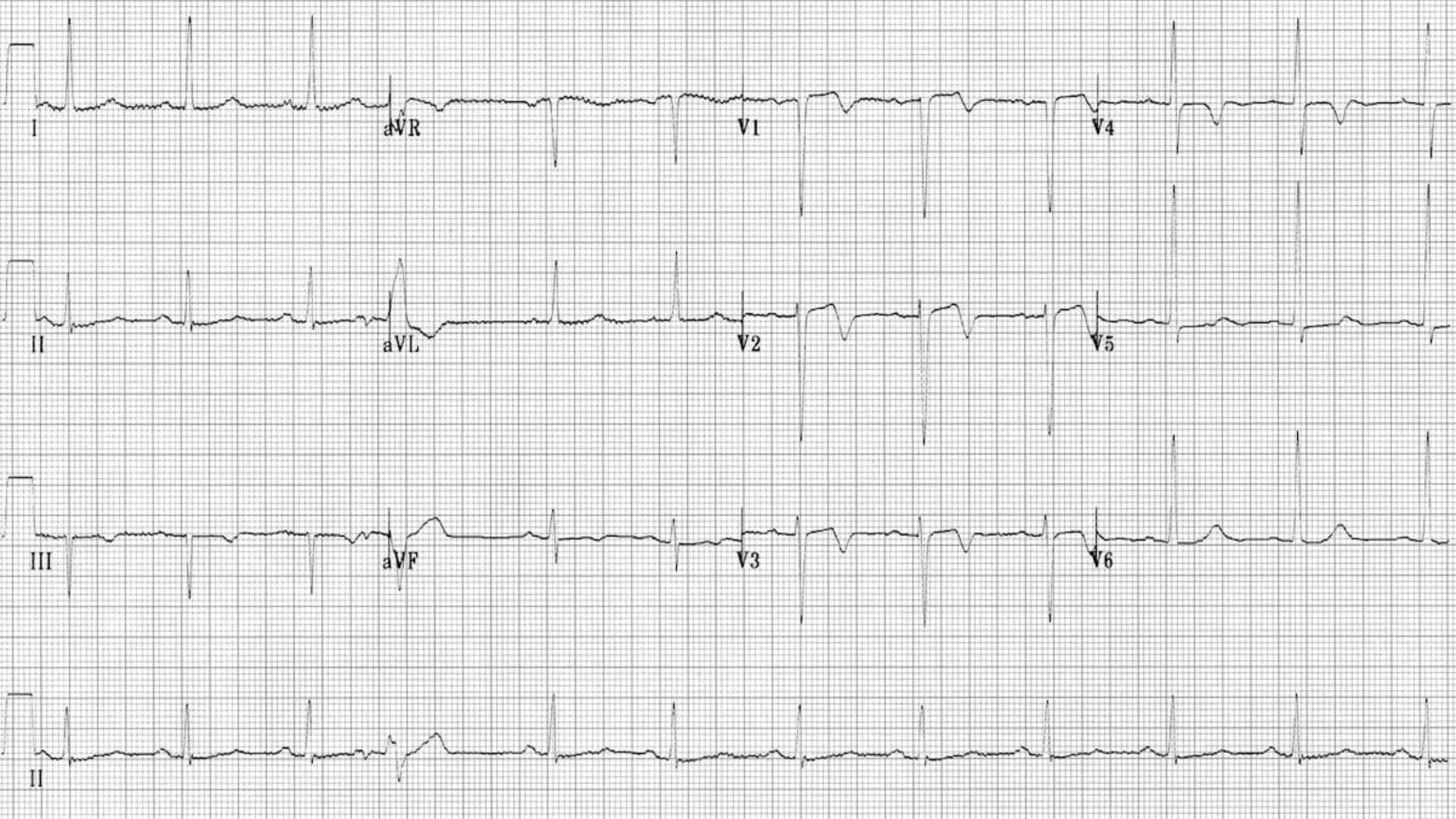
The anatomic location of the infarct determines the leads in which the typical ECG patterns appear.

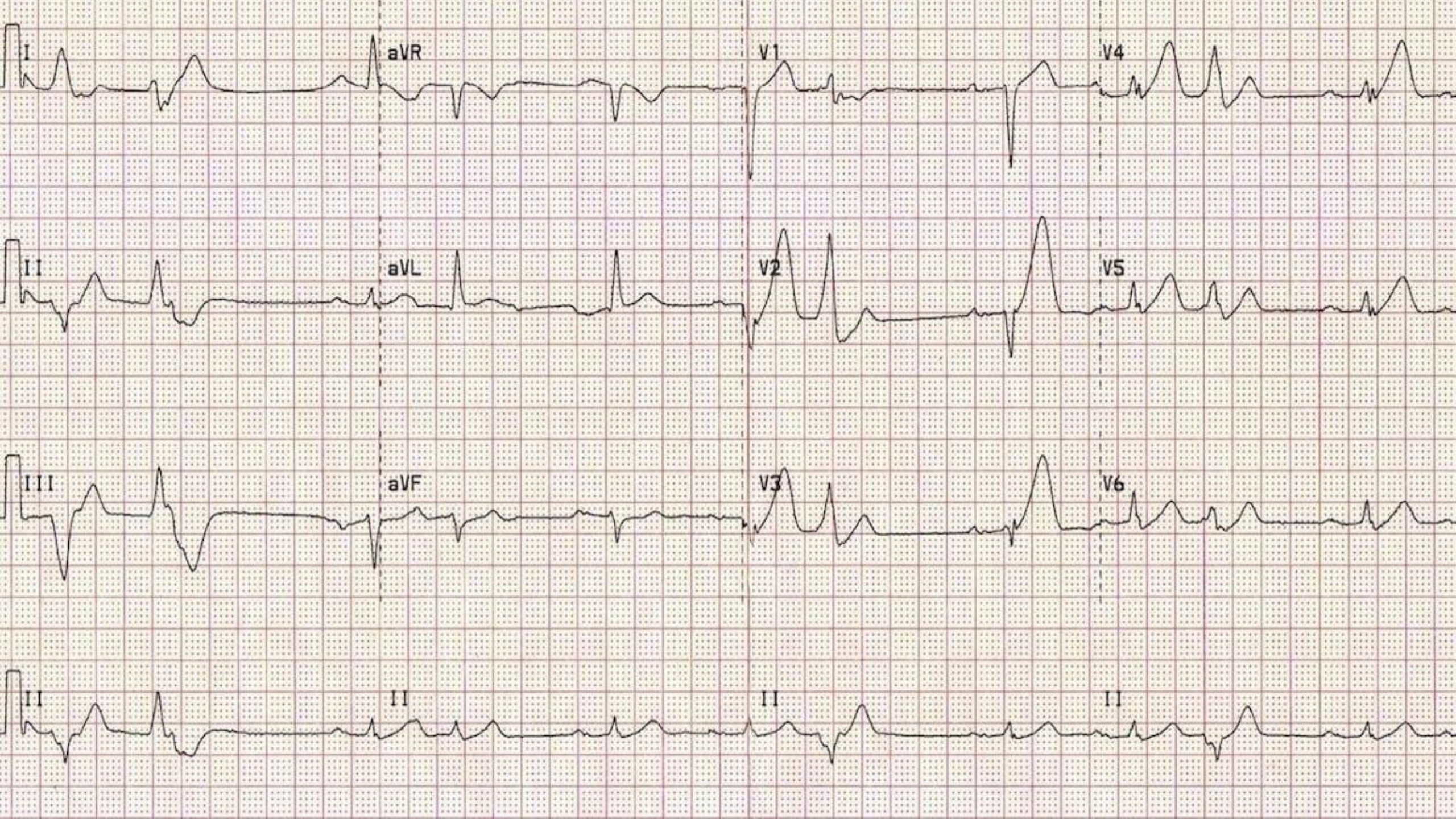

ST segment depression
T
S
T
S
T
S
upsloping
downsloping
horizontal

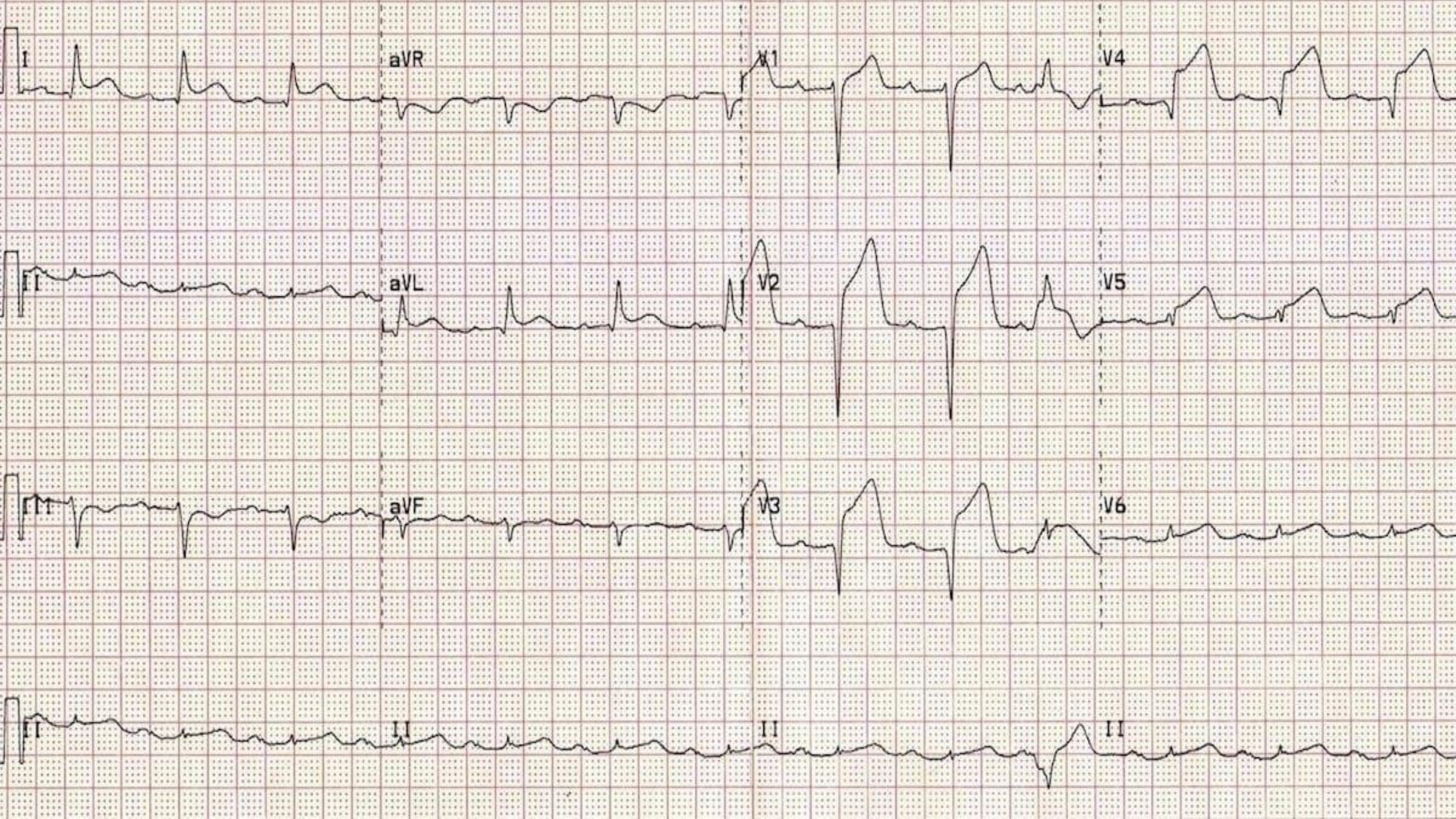


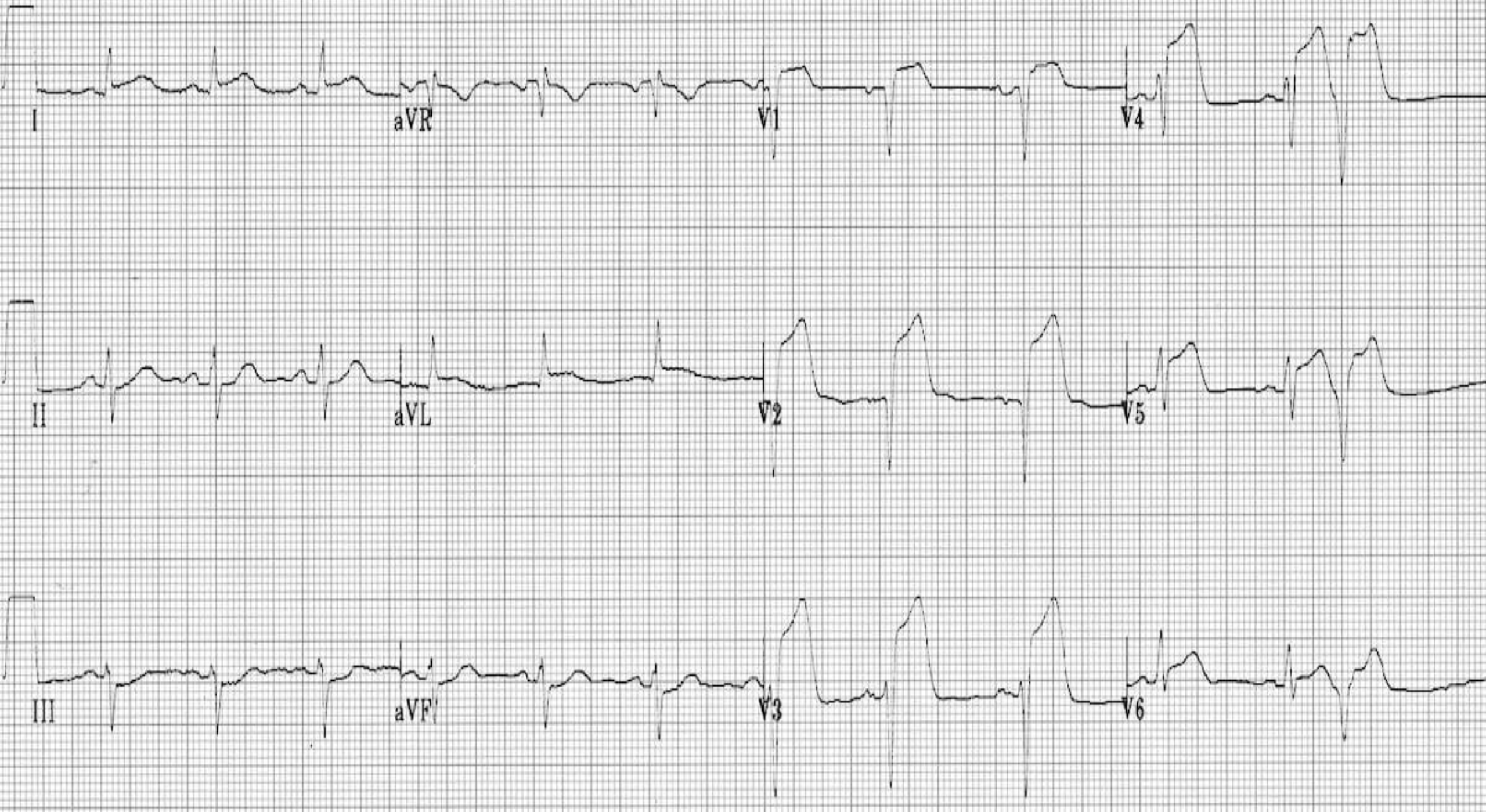

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

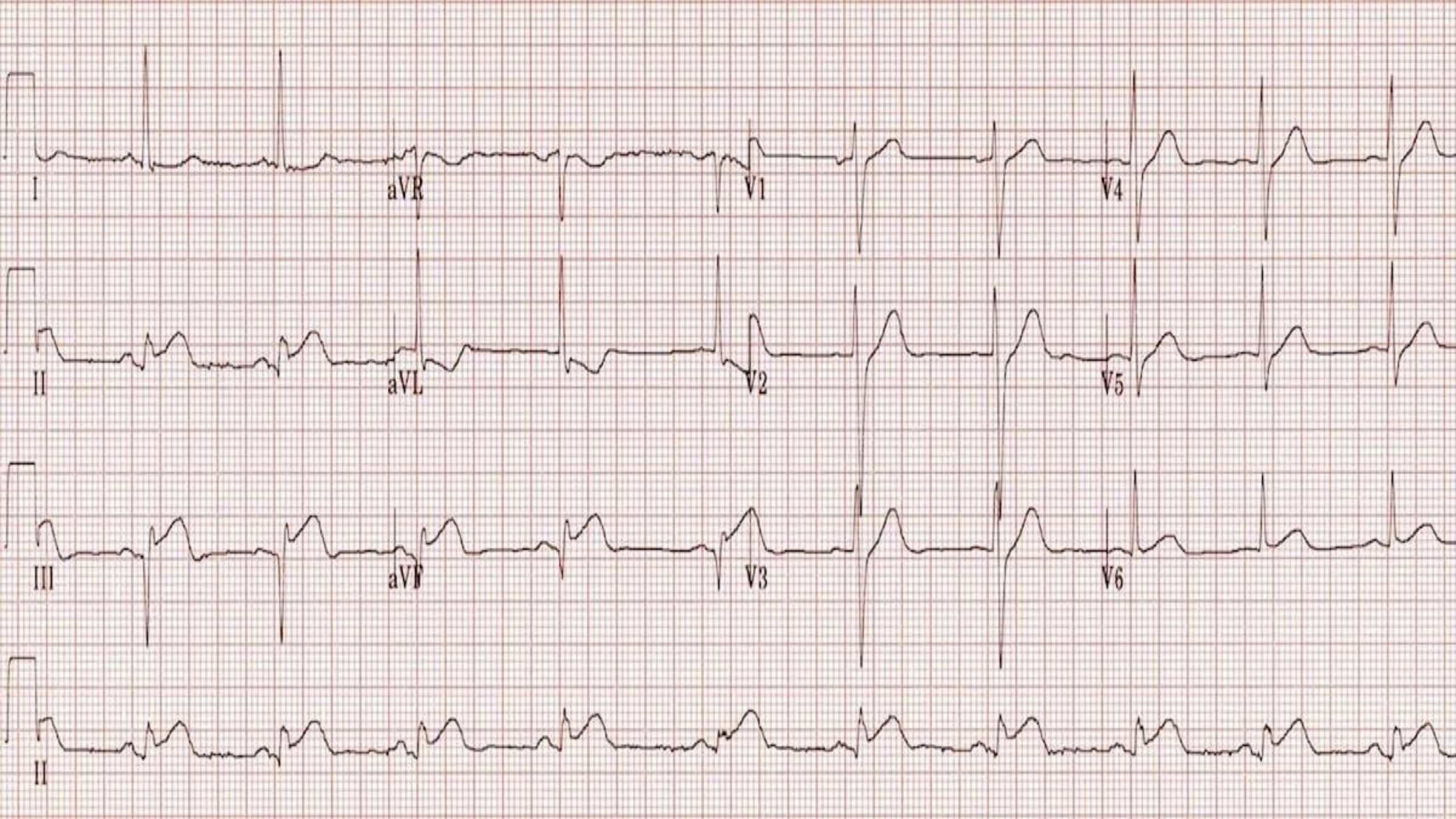

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

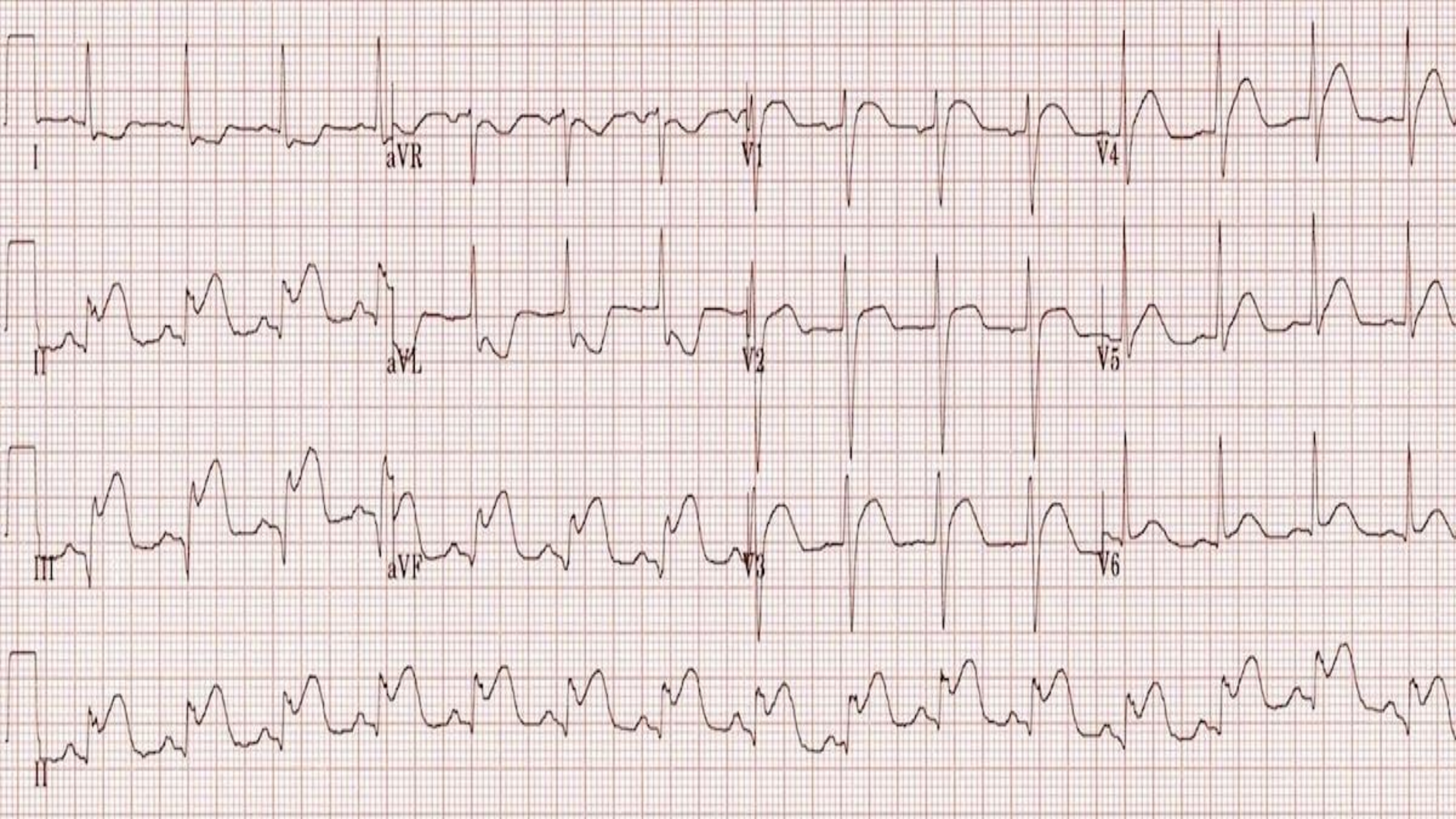

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

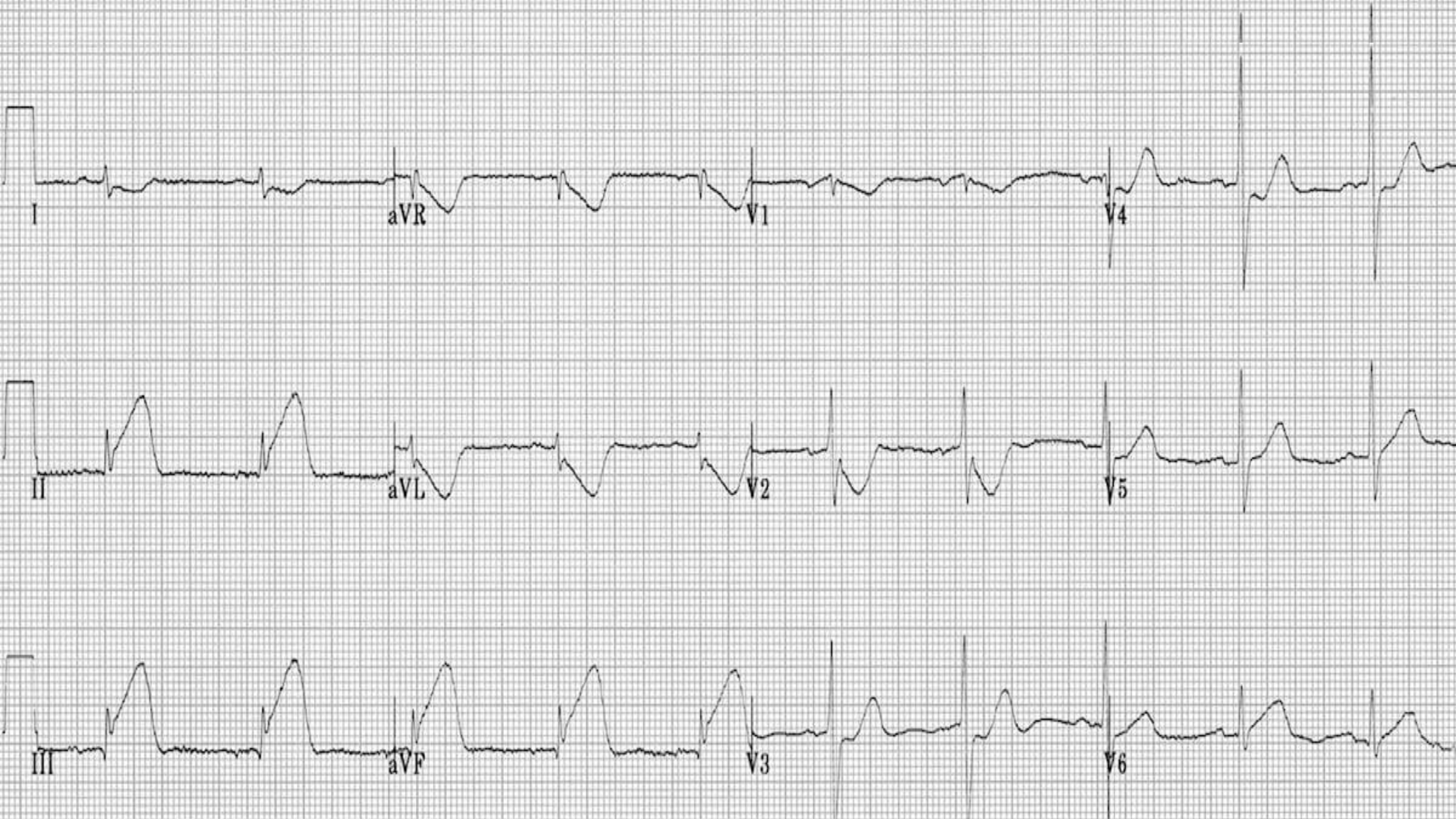

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
II
II
II

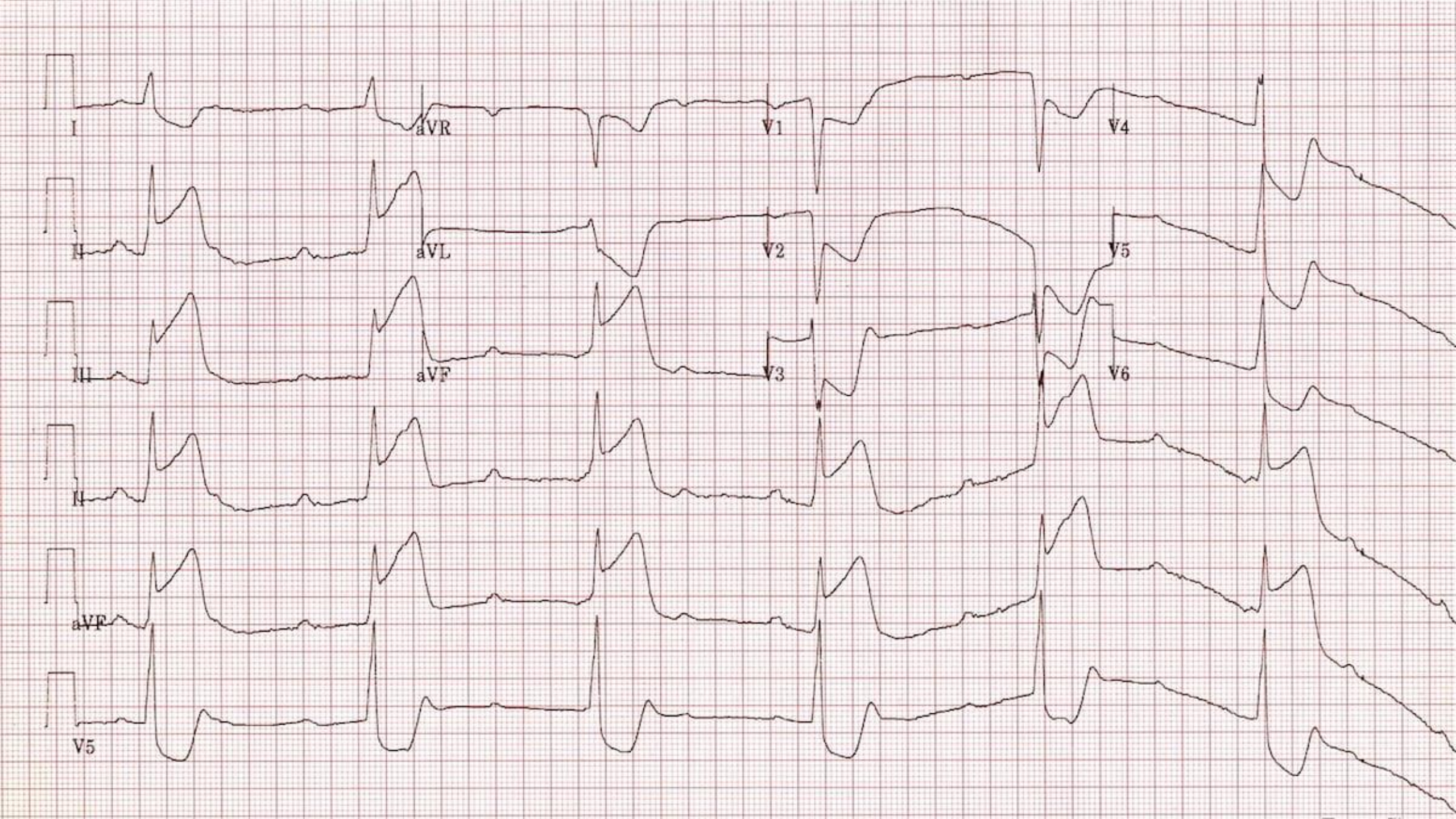

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
II
II

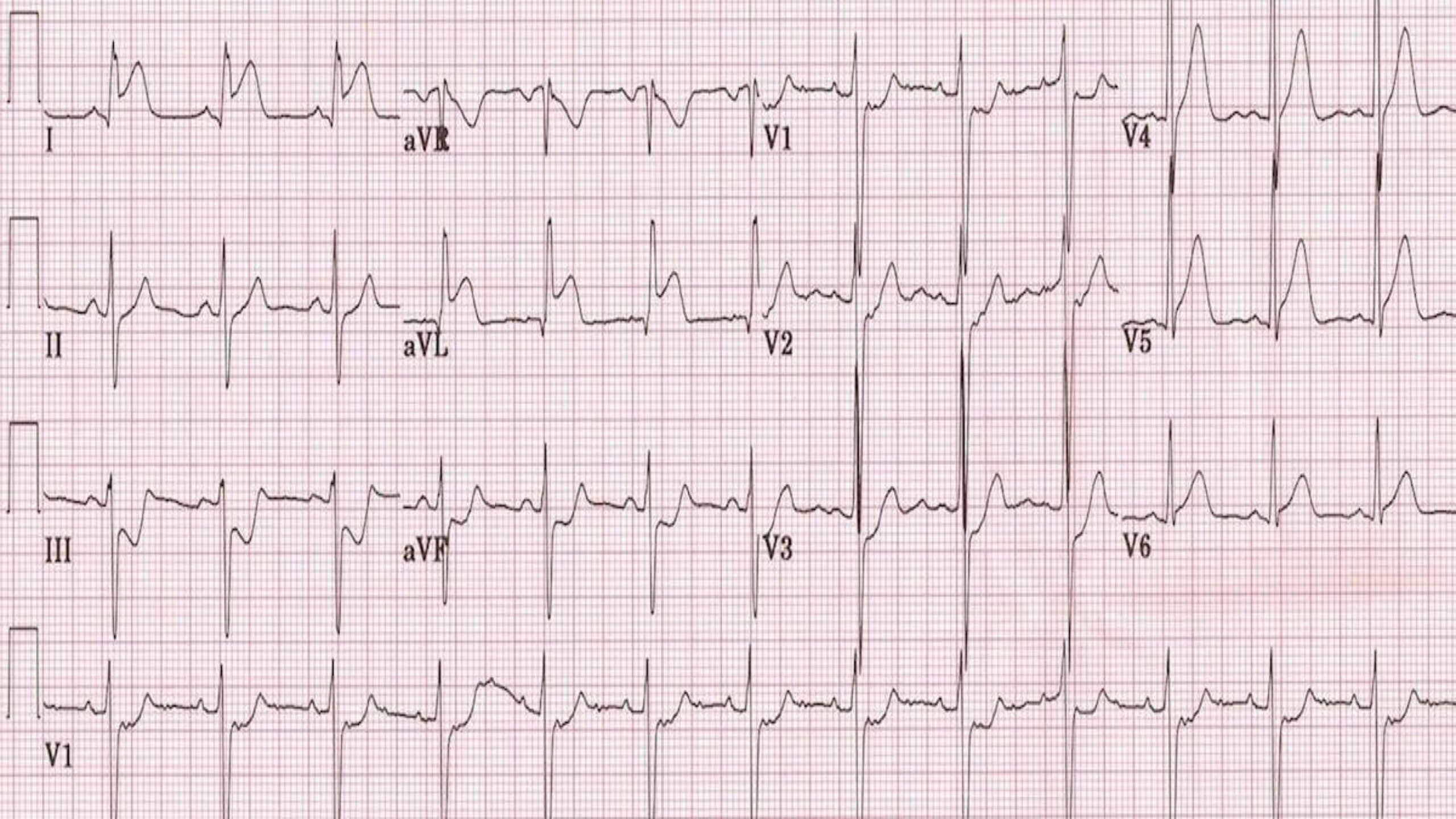

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

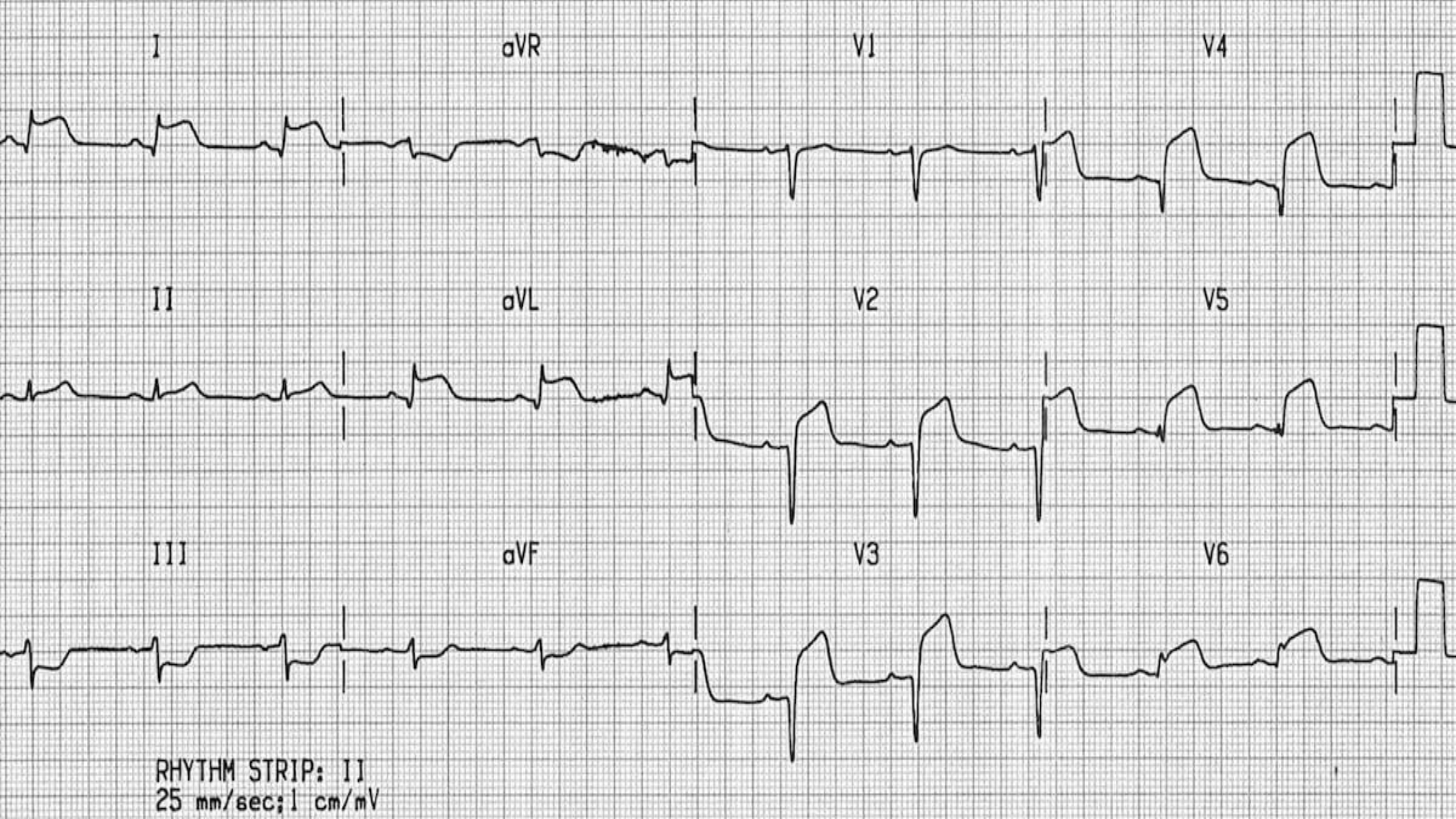

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

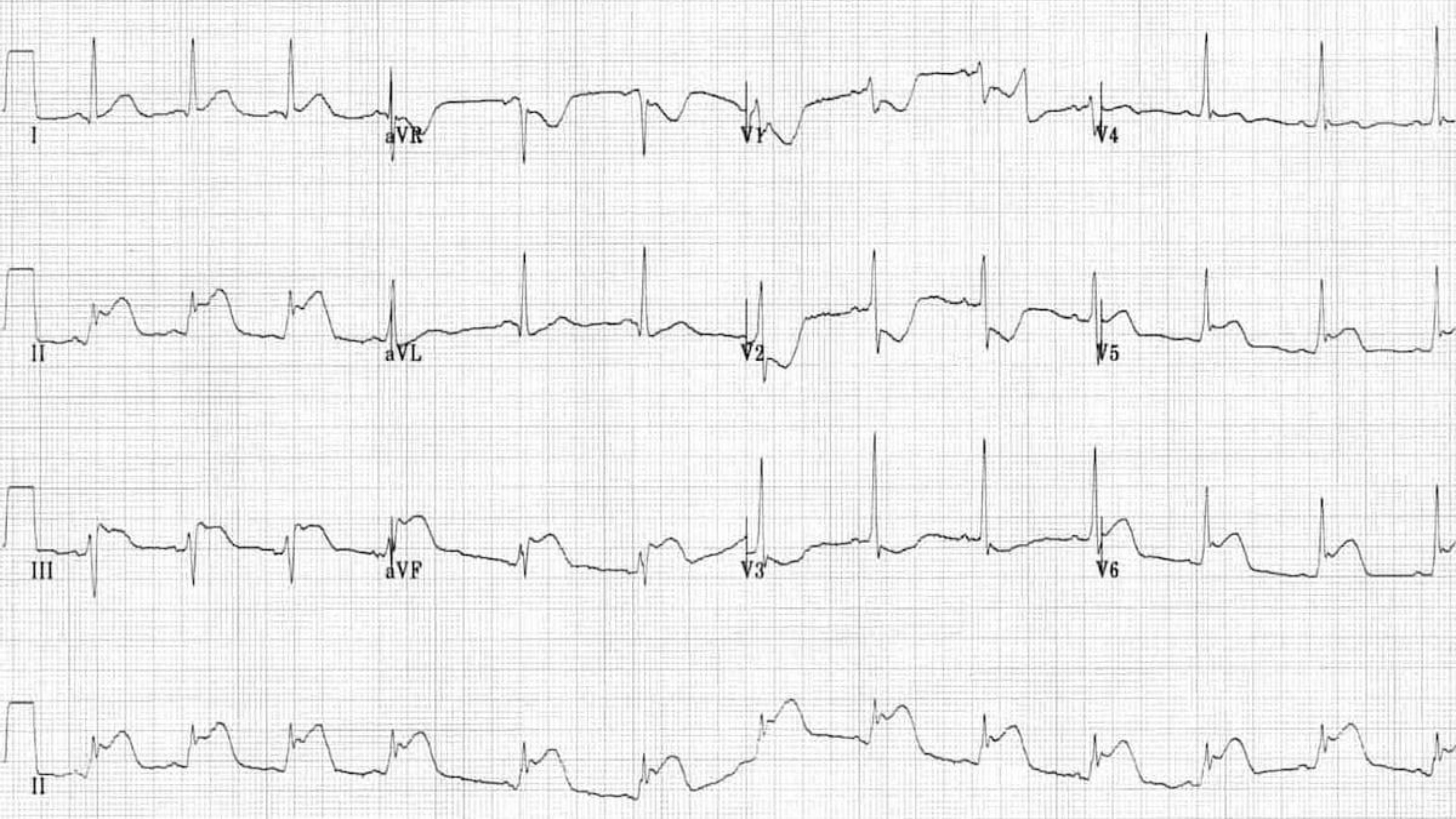

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


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


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


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


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV


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

Posterior MI is suggested by the following changes in V1-3:

- Horizontal ST depression
- Tall, broad R waves (>30ms)
- Upright T waves
- Dominant R wave (R/S ratio > 1) in V2

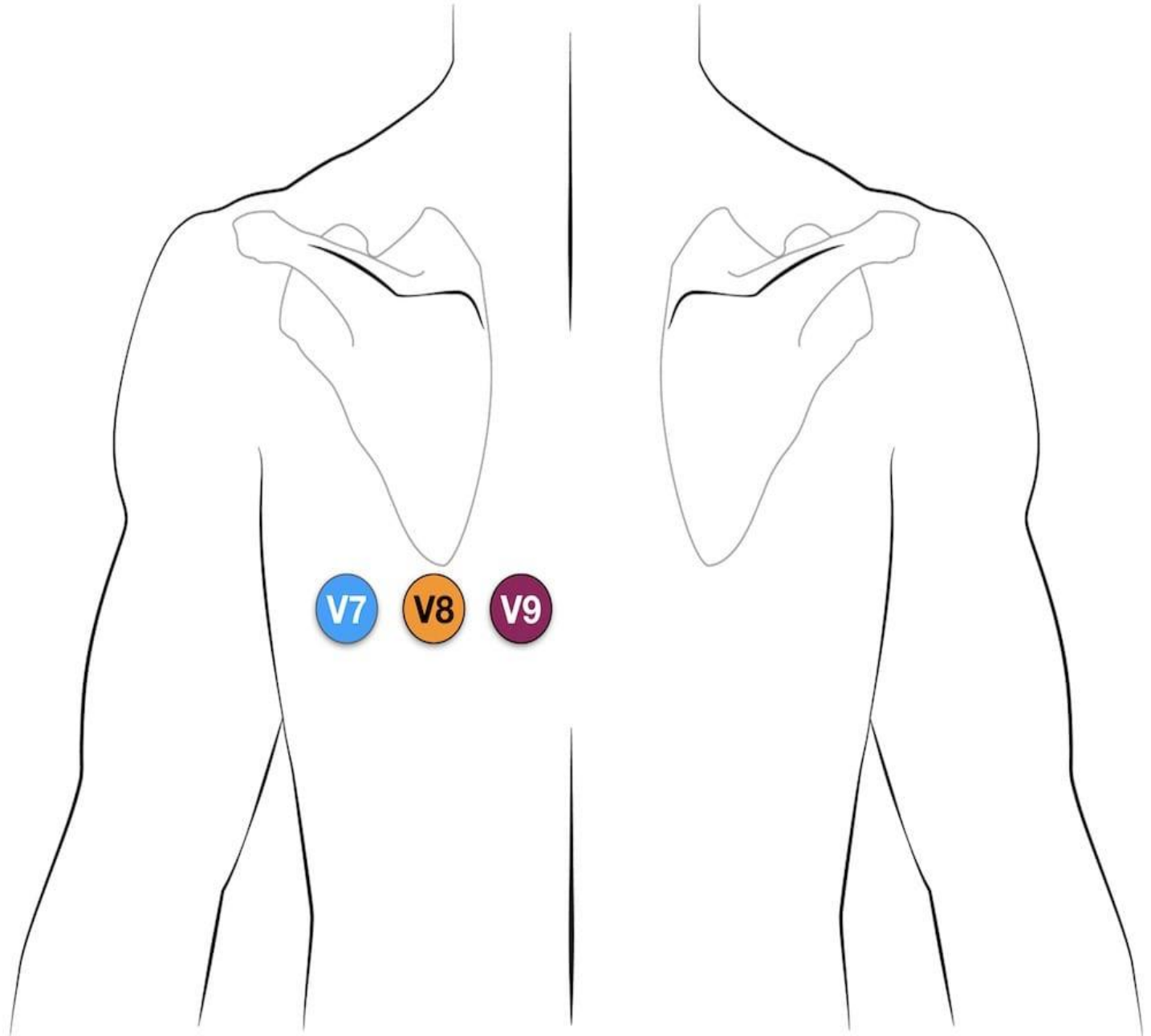
In patients presenting with ischaemic symptoms, horizontal ST depression in the anteroseptal leads (V1-3) should raise the suspicion of posterior MI.

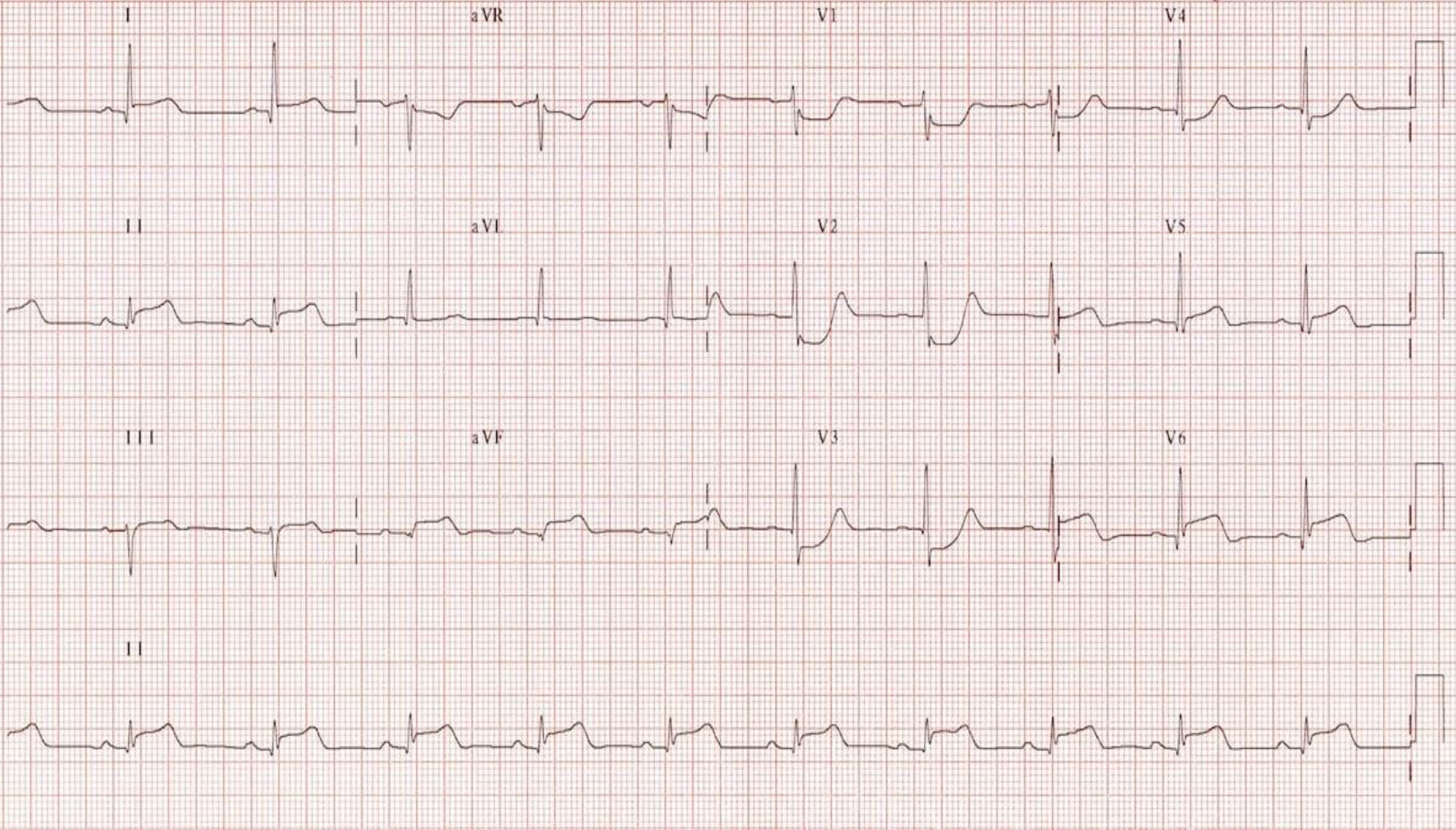
Posterior infarction is confirmed by the presence of ST elevation and Q waves in the posterior leads (V7-9).

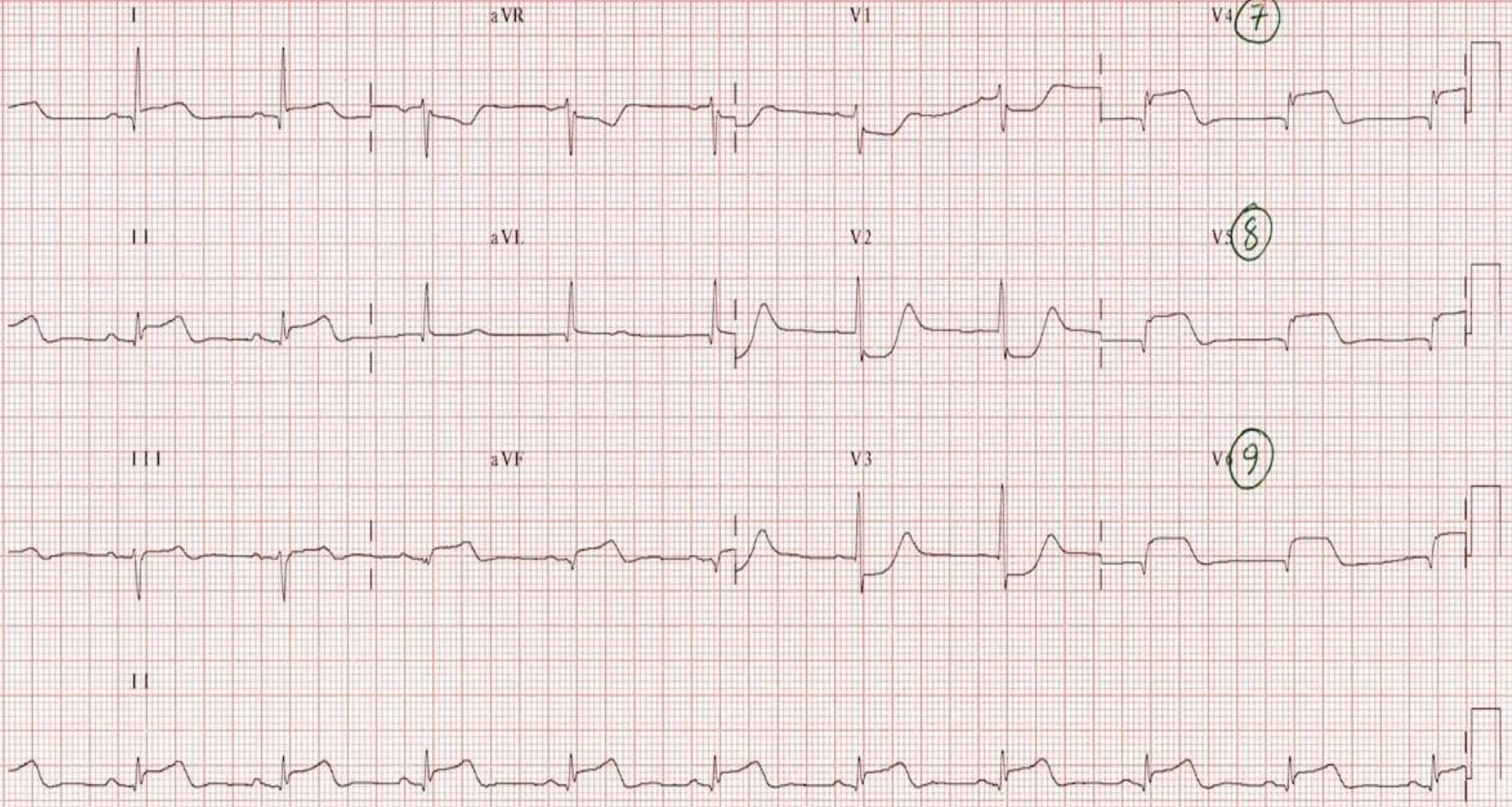
Posterior leads

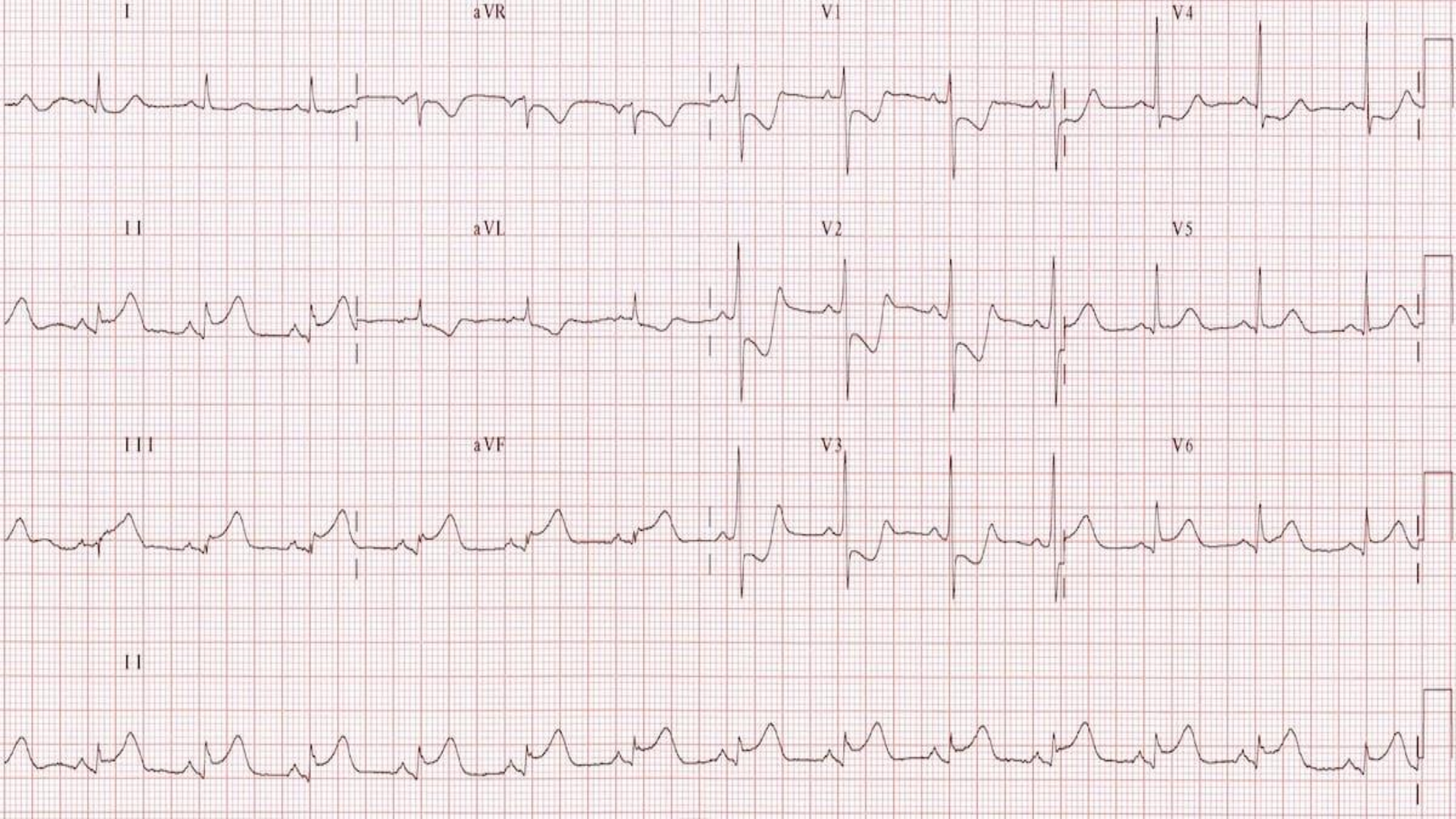
Leads V7-9 are placed on the posterior chest wall in the following positions:

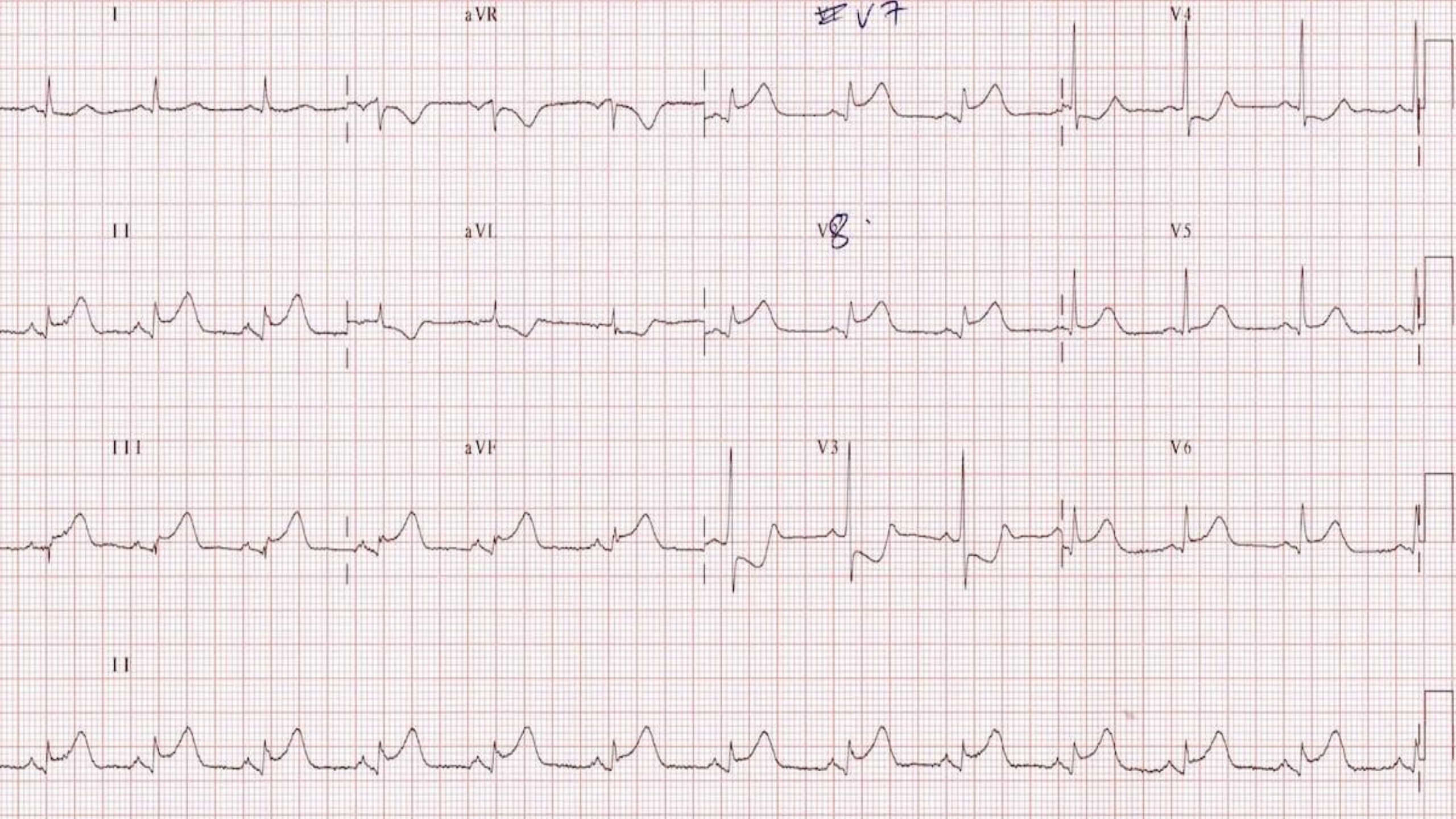
- V7 – Left posterior axillary line, in the same horizontal plane as V6.
- V8 – Tip of the left scapula, in the same horizontal plane as V6.
- V9 – Left paraspinal region, in the same horizontal plane as V6.




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


I
aVR
V1
V4
7
II
aVL
V2
V5
8
III
aVF
V3
V6
9
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

In patients presenting with inferior STEMI, right ventricular infarction is suggested by the presence of:

•**ST elevation in V1** – the only standard ECG lead that looks directly at the right ventricle.

•**ST elevation in lead III > lead II** – because lead III is more “rightward facing” than lead II and hence more sensitive to the injury current produced by the right ventricle.

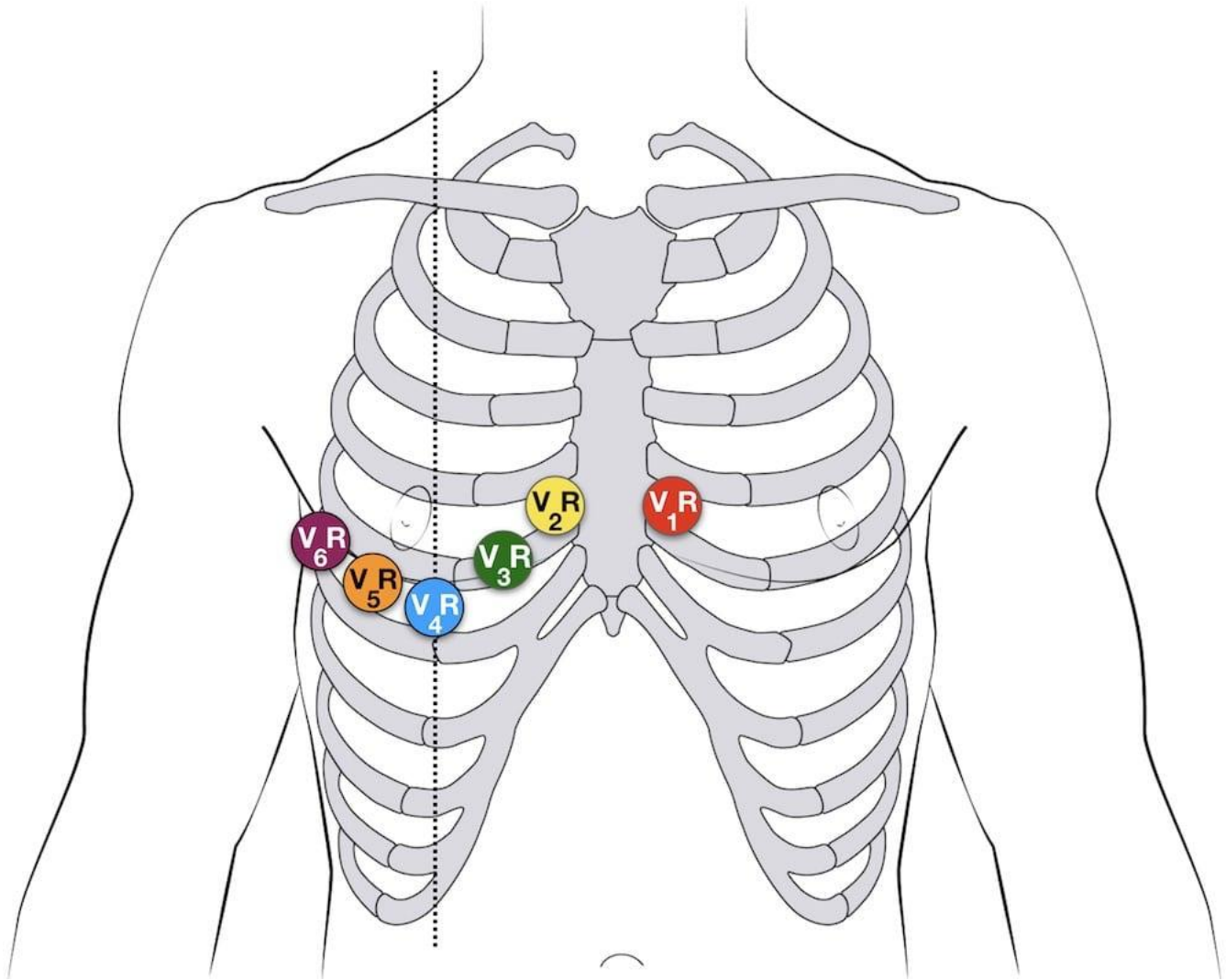
Other useful tips for spotting right ventricular MI:

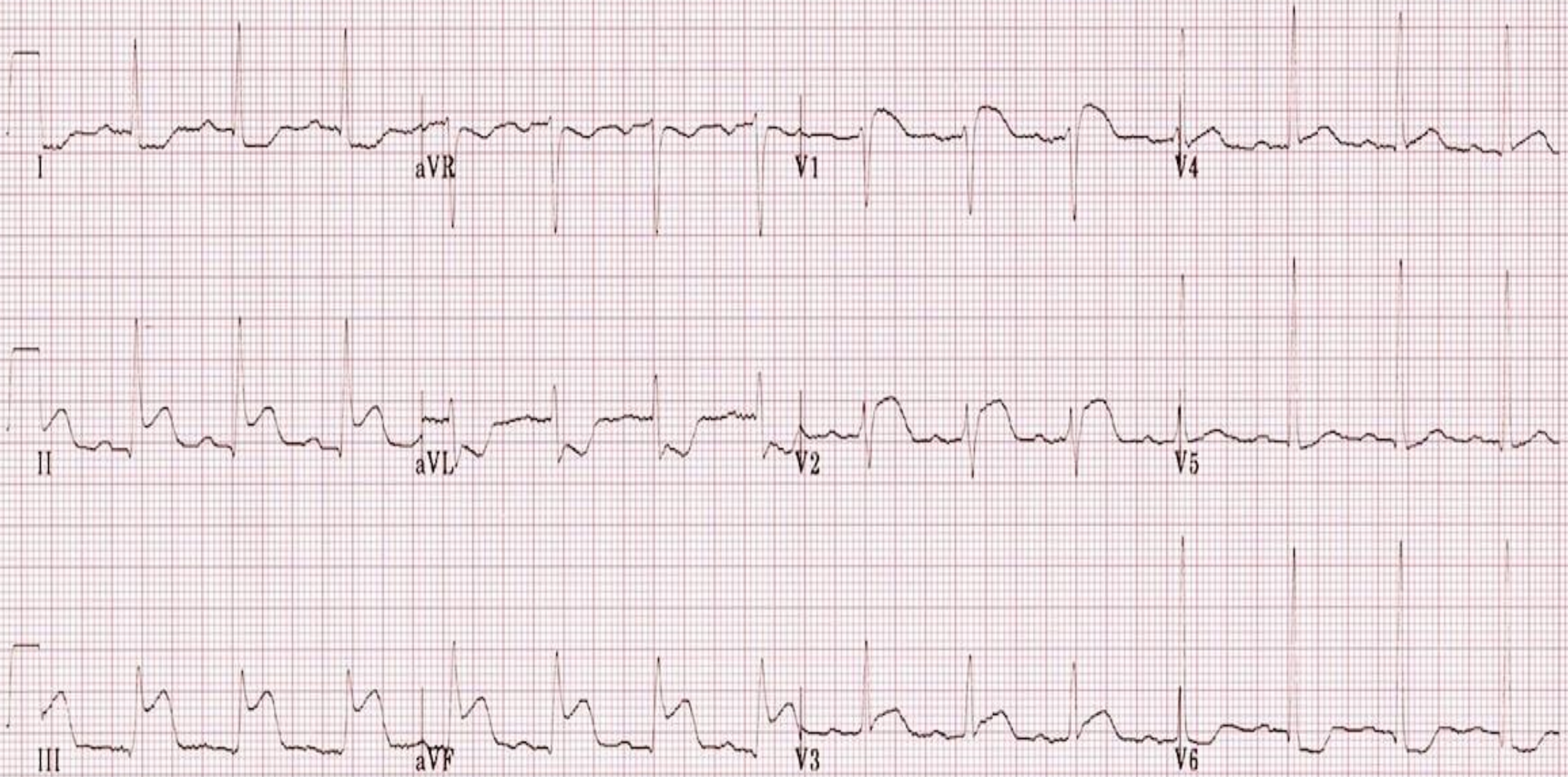
•**ST elevation in V1 > V2**.

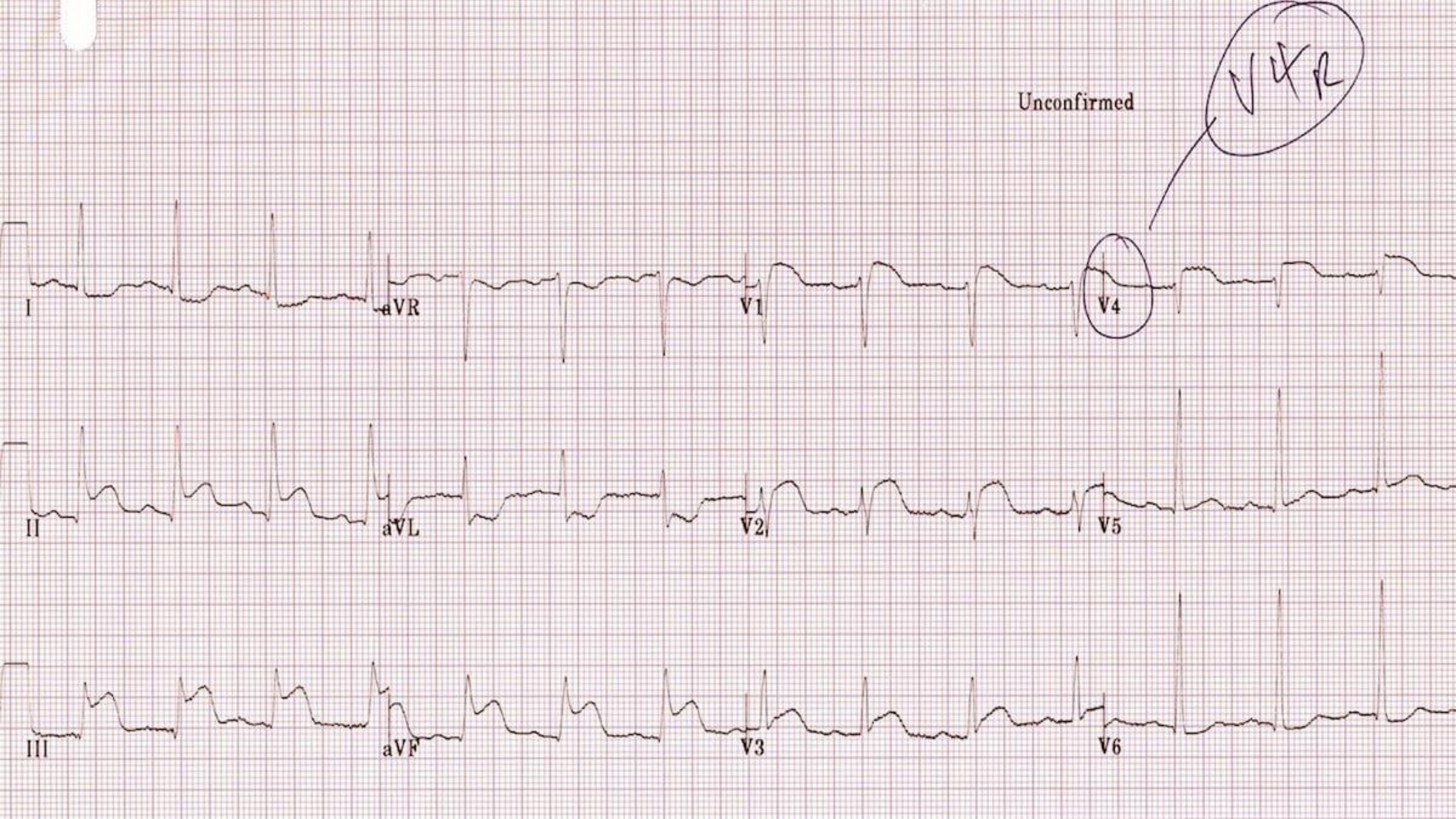
•**ST elevation in V1 + ST depression in V2** (= highly specific for RV MI).

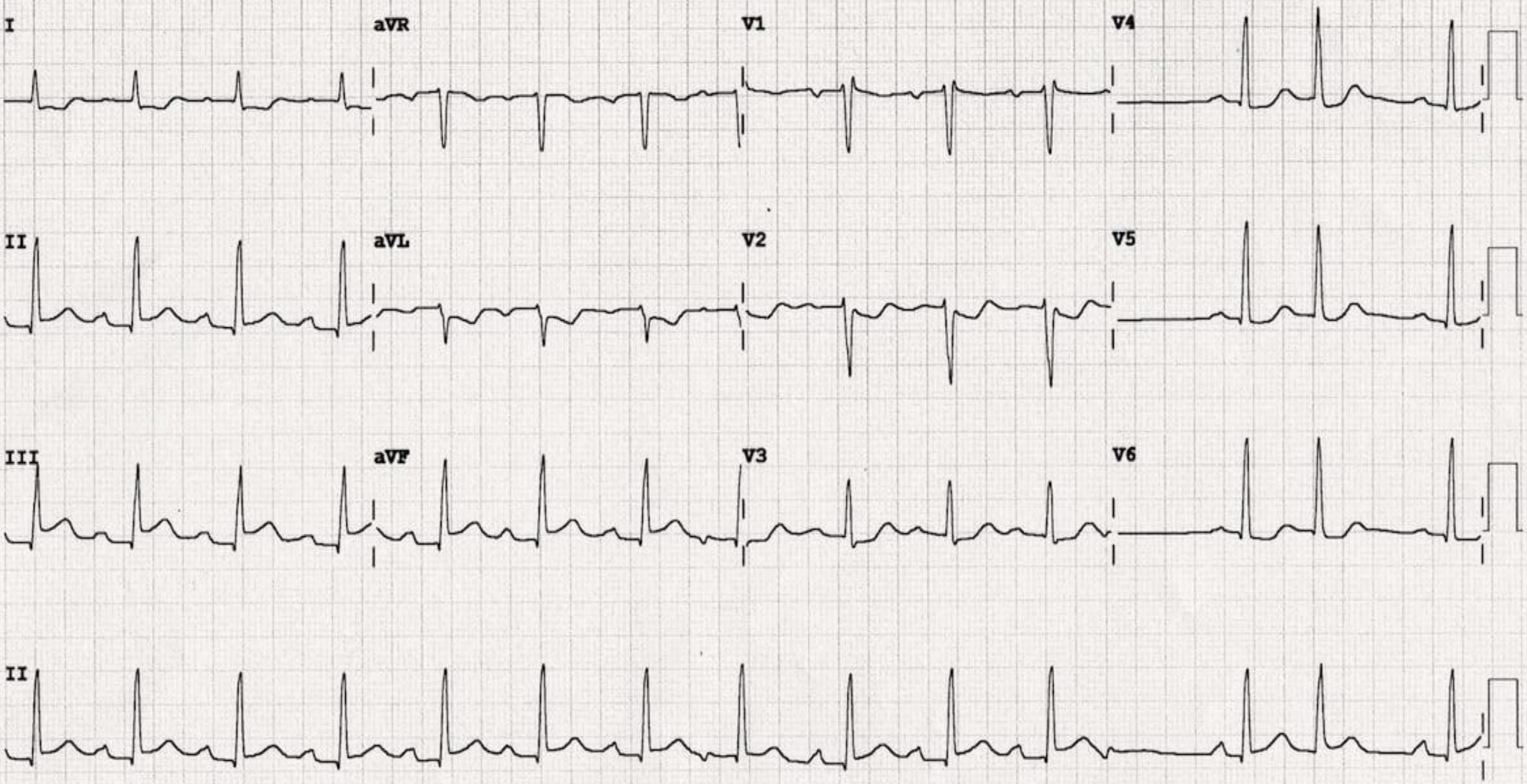
•Isoelectric ST segment in V1 with marked ST depression in V2.

Right ventricular infarction is confirmed by the presence of ST elevation in the right-sided leads (V3R-V6R).

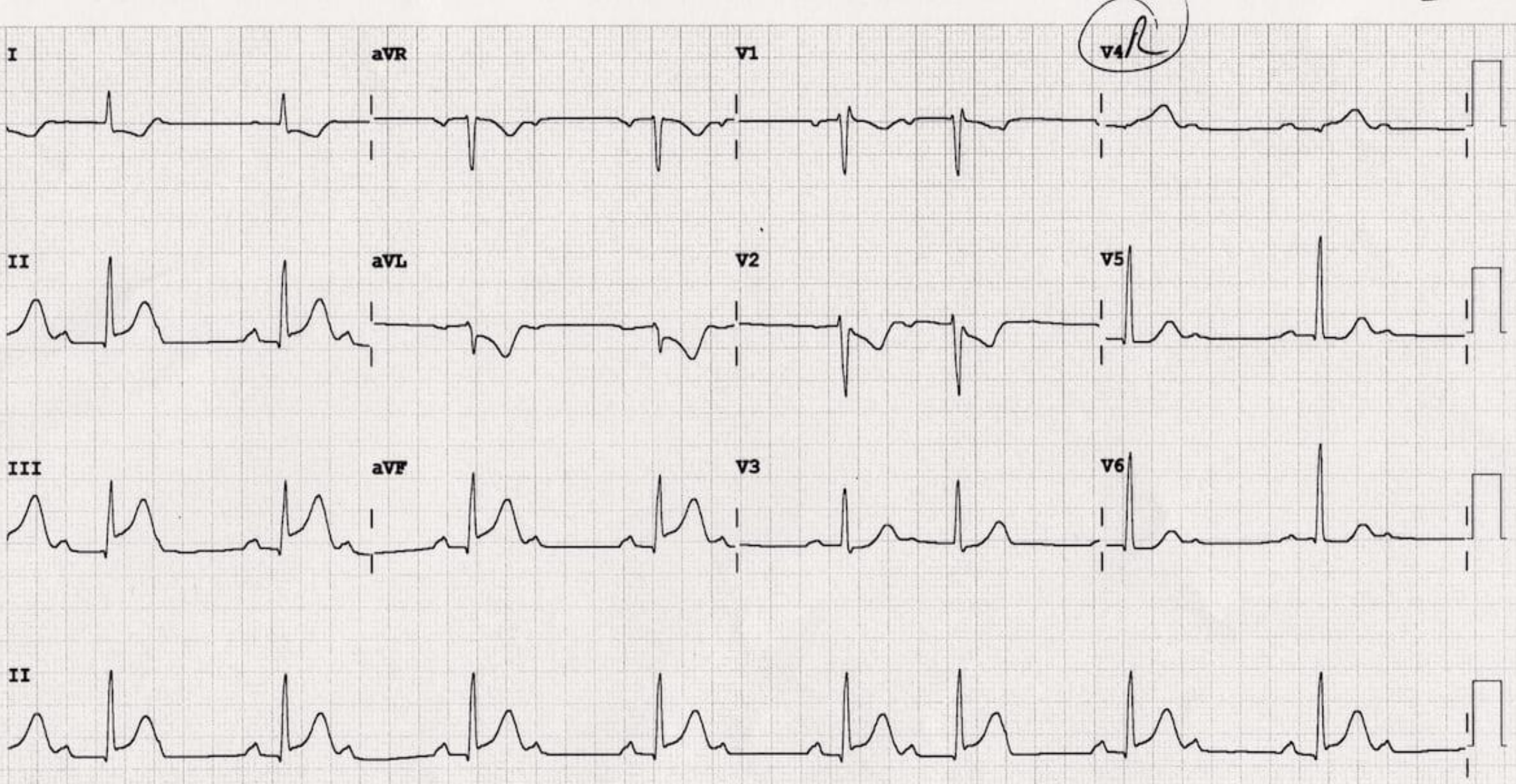



I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

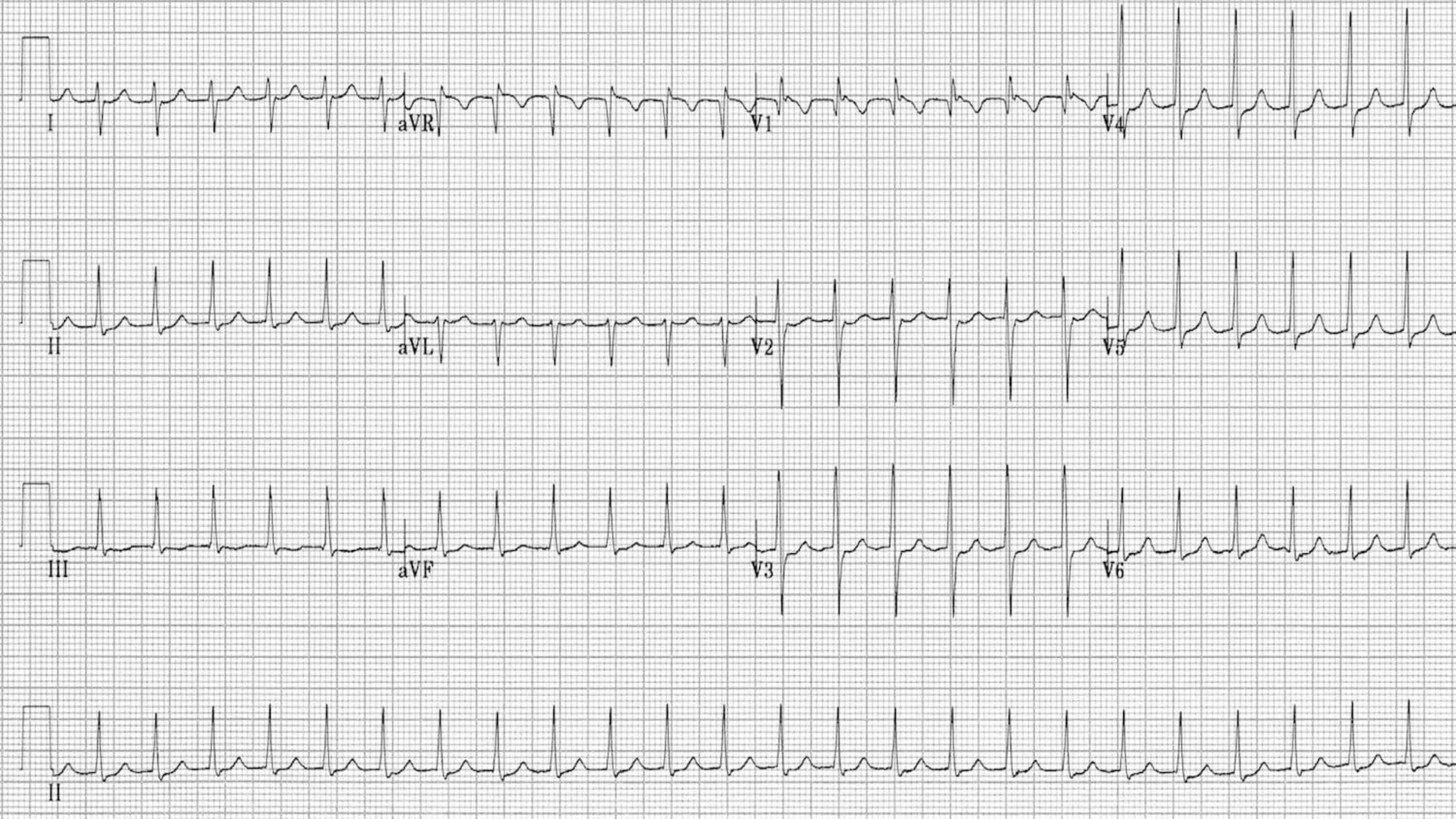

Unconfirmed
V4R
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

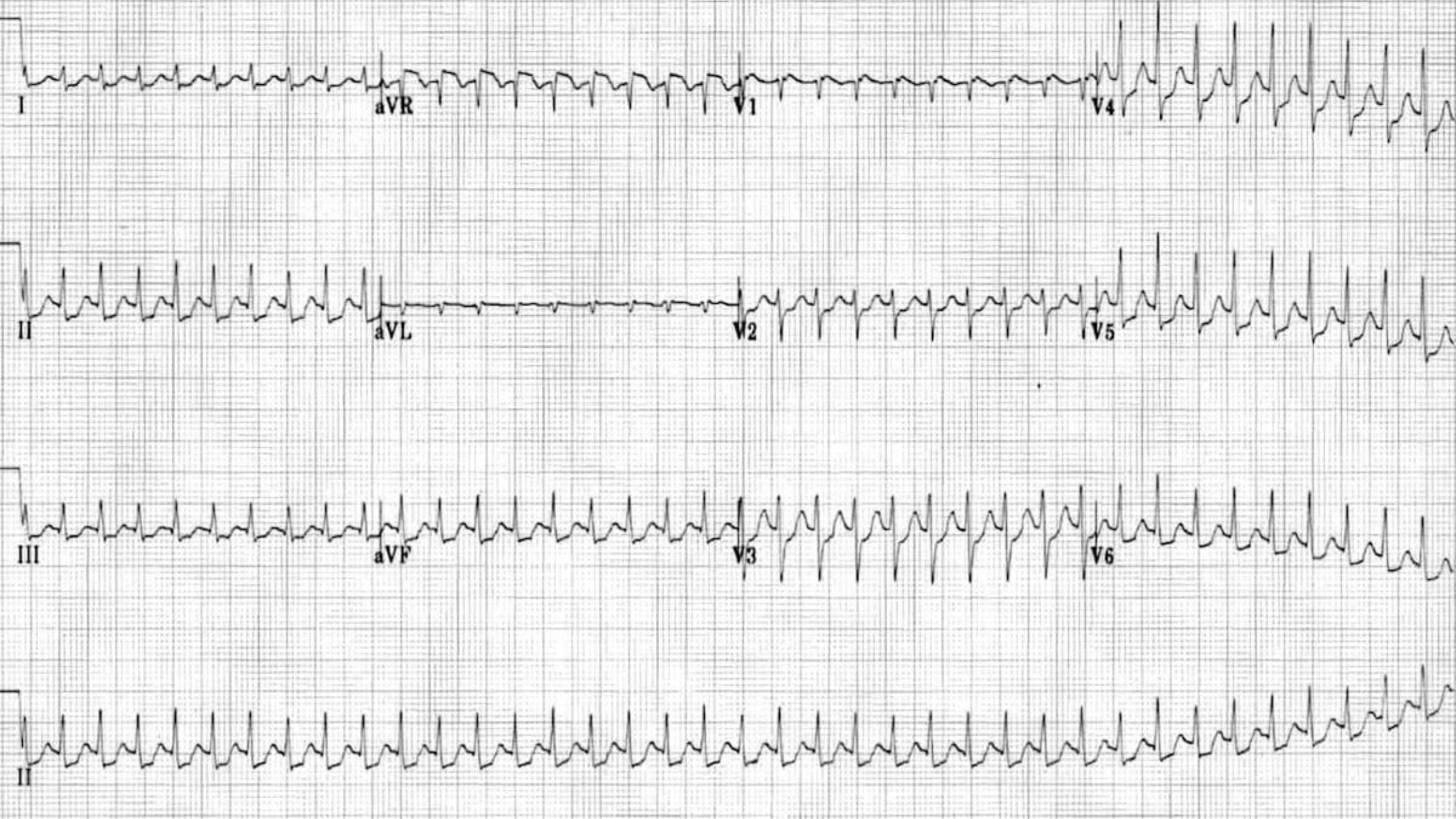


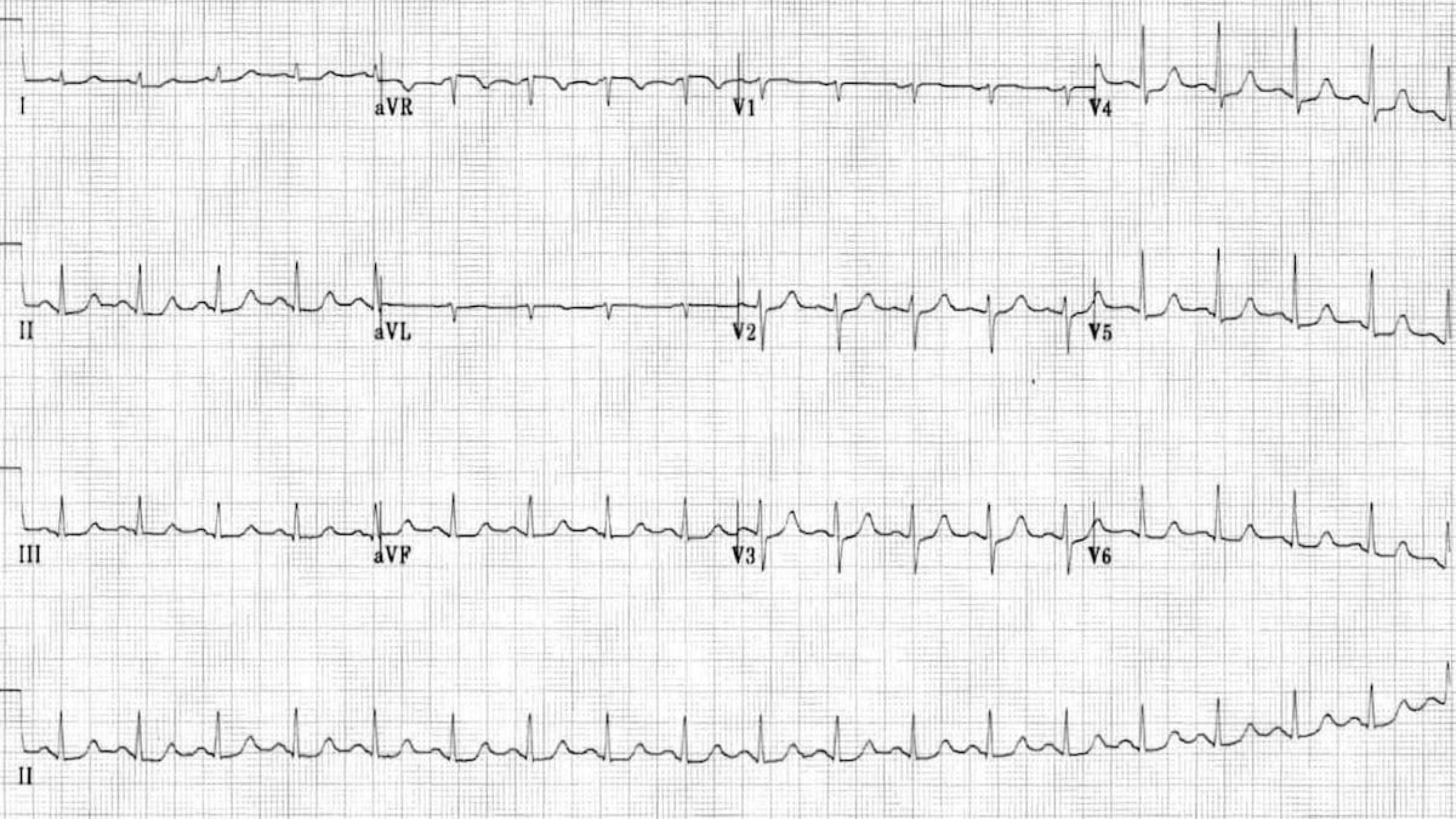
Device: Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10.0 mm/mV F 50~ 0.15-100 Hz PH100B CL P3



Device: Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10.0 mm/mV F 50~ 0.15-100 Hz PH100B CL P3


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

T -90 - ABNORMAL ECG - Unconfirmed diagnosis.